Lower and Middle Jurassic calcareous nannofossils from Portugal

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Lower and Middle Jurassic calcareous nannofossils from Portugal

By GILLIAN HAMILTON[1])

ABSTRACT

The stratigraphic distribution of 41 calcareous nannofossils in 24 samples from a Lower Jurassic section at Peniche and in 99 samples from two Middle Jurassic sections at Brenha and Cap Mondego is given. The biostratigraphic significance of the assemblages is discussed with reference to existing calcareous nannofossil zonal schemes and two new zones which embrace the Toarcian and Bajocian stages are proposed.

ZUSAMMENFASSUNG

Der vorliegende Artikel befasst sich mit der stratigraphischen Verteilung von 41 kalkigen Nannoplankton-Formen. Das Fossilmaterial wurde aus 24 Proben eines Profils bei Peniche (Unterer Jura) und aus 99 Proben zweier Profile bei Brenha bzw. Cap Mondego (Mittlerer Jura) aufbereitet. Die biostratigraphische Bedeutsamkeit der Vergesellschaftungen wird diskutiert unter Hinweis auf bereits bestehende Nannofossil-Zonierungen, ferner werden zwei neue Zonen vorgeschlagen, die das Toarcien bzw. das Bajocien umfassen.

The Lower Jurassic

The Peniche Section

Examination of a short section in the Lower Jurassic at Peniche enables a comparison of the calcareous nannofossil assemblages to be made with the zonal scheme recently proposed by the author for the Lower Jurassic of the neighbouring Brenha Road Section (HAMILTON 1977).

The Lower Jurassic outcrop in the peninsula at Peniche was described by MOUTERDE (1955) who demonstrated that the whole of the Lower Jurassic can be found in this area. Using the ammonite fauna, MOUTERDE was able to subdivide the outcrop into the established stage and zone system of NW Europe. For this present work a short section of Upper Pliensbachian to Lower Toarcian age was examined. The section is illustrated in Figure 1.

The Upper Pliensbachian part of the section (MOUTERDE's Beds 14 and 15, approx. 4 m thick) is in light grey micaceous, pyritized marls. The lowermost Toarcian beds (MOUTERDE's Bed 16, approximately 11 m thick) are in similar light

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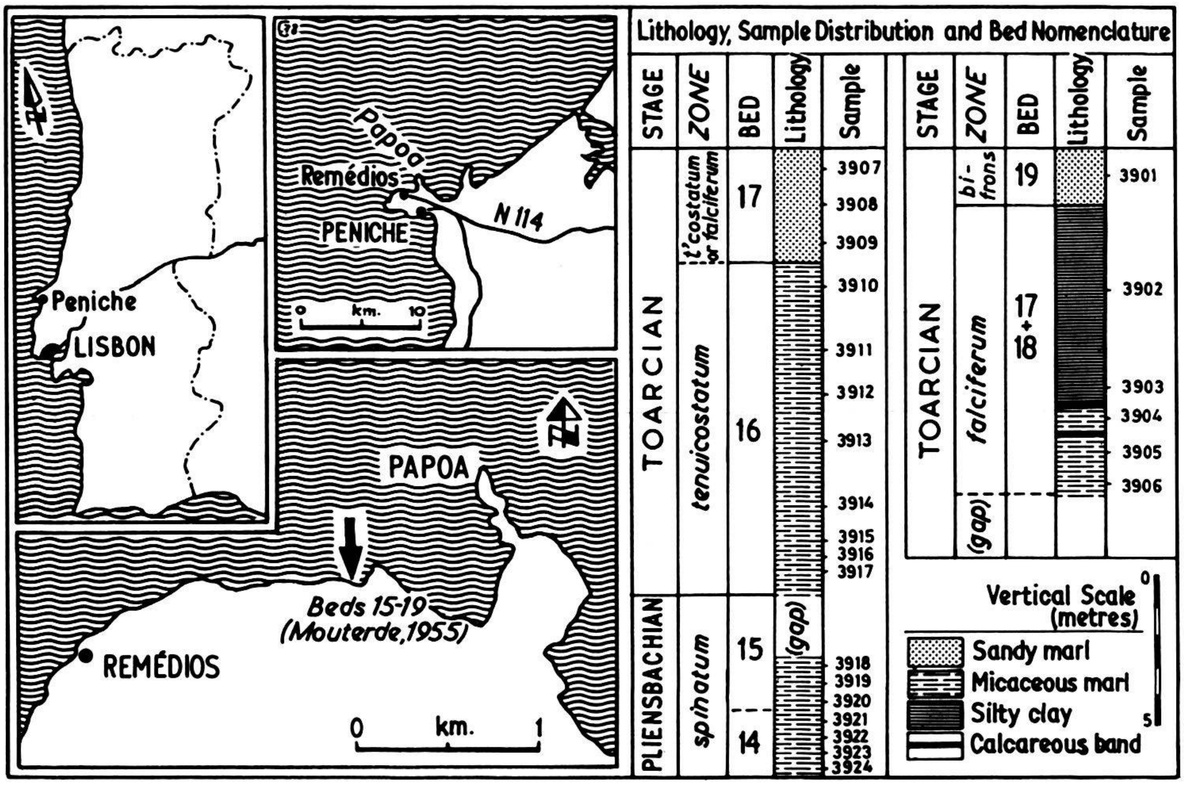

Fig. 1. The location, stratigraphy and sample distribution of the Peniche Section.

grey micaceous marls and these are interbedded with some narrow bands of compacted, calcite-rich marl. In MOUTERDE's Beds 17 and 18 (approximately 13 m thick) the marls become more sandy and are often yellowish-brown in colour. MOUTERDE noted that an increase in the amount of mica fragments and in the sand content of the sediment suggests that more littoral conditions prevailed in the area at the time that the later part of this section was deposited.

The samples produced fairly well preserved assemblages of calcareous nannofossils, whose stratigraphic distribution and abundance are given in Figure 2. Species abundance was recorded by counting the number of individuals of each species in 300 fields of view in a smear slide at a magnification of 1,280×. The total number of individuals of each species was divided by the number of fields of view and the abundance was expressed as follows:

abundant[2]) = 1 = more than 1 specimen in each field of view
very common = 0 = 1 specimen in each field of view
common = −1 = 1 specimen in 10 fields of view
rare = −2 = 1 specimen in 100 fields of view

The assemblages were dominated by *Schizosphaerella punctulata* and *Discorhabdus ignotus.* Samples 3924 to 3913 contained some typically early Lower Jurassic species such as *Crepidolithus cavus, Crepidolithus crucifer* and *Parhabdolithus* sp. Samples 3911 to 3901, on the other hand, contained *Podorhabdus macrogranulatus,*

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[2]) In HAMILTON (1977, 1978) "abundant" should be defined in the same sense as is given here, i.e. *abundant* = more than 1 specimen in each field of view.

