Labyrinthidoma Adams, Knight & Hodgkinson; an unusually large foraminiferal genus from the chalk facies (Upper Cretaceous) of southern England and northern France

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ABSTRACT

The genus *Labyrinthidoma*, and its type species (*L. dumptonense* Adams, Knight & Hodgkinson, 1973) is an unusually large taxon of agglutinated foraminifer described from the Santonian chalk of Kent. Within the Turonian chalks of southern England and northern France there are numerous records of "large agglutinated foraminifers", with a variety of names attached. The Turonian species, herein described as *Labyrinthidoma southerhamense* sp. nov., is closely related to *L. dumptonense*, and both taxa appear to be restricted to deeper-water parts of the chalk succession.

INTRODUCTION

Labyrinthidoma Adams, Knight & Hodgkinson was first described from the chalk of the Isle of Thanet (Kent) in 1973. The type locality of both the genus and its type species is Dumpton Gap on the coast immediately to the north of Ramsgate (see Fig. 1). The species was also recorded from the Western Undercliff at Ramsgate, and in Joss Bay and Kingsgate Bay. The chalk succession of these localities is well known (Peake, 1967a,b; Rowe, 1900) and has been investigated recently, for its foraminiferal content, by Bailey (1978). Bailey did not find the species in any of his samples, despite knowing of the species' existence and making a conscious attempt to find it in all his residues. At the time both he, and the present author, had no explanation for this absence and it was attributed to the "rareness" of the taxon. It was only in December 1993 that Mr. R.L. Hodgkinson *(personal communication)* explained that the specimens in The Natural History Museum had been collected **individually,** using a pen-knife and not collected by normal bulk sampling techniques. Bailey had, apparently, been distinctly unlucky not to have collected one specimen in his suite of regularly-spaced (1 metre interval) samples.

For many years (Hart, 1982; Mortimore & Wood, 1986; Robaszynski *et al.*. 1980) it has been known that a similar taxon is present in the Turonian chalks of southern England and northern France. In recent years this has generally been called *"Coscinophragma"*, with French micropalaeontologists usually describing it as *"Coscinophragma irregularis"* (d'Orbigny). Most authors have given the generic attribution in "quotation marks", with nobody actually giving a proper designation. Everyone appears to have been waiting for someone else to investigate the taxon properly! This account will attempt to do this.

THE TURONIAN TAXON

In southern England (Fig. 1) *"Coscinophragma"* is known from the Turonian successions (Hart, 1982) of Dover, the Isle of Wight and S.E. Devon as well as Cap Blanc Nez (Robaszynski *et al.*, 1980) and the Touraine (Robaszynski *et al*, 1982). Despite some regional variations (Hart, 1982; Hart & Weaver, 1977) the range of this species appears to be early to mid-Turonian. In many areas the species becomes extinct (or disappears from the local succession) just above the regionally distinctive first appearance of *Marginotruncana coronata* (Bolli).

The first appearance of the species is also variable, as indicated by Hart (1982). In the Touraine (Robaszynski *et al.*, 1982) it appears in the *Whiteinella archaeocretacea* Zone while in the Boulonnais the appearance is well up within the *Praeglobotruncana helvetica* Zone. This variability in range was always regarded as a function of ecology; probably water depth. It was also noted that there were morphological variations within the taxon across the Wessex Basin with specimens from Beer (see Fig. 1) and Membury (Hart, 1975) being much smaller and delicate. Specimens from Sussex were always much more massive and better developed. As indicated in Figure 1 an excellent locality from which to collect the species is a small pit on the track up the east side of Mount Caburn (west of Glynde, Sussex). In the upper part of this pit can be found the Southerham Marl No. 1, as described by Mortimore & Pomerol (1991).