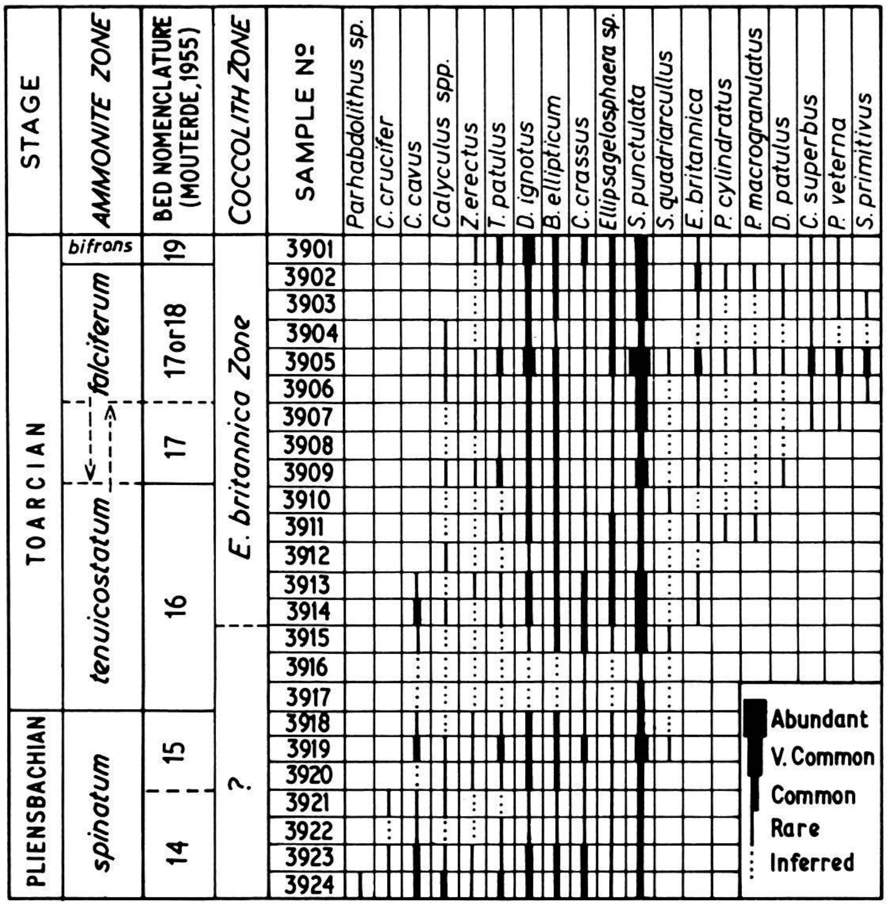


Fig. 2. The stratigraphic distribution and abundance of calcareous nannofossils in the Peniche Section.

Discorhabdus patulus, Carinolithus superbus and *Striatomarginis primitivus,* species which are known in the Toarcian and Bajocian. The calcareous nannofossils thus indicate a late Pliensbachian to early Toarcian age.

Comparison with the Brenha Road Section and zonal scheme

The assemblages from the Peniche Section compare quite closely with those from coeval sediments of the Brenha Road Section. However, the zonal scheme of HAMILTON (1977) cannot be applied satisfactorily to the Peniche Section because *Striatomarginis veterna* (*Paleopontosphaera veterna* in HAMILTON 1977), the marker species for the mid-Pliensbachian to Lower Toarcian zone, is not recorded at Peniche until the Lower Toarcian.

Discussion of Lower Jurassic calcareous nannofossil biostratigraphy

The zonal scheme of HAMILTON (1977) was developed from the examination of only one section, the Brenha Road Section, and it requires modification to give it a broader application. A revised scheme, which broadly combines the proposals of AMEZIEUX (1972), HAMILTON (1977), PRINS (1969), STRADNER (1963) and THIERSTEIN (1976), is therefore suggested and is compared with the earlier scheme of

Hamilton (1977) in Figure 3. The *Discorhabdus patulus* Zone of Hamilton (1977) is replaced by a new zone, the *Ellipsagelosphaera britannica* Zone (described below), because since 1977 the author has found that *Discorhabdus patulus* is a rare form that is not suitable as a zonal marker while *Ellipsagelosphaera britannica* is easily recognized and is normally quite abundant in assemblages. The new scheme gives three broad zones for the Sinemurian to Toarcian interval of the Lower Jurassic. However, more detailed biostratigraphy may be obtained by using the three biohorizons, that is the highest occurrences of *P. marthae, P. liasicus* and *C. primulus.*

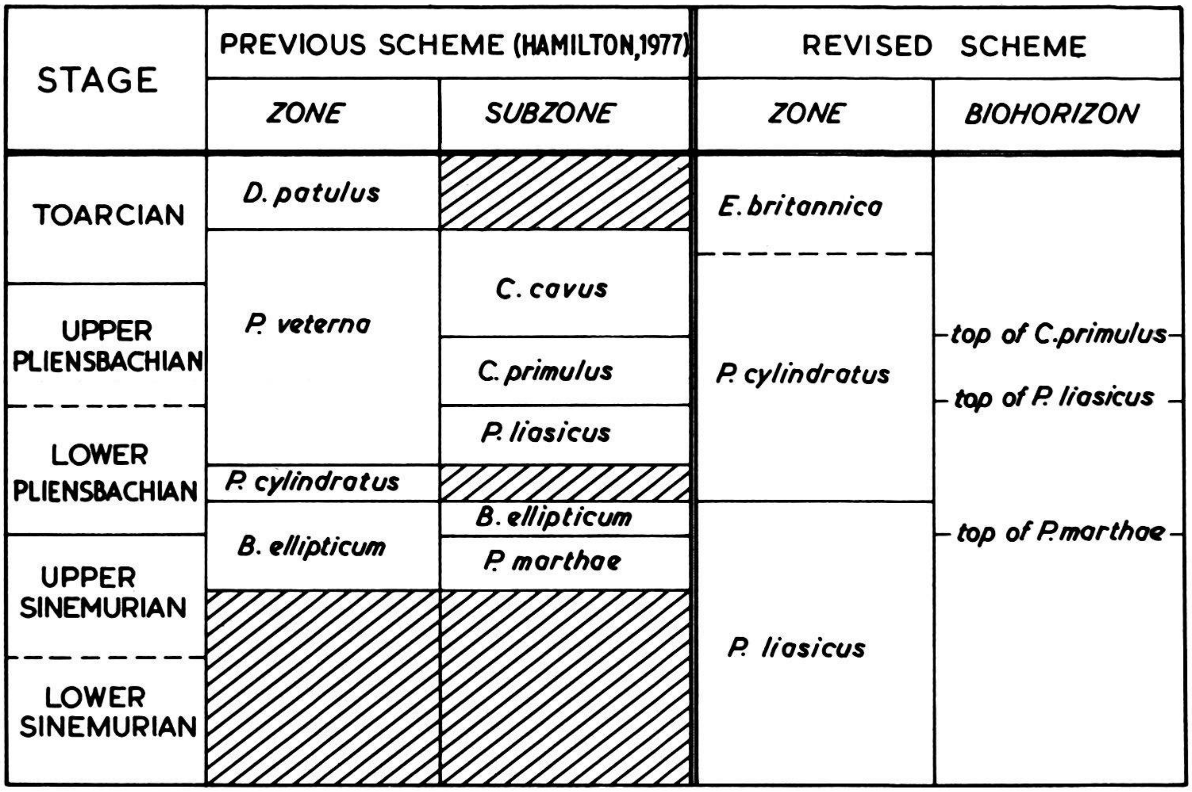
Ellipsagelosphaera britannica Zone

Limits: From the lowest occurrence of *Ellipsagelosphaera britannica* to the lowest occurrence of *Ellipsagelosphaera keftalrempti.*

Age: Toarcian

Species present from the Pliensbachian: *Biscutum ellipticum, Calyculus* spp., *Crepidolithus cavus, Crepidolithus crassus, Discorhabdus ignotus, Ellipsagelosphaera* sp., *Parhabdolithus* sp., *Podorhabdus cylindratus, Schizosphaerella punctulata, Staurorhabdus quadriarcullus, Striatomarginis veterna, Tubirhabdus patulus, Zygodiscus erectus.*

Species appearances in the Toarcian: *Carinolithus superbus, Diazomatolithus lehmani, Discorhabdus patulus, Ellipsagelosphaera britannica, Podorhabdus macrogranulatus, Striatomarginis primitivus.*



STAGE	PREVIOUS SCHEME (HAMILTON,1977)		REVISED SCHEME	
	ZONE	*SUBZONE*	*ZONE*	*BIOHORIZON*
TOARCIAN	*D. patulus*	▨	*E. britannica*	
	P. veterna	*C. cavus*	*P. cylindratus*	
UPPER PLIENSBACHIAN		*C. primulus*		*top of C. primulus*
LOWER PLIENSBACHIAN		*P. liasicus*		*top of P. liasicus*
	P. cylindratus	▨		
	B. ellipticum	*B. ellipticum*	*P. liasicus*	*top of P. marthae*
UPPER SINEMURIAN		*P. marthae*		
LOWER SINEMURIAN	▨	▨		

Fig. 3. Lower Jurassic calcareous nannofossil biostratigraphy.

The Middle Jurassic

The Brenha Road Section

The Middle Jurassic part of the Brenha Road Section lies to the south of the Lower Jurassic part (discussed in HAMILTON 1977) on the new road from Figueira da Foz to Aviero which passes to the west of the village of Brenha. The section is illustrated in Figure 4. SCHOTT & STAESCHE (1957) described a section along the old road which ran through Brenha. They showed that a complete section from the

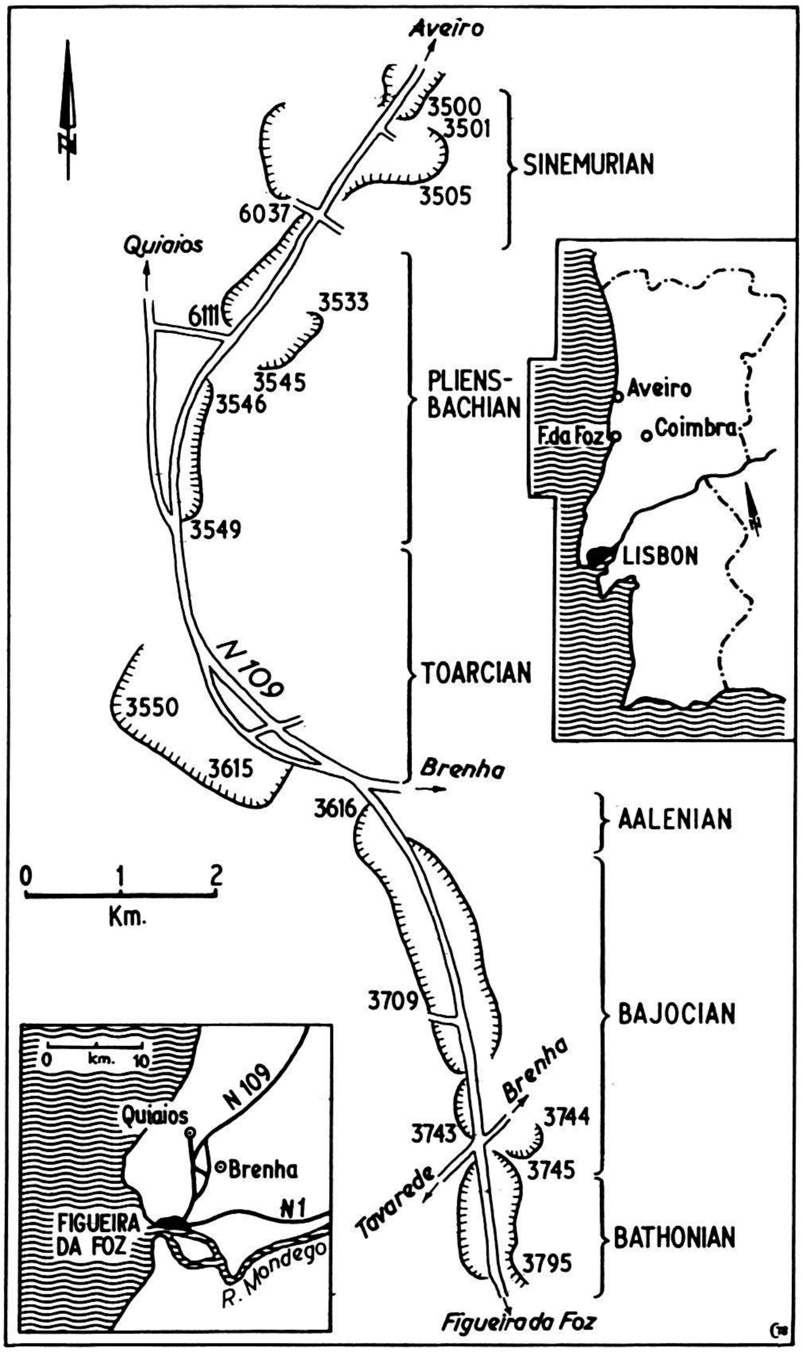


Fig. 4. The location and sample distribution of the Brenha Road Section.