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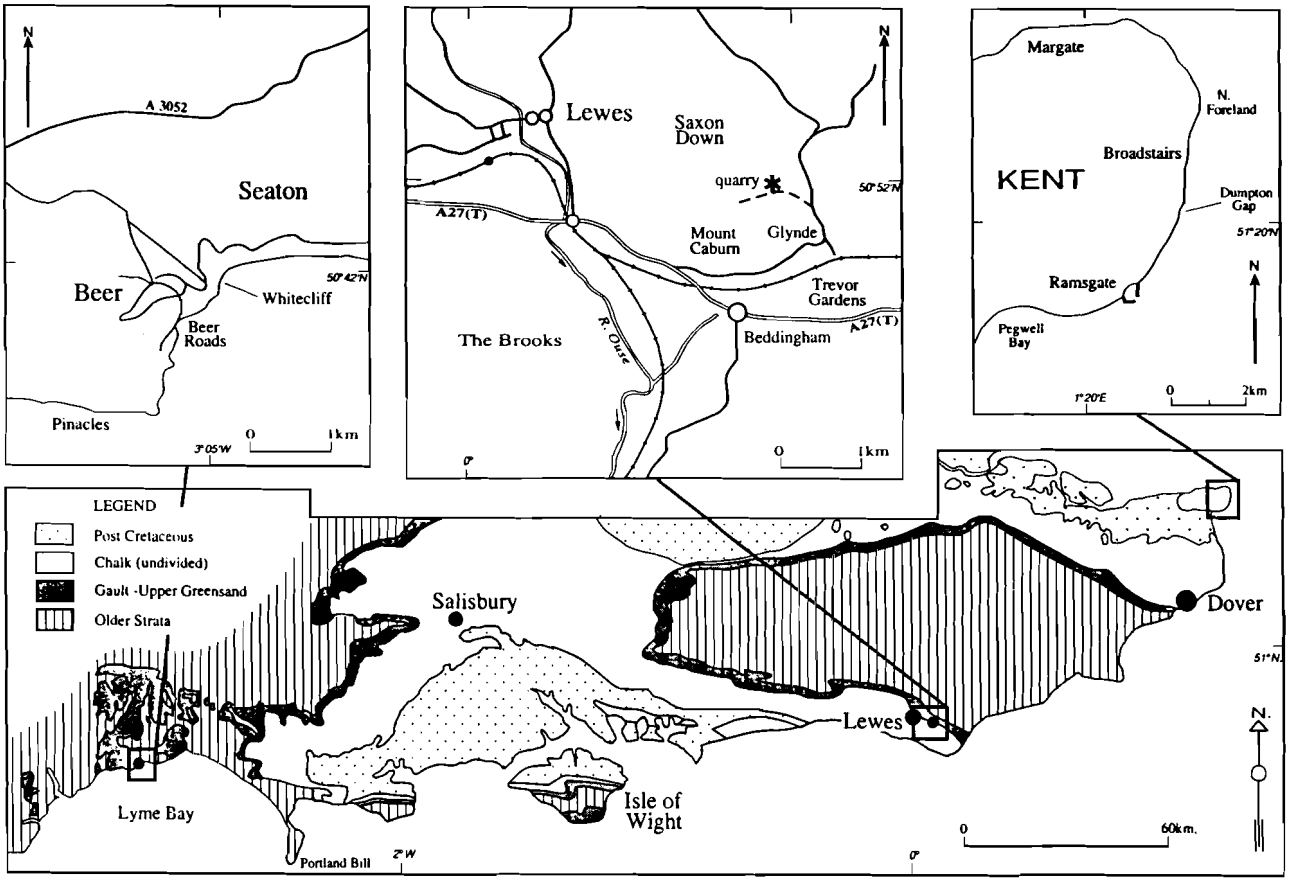


Figure 1. Outline geological map of Southern England with inset maps of the principal locations from which material can be collected. On the east coast of Kent, immediately north-east of Ramsgate, *L. dumptonense* can be collected (especially near Dumpton Gap). Just to the East of Lewes the type locality of *L. southerhamense* is found on Mount Caburn north-west of Glynde. In S.E. Devon, near the village of Beer, the mid-Turonian can be inspected in Beer Roads [collecting not allowed] and in the cliffs above the Pinnacles.

This grey/green marl is some 10-15 cm thick and is found about 0.70m above a layer of single scattered flints. The taxon is abundant in the marl and can also be found in the chalks lower in the succession. As far as can be determined it disappears approximately midway between Southerham Marls 1 and 2. Using material from Mount Caburn and Beer the taxonomic position of this "species" has been investigated.