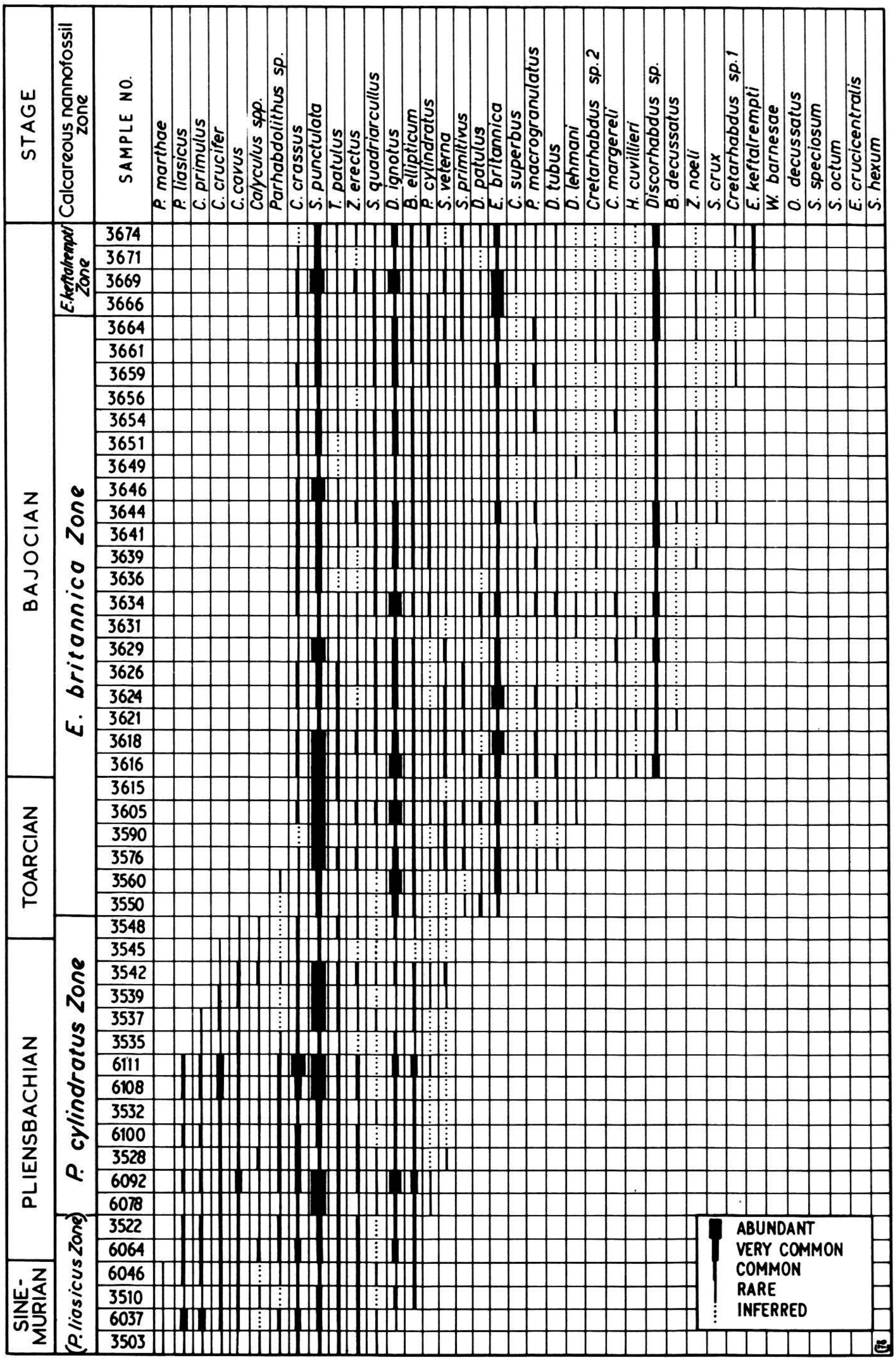


Fig. 5a. The stratigraphic distribution and abundance of calcareous nannofossils in the Sinemurian-Bajocian interval of the Brenha Road Section.

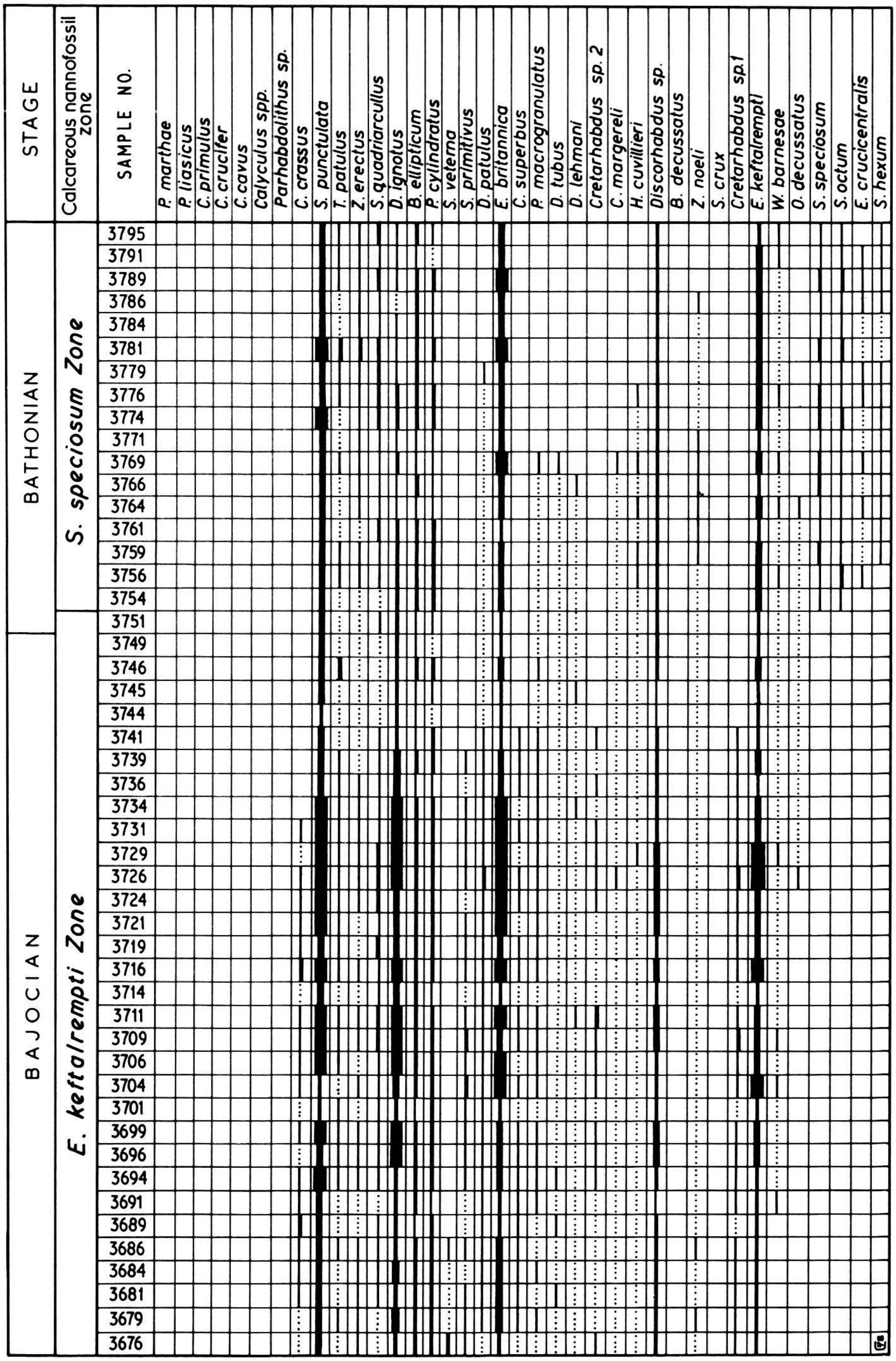


Fig. 5b. The stratigraphic distribution and abundance of calcareous nannofossils in the Bajocian-Bathonian interval of the Brenha Road Section.

Sinemurian (Lower Jurassic) to the Lower Lusitanian (Upper Jurassic) exists in this area. For the present work only the Bajocian and Bathonian were sampled because the Callovian and Lusitanian interval is largely represented by non-marine, paralic and lagoonal deposits in which calcareous nannofossils are rare or absent.

The Lower Bajocian part of the section is in an interbedded series of thin shale, marl and limestone bands. In the Middle Bajocian the limestone is more massive and the Upper Bajocian, which outcrops to the south of the Tavarede to Brenha road junction, is in massive blue limestones interbedded with cross-bedded silty limestones. The Lower Bathonian consists of grey limestones alternating with beds of siltstone and in the Upper Bathonian light grey shales with thin bands of silty limestone are dominant.

The 73 samples from the Brenha Road Section yielded assemblages which contained numerous calcareous nannofossils. The specimens were generally not very well preserved and many showed signs of secondary calcite overgrowth and dissolution. The stratigraphic distribution of the calcareous nannofossils and the abundance of each species are given in Figures 5a/b. The Lower Jurassic part of the Brenha Road Section is included in Figure 5a for completeness.

The Cap Mondego Section

Sediments of Bajocian to Lusitanian age are exposed at Cap Mondego, which is situated on the coast to the west of the Brenha Road Section (Fig. 6). In a study of the area, RUGET-PERROT (1961) noted that at Cap Mondego Middle Jurassic sediments are well exposed and are very fossiliferous. RUGET-PERROT identified the ammonite fauna and showed that deposits of Bajocian and Bathonian age are found in the coastal strip. A section of approximately 90 m of Bajocian and Bathonian marls and limestones (Fig. 6) was examined for this work from which 14 samples were processed. Limestones, shales and marls of Callovian age are exposed in the northernmost of two inland quarries. From a section in this quarry of approximately 20 m in length 12 samples have been processed. The southern quarry exposes Lusitanian age sediments. Three samples were collected from this quarry.

The Bajocian to Callovian aged samples produced abundant calcareous nannofossils. Their stratigraphic distribution and abundance are given in Figure 7. The preservation of the specimens was not very good and many of them were overgrown.

Analysis of three samples from the Lusitanian (southern) quarry revealed that sample 3853 was barren while samples 3852 and 3854 contained only one species, *Tetralithus gothicus.* Its persistance into this supposedly non-marine sediment could be a result of reworking or contamination, although three or four specimens were recovered in each sample, or it might suggest that this species has a high tolerance of salinity change, which is unusual in calcareous nannofossils, or it might be that these specimens are not fossils at all.

Middle Jurassic calcareous nannofossil biostratigraphy

The biostratigraphic significance of Middle Jurassic calcareous nannofossils has been discussed by AMEZIEUX (1972), BARNARD & HAY (1974), MOSHKOVITZ & EHRLICH (1976), STRADNER (1963) and THIERSTEIN (1976). These authors have

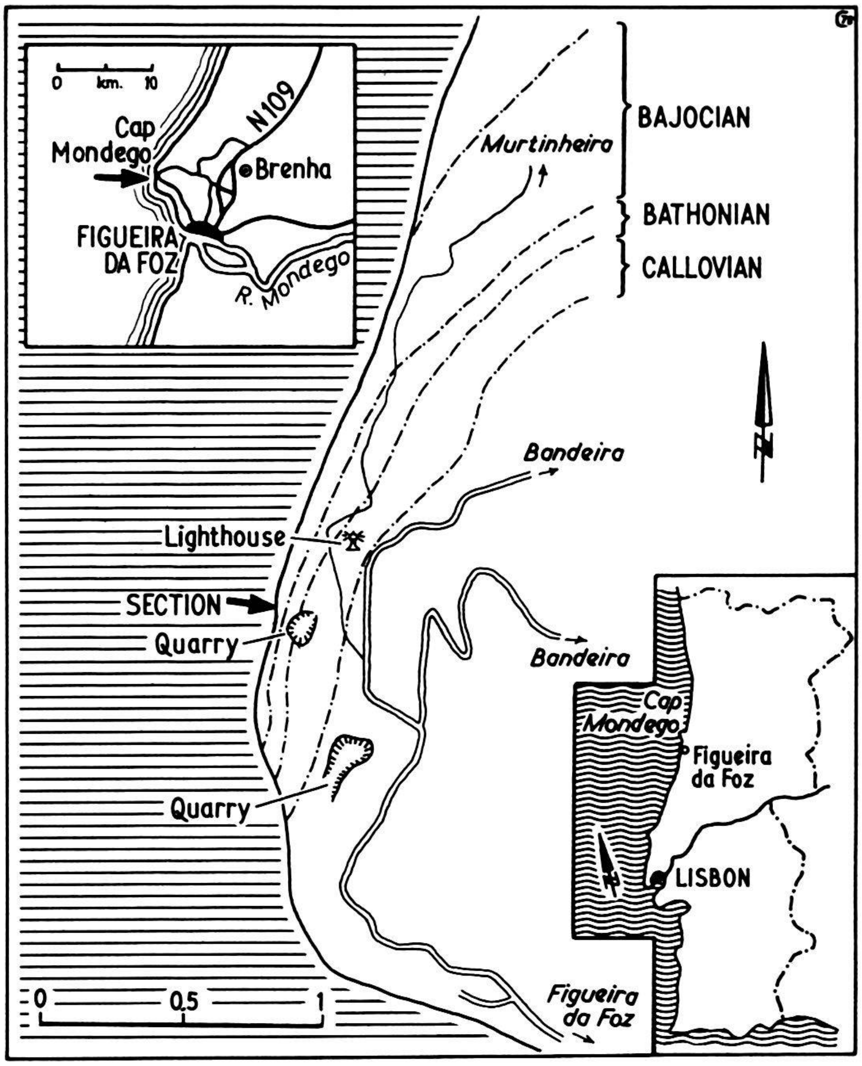


Fig. 6. The location of the Cap Mondego Section.