THE GENERIC DETERMINATION

Within the Lituolacea of Loeblich & Tappan (1987) there are a number of large genera with some of the characteristics of the Turonian species. The characteristics of six of these genera are listed in Table 1.

Thomasinella Schlumberger, 1893 [for a good review see Arnaud-Vanneau & Prestat, 1984] can be discounted because of the nature of its aperture and arborescent growth form.

Navarella Ciry & Rat, 1951 is a relatively small genus with a non-cribate aperture and simple septa.

Bulbophragmium Maync, 1952 is also a small genus, with other species well-known from the Cretaceous succession in the UK. Even though *Bulbophragmium* possesses an initial streptospiral coil and has a cribrate aperture, its interior is always of simple construction.

Bdelloidina Carter, 1877 is generally an attached genus and also possesses an internally complex alveolar structure. The aperture in *Bdelloidina* is also non-cribrate.

Coscinophragma Thalmann, 1951 is about the right size, is free-living, has a cribrate aperture and a very similar wall structure but is generally branching and does not possess the early streptospiral coil of the present genus.

Labyrinthidoma Adams, Knight & Hodgkinson, 1973 (see Textfig. 2), would appear to be the most suitable genus and an inspection of the material housed in the Micropalaeontology Collections of The Natural History Museum in London confirmed this view. Material has also been collected from the Margate area of Kent (see Fig. 1).

The stratigraphic distribution of *Labyrinthidoma* [there is only one recorded species - *L. dumptonense*] is known with any precision. Despite sampling the whole succession of East Kent, Bailey (1978) did not find the genus and so the only available data are those in the initial designation of the genus. The species/genus reportedly disappears some 3.0m above "Whitaker's 3 inch Band", a prominent flint band in the uppermost part of the Seaford Chalk in the mid-Santonian (see Fig. 3). The author, and

Table 1. Generic characteristics of some large Cretaceous agglutinated Foraminiferida

Features / Genera	*Coscinophragma* Thalmann, 1951	*Thomasinella* Schlumberger, 1893	*Labyrinthidoma* Adams, Knight & Hodgkinson, 1973	*Bdelloidina* Carter, 1877	*Bulbophragmium* Maync, 1952	*Navarella* Ciry & Rat, 1951
size (max size in mm.)	large 34mm.	"large" 7mm.	large 50mm.	large 20mm.	"large" 5mm.	"large" 5-6mm.
attached or free	free	?	free	attached	free	free
branching growth form	yes	yes (arborescent)	rare (very)	yes	no	no
early growth stage of the microspheric form	trochospiral coil	?	high trochspiral coil	?	?	?
early growth stage of the megalospheric form	no coil, totally uniseral	"globular"	involute streptospiral coil	irregular on the attachment surface	? streptospiral	streptospiral
aperture in the uniserial growth stage	cribrate (numerous)	simple, round or ovoid	cribate (numerous)	single or double row of pores	cribate (7-8)	small circular areal openings
cement in the outer wall	yes- acid resistant	?	yes- some carbonate	?	?	yes- some carbonate
internal structures	median layer posseses canaliculi	wall canaliculate	labyrinthic interior	perforate, alveolar structure	radiating vertical partitions	simple septa
nature of the inner wall	chamber cavity smooth	?	chamber cavity smooth	?	?	?
currently known range	Middle Albian to Lower Turonian	Cenomanian	Santonian	Palaeocene to Holocene	Campanian	Maastrichtian
geographical distribution	Central Europe	N. Africa India	S.E. England	USA Indonesia Indian Ocean Pacific Ocean	Europe	France Spain Switzerland

none of his research students working on higher levels in the succession (e.g. Swiecicki, 1980) or in the Coniacian and Turonian chalks of the area (Bailey, 1978) have found the genus. The original designation of the genus does not give a level of first appearance and the author (as indicated above) can give no data on this matter. The genus, therefore, appears in the uppermost Coniacian, just below the level of Bedwells Columnar Flint.

THE SPECIFIC DETERMINATION

As indicated above, the species under discussion is almost certainly a *Labyrinthidoma* The initial diagnosis of the genus (from Adams, Knight & Hodgkinson, 1973) is as follows:

"Test free, agglutinating. Initially coiled streptospirally in the megalospheric form, later becoming uncoiled. Microspheric form similar, but with a trochospiral and/or biserial stage prior to becoming streptospiral. Most chambers labyrinthic, wall canaliculate but non-labyrinthic, not composed of a distinct epidermis and hypodermis. Aperture cribrate."

This is clearly the genus under discussion but the Turonian individuals are different from those included in *L. dumptonense* and for this reason a new species is proposed.

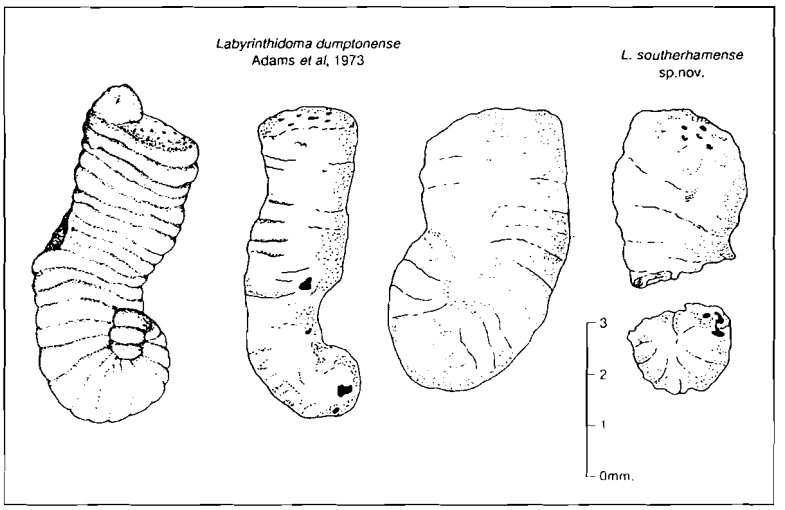
Family LABYRINTHIDOMATIDAE Loeblich & Tappan, 1987

Labyrinthidoma Adams, Knight & Hodgkinson, 1973

Type species: *Labyrinthidoma dumptonense* Adams *et al.*, 1973 as [*Labyrinthidoma dumptonensis*].

Labyrinthidoma southerhamense sp.nov.
Textfigure 2 and Plates 1, 2

Material. Several hundred specimens from a range of localities in S. England and N. France. Type material has been deposited in the collections of The Natural History Museum, London. Additional material is also



Textfigure 2. Comparison of *Labyrinthidoma dumptonense* and *L. southerhamense*. From left to right: *L. dumptonense* from Kent reproduced from Adams *et al.*, 1973, text-fig.2; *L. dumptonense* from the collections of The Natural History Museum (P48628); *L. dumptonense* from the collections of The Natural History Museum (Dr. Knight Collection No. 0930); *L. southerhamense*, Holotype (PF 53023).

retained in the collections of the University of Plymouth.

Diagnosis. A species of *Labyrinthidoma* with an initial streptospiral coil followed by up to 12 uniserially arranged, slowly expanding chambers. Aperture terminal, cribrate, with 6-8 openings.

Holotype. PF 53023 (Textfig. 2).

Paratypes. PF 53026 (Pl. 1, Fig. 6), PF 53024 (Pl. 1, Fig. 2), PF 53027 (Pl. 1, Fig. 5), PF 53025 (Pl. 1, Fig. 4), PF 53031, PF 53032.

Additional material, from both Mt. Caburn and Beer, is also deposited in the collections of The Natural History Museum. These are listed as PF 53028/29/30/33/34/35/36/37.

Horizon. Turonian; from the Southerham Marl No.1, in the lower part of the Lewes Chalk. The Southerham Marl No. 1 is of *Collignoceras woolgari* Zone age in the mid-Turonian, and is located within the *Marginotruncana pseudolinneiana* Interval Zone of Hart *et al.* (1989).

Locality. Chalk pit (Grid Reference: TQ.449096) on north side of track from Glynde Place to Mount Caburn, north-west of the village of Glynde, near Lewes in Sussex (Fig. 1).