noted the value of members of the genus *Stephanolithion* for biostratigraphy which results from their being readily recognizable under both the light microscope and the scanning electron microscope and from their comparatively short stratigraphic ranges. AMEZIEUX (1972), MOSHKOVITZ & EHRLICH (1976) and THIERSTEIN (1976) used the earliest occurrence of *Stephanolithion speciosum* to indicate the base of the Bathonian. Similarly, AMEZIEUX (1972), BARNARD & HAY (1974), MOSHKOVITZ & EHRLICH (1976), STRADNER (1963) and THIERSTEIN (1976) defined the base of the Callovian on the first occurrence of *Stephanolithion bigoti* DEFLANDRE 1939. The chart in Figure 5b demonstrates that in Portugal the lowest occurrence of *Stephanolithion speciosum* is also at the base of the Bathonian. However, the diagram in Figure 7 shows that *Stephanolithion bigoti* is not found in the Callovian at Cap Mondego.

Calcareous nannofossil biostratigraphy is less satisfactory for the Bajocian as there are few useful biostratigraphic events during the stage. This may reflect the generally shallow water conditions that prevailed during the Bajocian which did not support a diverse flora. THIERSTEIN (1976) described the earliest occurrence of

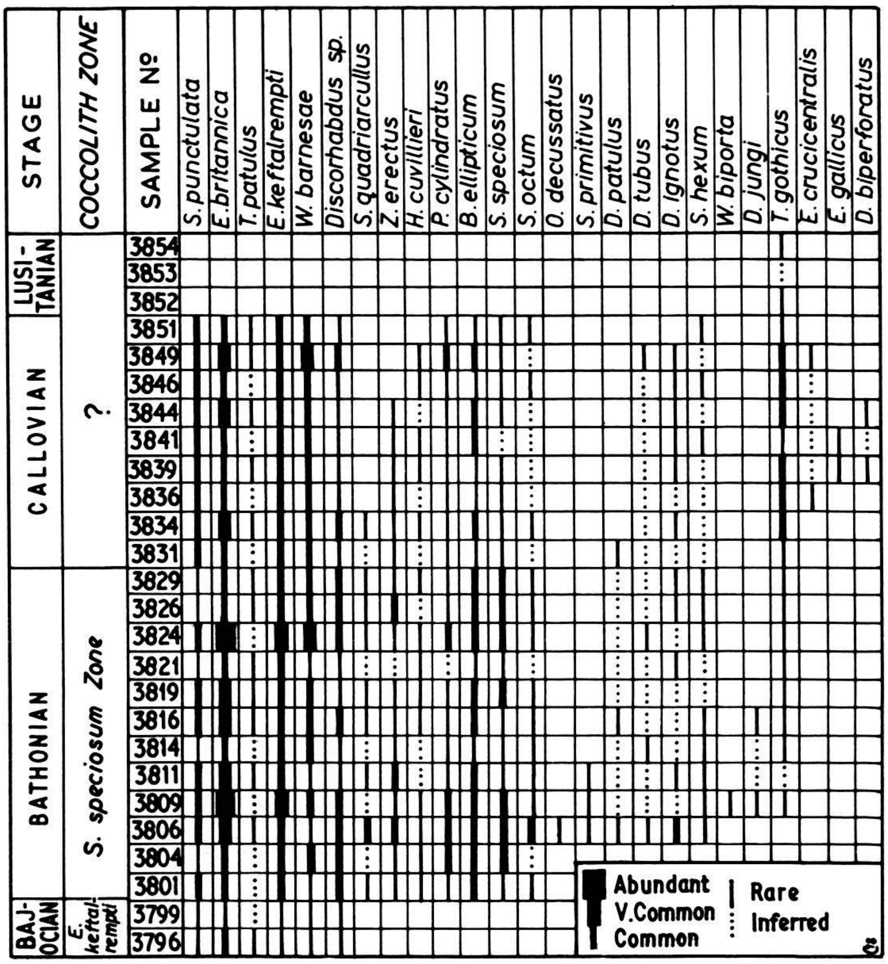


Fig. 7. The stratigraphic distribution and abundance of calcareous nannofossils in the Cap Mondego Section.

Watznaueria communis REINHARDT 1964 (regarded here as a synonym of *Ellipsagelosphaera britannica*) as a biohorizon marking the early Bajocian. AMEZIEUX (1972) also used the first appearance of members of the genus *Ellipsagelosphaera* to indicate the base of the Bajocian. MOSHKOVITZ & EHRLICH (1976) selected *Hexalithus magharensis* MOSHKOVITZ & EHRLICH 1976 as the marker species for their Bajocian zone which contained *Ellipsagelosphaera communis* (REINHARDT 1964) PERCH-NIELSEN 1968 and *Cyclagelosphaera margereli* as the most common components. *Hexalithus magharensis* has not been recorded by other researchers working outside Israel and northern Sinai.

Clearly, Bajocian assemblages are dominated by members of the genus *Ellipsagelosphaera.* The present author follows AMEZIEUX (1972) and THIERSTEIN (1976) in using these forms as the diagnostic species, despite their common occurrence in younger assemblages. A new zone, the *Ellipsagelosphaera keftalrempti* Zone, is therefore proposed.

Ellipsagelosphaera keftalrempti Zone

Limits: From the lowest occurrence of *Ellipsagelosphaera keftalrempti* to the lowest occurrence of *Stephanolithion speciosum.*

Age: Bajocian

Species present from the Toarcian: *Biscutum ellipticum, Carinolithus superbus, Crepidolithus crassus, Diazomatolithus lehmani, Discorhabdus ignotus, Discorhabdus patulus, Discorhabdus tubus, Ellipsagelosphaera britannica, Podorhabdus cylindratus, Podorhabdus macrogranulatus, Schizosphaerella punctulata, Staurorhabdus quadriarcullus, Striatomarginis primitivus, Striatomarginis veterna, Tubirhabdus patulus, Zygodiscus erectus.*

Species appearances in the Bajocian: *Bennocyclus decussatus, Cretarhabdus* sp. 1, *Cretarhabdus* sp. 2, *Cyclagelosphaera margereli, Discorhabdus* sp., *Ellipsagelosphaera keftalrempti, Hexapodorhabdus cuvillieri, Octopodorhabdus decussatus, Staurolithites crux, Watznaueria barnesae, Zygodiscus noeli.*

Discussion

The calcareous nannofossil assemblages from the Lower and Middle Jurassic of Portugal are closely comparable with coeval assemblages recorded by other researchers working in NW Europe and Israel (AMEZIEUX 1972, BARNARD & HAY 1974, MOSHKOVITZ & EHRLICH 1976, STRADNER 1963, THIERSTEIN 1976).