Description. Test finely agglutinated, with a prominent involute steptospiral initial coil of numerous chambers. Later growth stage rectilinear with up to 12 chambers; all chambers wider than high, may be circular or elliptical (flattened?) in cross section. Sutures slightly depressed. Chamber walls thick, composed of agglutinated chalk grains, shell debris, calcareous nannofossils, broken foraminiferal tests, calcispheres and in S.E. Devon in particular - sponge spicules (which have usually been dissolved out leaving cavities). In the rectilinear part of the test, short, stout, irregular partitions project inwards from the wall, often showing perforation by coarse pores. The proloculus has rarely been seen but in some broken specimens it can be seen to be spherical and about 0.30 - 0.40mm in diameter. The initial coil is thought to be streptospiral but in many individuals may be irregular. Trochospiral or biserial stages (as in *L. dumptonense*) have not been observed. The interior wall of all chambers is smooth with the intercommunicating spaces of irregular size and shape. No branching growth forms have been seen and no specimens with a point of attachment have been recorded. The aperture is always terminal, cribrate and comprising circular pores. These pores are irregularly distributed over the apertural face.

Remarks. *Labyrinthidoma southeramense* is, generally, smaller than *L. dumptonense* with a less prominent initial coil. There are fewer rectilinear chambers. The apertural face is always flat and has a cribrate aperture of 4-8 circular pores. This is much less than the "normal" figure of 16-18 quoted by Adams *et al.* (1973) for *L. dumptonense.*

STRATIGRAPHIC DISTRIBUTION

Labyrinthidoma is only known from the Upper Cretaceous successions in the UK and Northern France. In all cases it is found in the chalk facies. As indicated in Figure 3 the ranges of the two species are not overlapping with a distinct gap in the record in the late Turonian and early Coniacian. The majority of authors (Hancock & Kauffman, 1979; Hancock, 1989; Mortimore 1986a,b; Mortimore & Pomerol, 1991; Haq *et al*, 1988; Hart & Bailey, 1979) agree that this is a time of eustatic low-stand. The genus appears to be restricted to the deeper-water parts of the succession in the lower to middle Turonian (*L. southerhamense*) and the upper Coniacian-Santonian (*L. dumptonense*). The distribution of the genus also seems to avoid the lower values of ∂13C recorded by Jenkyns *et al.* (1994), perhaps lending support to the idea that the ∂13C curve may, in some cases, be acting as a surrogate sea-level curve.

As shown in Plate 2, Figs. 3-5 the wall structure of *L. southerhamense* is generally composed on fine grained silt material (usually quartz) in the Beer area of S.E. Devon. Specimens from this locality also contain large numbers of sponge spicules that have usually been removed. It is noticeable that the middle Turonian of the Beer successions are characterised by the presence of abundant flints, while this is not the case in Sussex. In Sussex (Pl. 2, Figs. 1, 2, 9) specimens are almost invariably composed of carbonate material, including coccoliths and calcispheres. It is

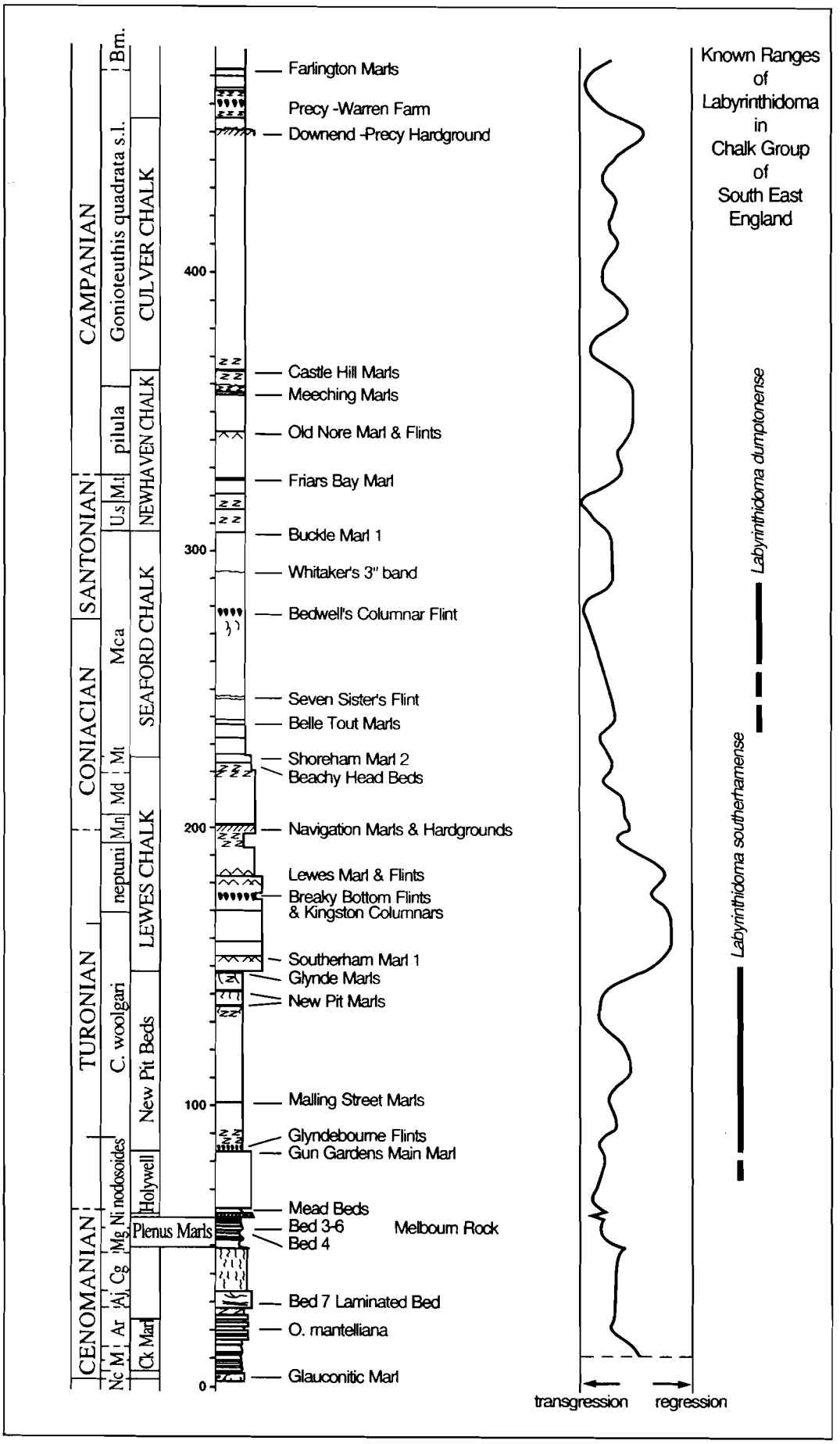


Figure 3. The Cenomanian-Campanian succession of S.E. England, an outline sea level curve and the presently known distribution of *Labyrinthidoma* [partly based on a modified figure from Mortimore & Pomerol, 1991].

also apparent that the Devon material usually have 3-4 pores in the cribrate aperture (Pl. 2, Figs. 4, 5), while those from Sussex generally have 6-8 pores (Pl. 1, Figs. 4, 5).

SUMMARY

Labyrinthidoma southerhamense is a characteristic species of the Early-Middle Turonian of Southern England and Northern France. It is probably ancestral to *L. dumptonense*, a larger, more complex, taxon of the Late Coniacian and Santonian. No transitional forms have been discovered. Both taxa appear to be characteristic of deeper-water environments.