Within Portugal there is no significant change in the calcareous nannofossil assemblages between those in the Lower Jurassic at Peniche and those in the Brenha Road Section nor between those from the Middle Jurassic at Cap Mondego and those in the Brenha Road Section. The sampled sections were deposited in the same sedimentary basin which encompassed the area to the north of the River Tagus and which was believed to have been open towards the west during the Jurassic (RUGET-PERROT 1961). The fauna of this area shows close affinities with that of other parts of western Europe (MOUTERDE et al. 1971). In the south of Portugal another sedimentary basin, the Algarve Basin, was also open to the west during the Jurassic (RUGET-PERROT 1961). This basin is known to contain a southern ammonite fauna (MOUTERDE et al. 1971) which differs markedly from that recorded in the northern sedimentary basin. Unfortunately, no samples were collected for the present study from this basin.

Systematic palaeontology

The following species were recorded and a full discussion of the species can be found in the references cited in square brackets.

Bennocyclus decussatus GRÜN, PRINS & ZWEILI 1974 - [GRÜN, PRINS & ZWEILI 1974]
Biscutum ellipticum (GORKA 1957) GRÜN & ALLEMANN 1975 - [GRÜN & ALLEMANN 1975]
Calyculus spp. - See below
Carinolithus superbus (DEFLANDRE 1954) PRINS 1969 - [GRÜN, PRINS & ZWEILI 1974]
Crepidolithus cavus PRINS 1969 ex ROOD, HAY & BARNARD 1973 - [ROOD, HAY & BARNARD 1973]
Crepidolithus crassus (DEFLANDRE 1954) NOËL 1965 - [GRÜN, PRINS & ZWEILI 1974]
Crepidolithus crucifer PRINS 1969 ex ROOD, HAY & BARNARD 1973 - [ROOD, HAY & BARNARD 1973]
Cretarhabdus sp. 1 - See below
Cretarhabdus sp. 2 - See below
Crucirhabdus primulus PRINS 1969 ex ROOD, HAY & BARNARD 1973 - [ROOD, HAY & BARNARD 1973]

Cyclagelosphaera margereli NOËL 1965 - [GRÜN & ALLEMANN 1975]
Diazomatolithus lehmani NOËL 1965 - [THIERSTEIN 1971]
Discorhabdus ignotus (GORKA 1957) PERCH-NIELSEN 1968 - [GRÜN & ALLEMANN 1975]
Discorhabdus patulus (DEFLANDRE 1954) NOËL 1965 - [ROOD, HAY & BARNARD 1973]
Discorhabdus sp. - See below
Discorhabdus tubus NOËL 1965 - [ROOD, HAY & BARNARD 1971]
Ellipsagelosphaera britannica (STRADNER 1963) PERCH-NIELSEN 1968 - [GRÜN & ALLEMANN 1975]
Ellipsagelosphaera crucicentralis MEDD 1971 - [MEDD 1971]
Ellipsagelosphaera keftalrempti GRÜN & ALLEMANN 1975 - [GRÜN & ALLEMANN 1975]
Ellipsagelosphaera sp. - See below
Ethmorhabdus gallicus NOËL 1965 - [ROOD, HAY & BARNARD 1973]
Hexapodorhabdus cuvillieri NOËL 1965 - [ROOD, HAY & BARNARD 1973]
Octopodorhabdus decussatus (MANIVIT 1959) ROOD, HAY & BARNARD 1971 - [ROOD, HAY & BARNARD 1973]
Parhabdolithus liasicus DEFLANDRE 1952 - [ROOD, HAY & BARNARD 1973]
Parhabdolithus marthae DEFLANDRE 1954 - [ROOD, HAY & BARNARD 1973]
Parhabdolithus sp. - See below
Podorhabdus cylindratus NOËL 1965 - [NOËL 1973]
Podorhabdus macrogranulatus PRINS 1969 ex ROOD, HAY & BARNARD 1973 - [ROOD, HAY & BARNARD 1973]
Schizosphaerella punctulata DEFLANDRE & DANGEARD 1938 - [GRÜN, PRINS & ZWEILI 1974]
Staurolithites crux (DEFLANDRE 1954) CARATINI 1963 - [CARATINI 1963]
Staurorhabdus quadriarcullus (NOËL 1965) NOËL 1973 - [KEUPP 1977]
Stephanolithion hexum ROOD & BARNARD 1972 - [MOSHKOVITZ & EHRLICH 1976]
Stephanolithion speciosum DEFLANDRE 1954 - [ROOD & BARNARD 1972]
Stephanolithion speciosum var. *octum* ROOD & BARNARD 1972 - [ROOD & BARNARD 1972]
Striatomarginis primitivus ROOD, HAY & BARNARD 1973 - [ROOD, HAY & BARNARD 1973]
Striatomarginis veterna (PRINS 1969 ex ROOD, HAY & BARNARD 1973) WISE & WIND 1976 - [WISE & WIND 1976]
Tetralithus gothicus DEFLANDRE 1959 - [WISE & WIND 1976]
Tubirhabdus patulus PRINS 1969 ex ROOD, HAY & BARNARD 1973 - [ROOD, HAY & BARNARD 1973]
Watznaueria barnesae (BLACK 1959) PERCH-NIELSEN 1968 - [HILL 1976]
Zygodiscus erectus (DEFLANDRE 1954) MANIVIT 1971 - [MANIVIT 1971]
Zygodiscus noeli (ROOD, HAY & BARNARD 1971) TAYLOR 1978 - [TAYLOR 1978]

Calyculus spp.

Specimens of *Calyculus cribrum* NOËL 1973 and *Calyculus pugnatum* GRÜN, PRINS & ZWEILI 1974 are included in this group because it is not easy to differentiate between the two species in the light microscope.

Cretarhabdus sp. 1

The figured specimens (Plate, Fig. 6, 7) display the rim features characteristic of the genus *Cretarhabdus*. The central area contains a mesh structure with many holes which are arranged in regular rows in contrast to *Cretarhabdus* sp. 2.

Cretarhabdus sp. 2

These specimens (Plate, Fig. 8) are similar to *Cretarhabdus* sp. 1 except that the holes of the central mesh are not regularly aligned.

Discorhabdus sp.

The figured specimen (Plate, Fig. 12) differs from *Discorhabdus ignotus* in having a larger overall size and in the greater diameter of the central area. It is similar to *Discorhabdus biperforatus* ROOD, HAY & BARNARD 1973 in the size of the central area but differs in its lack of a perforated stem. The identification of many of the other species of *Discorhabdus* is often made on the nature of the axial stem (*D. jungi* NOËL 1965 and *D. patulus* for example). In view of the absence of the complete stem in the present specimens no new species is created.

Ellipsagelosphaera sp.

This group includes very small specimens of the genus *Ellipsagelosphaera* which cannot be identified at species level because of their small size. These specimens may be the ancestral forms of *Ellipsagelosphaera britannica.*

Parhabdolithus sp.

1977 *Ethmorhabdus* aff. *E. gallicus* NOËL 1965 - HAMILTON, p. 587; Pl. 1, Fig. 4-6; Pl. 3, Fig. 4, 5.

The rim structure of these Lower Jurassic specimens (HAMILTON 1977, Pl. 1, Fig. 4-6; Pl. 3, Fig. 4, 5), a single layer of upright elements, is not characteristic of the genus *Ethmorhabdus,* whose members possess a double series of calcite elements in the ring. The specimens should rather be included in the genus *Parhabdolithus.* They show some similarity to the Cretaceous species, *Parhabdolithus asper* (STRADNER 1963) MANIVIT 1971. The other Lower Jurassic species of *Parhabdolithus (P. liasicus* and *P. marthae)* are best known in their side view and are seldom figured in polar view. It might be, therefore, that these specimens are the polar views of one of the two Lower Jurassic species. A new species designation is not therefore thought appropriate at the moment.

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Plate

Fig. 1	*Ellipsagelosphaera britannica* (Stradner); distal side, ×4,500 Bathonian, Cap Mondego, Neg. No. UCL-371-2
Fig. 2	*Ellipsagelosphaera britannica* (Stradner); proximal side, ×3,800 Bathonian, Cap Mondego, Neg. No. UCL-374-19
Fig. 3	*Ellipsagelosphaera keftalrempti* Grün & Allemann; distal side, ×4,100 Bathonian, Cap Mondego, Neg. No. UCL-390-19
Fig. 4	*Ellipsagelosphaera keftalrempti* Grün & Allemann; proximal side, ×4,000 Bathonian, Cap Mondego, Neg. No. UCL-403-3
Fig. 5	*Ellipsagelosphaera crucicentralis* Medd; distal side, ×3,700 Bathonian, Cap Mondego, Neg. No. UCL-366-23
Fig. 6	*Cretarhabdus* sp. 1; proximal side, ×3,100 Bajocian, Brenha Road, Neg. No. UCL-98-27
Fig. 7	*Cretarhabdus* sp. 1; distal side, ×4,600 Bajocian, Brenha Road, Neg. No. UCL-98-29
Fig. 8	*Cretarhabdus* sp. 2; proximal side, ×5,200 Bajocian, Brenha Road, Neg. No. UCL-97-25
Fig. 9	*Discorhabdus ignotus* (Gorka); proximal side, ×3,800 Bajocian, Brenha Road, Neg. No. UCL-91-18
Fig. 10	*Discorhabdus ignotus* (Gorka); proximal side, ×4,300 Bajocian, Brenha Road, Neg. No. UCL-90-18
Fig. 11	*Discorhabdus ignotus* (Gorka); proximal side, ×4,800 Bajocian, Brenha Road, Neg. No. UCL-91-3
Fig. 12	*Discorhabdus* sp.; distal side, ×4,500 Bathonian, Cap Mondego, Neg. No. UCL-396-26
Fig. 13	*Stephanolithion speciosum* var. *octum* Rood & Barnard; proximal side, ×4,100 Bathonian, Cap Mondego, Neg. No. UCL-378-3
Fig. 14	*Stephanolithion speciosum* Deflandre; proximal side, ×3,300 Bathonian, Cap Mondego, Neg. No. UCL-370-24
Fig. 15	*Biscutum ellipticum* (Gorka); distal side, ×5,500 Bajocian, Brenha Road, Neg. No. UCL-91-1
Fig. 16	*Tetralithus gothicus* Deflandre; ×7,300 Bathonian, Cap Mondego, Neg. No. UCL-414-16
Fig. 17	*Striatomarginis primitivus* Rood, Hay & Barnard; distal side, ×5,900 Toarcian, Brenha Road, Neg. No. UCL-60-11
Fig. 18	*Striatomarginis veterna* (Prins); proximal side, ×3,700 Bajocian, Brenha Road, Neg. No. UCL-88-7
Fig. 19	*Staurorhabdus quadriarcullus* (Noël); proximal side, ×5,200 Bajocian, Brenha Road, Neg. No. UCL-98-21
Fig. 20	*Schizosphaerella punctulata* Deflandre & Dangeard; ×1,900 Bathonian, Brenha Road, Neg. No. UCL-104-13


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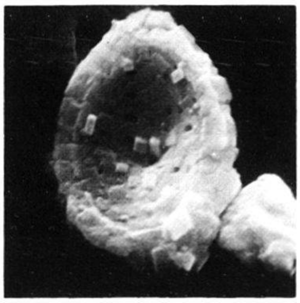
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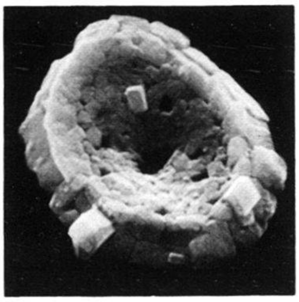
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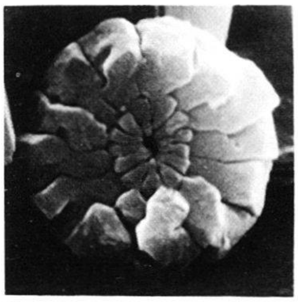
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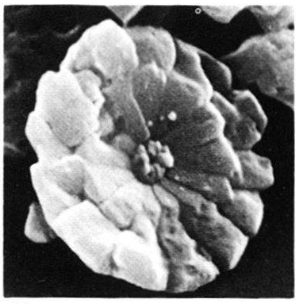
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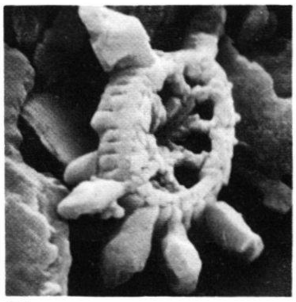
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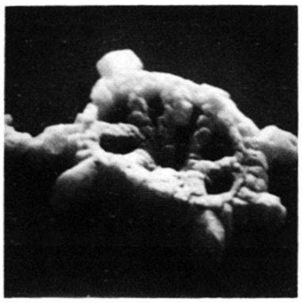
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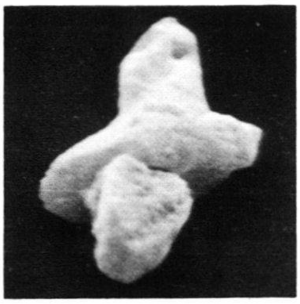
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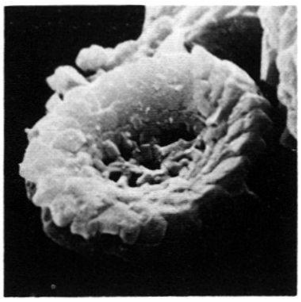
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