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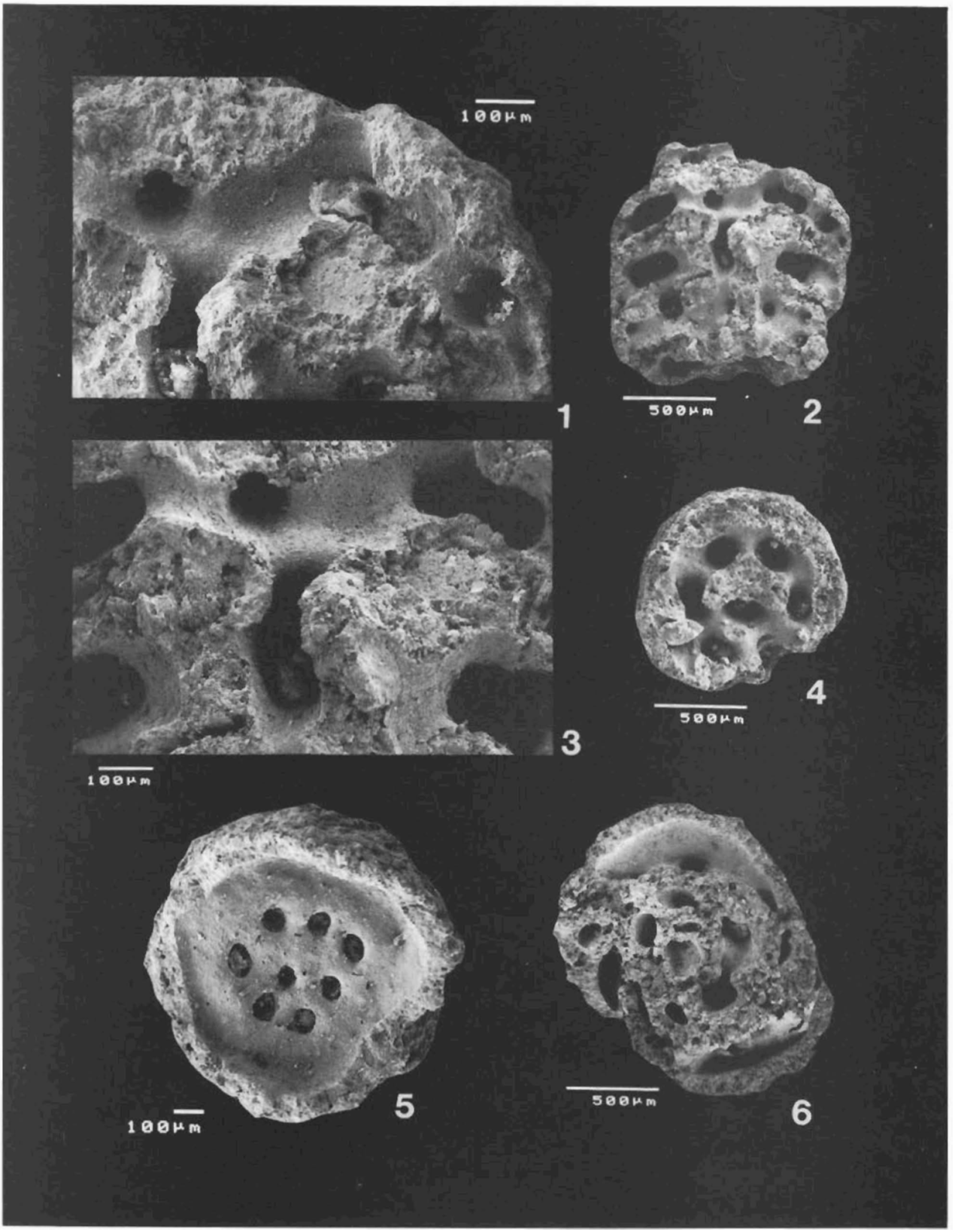

Plate 1. All material based on specimens of *L. southerhamense* from the Southerham Marl No. 1, Mount Caburn, Sussex. **1.** Enlargement of upper part of Pl. 1, Fig. 2 showing thick walls, chambers and connecting passages. **2.** Dissected specimen showing chambers, walls and connecting passages. Paratype, PF 53024. **3.** Different view of part of area illustrated in Pl. 1, Fig. 1, showing smooth internal walls of chambers. **4.** Dissected specimen showing thickness of wall and position of seven pores in the cribrate aperture. Paratype, PF 53025. **5.** Dissected specimen showing thickness of outer wall. This is the inside of the final apertural face, with the cribrate aperture clearly visible. Paratype, PF 53027. **6.** Dissected specimen showing the initial coil and what has been regarded as a part of the proloculus. Paratype, PF 53026.

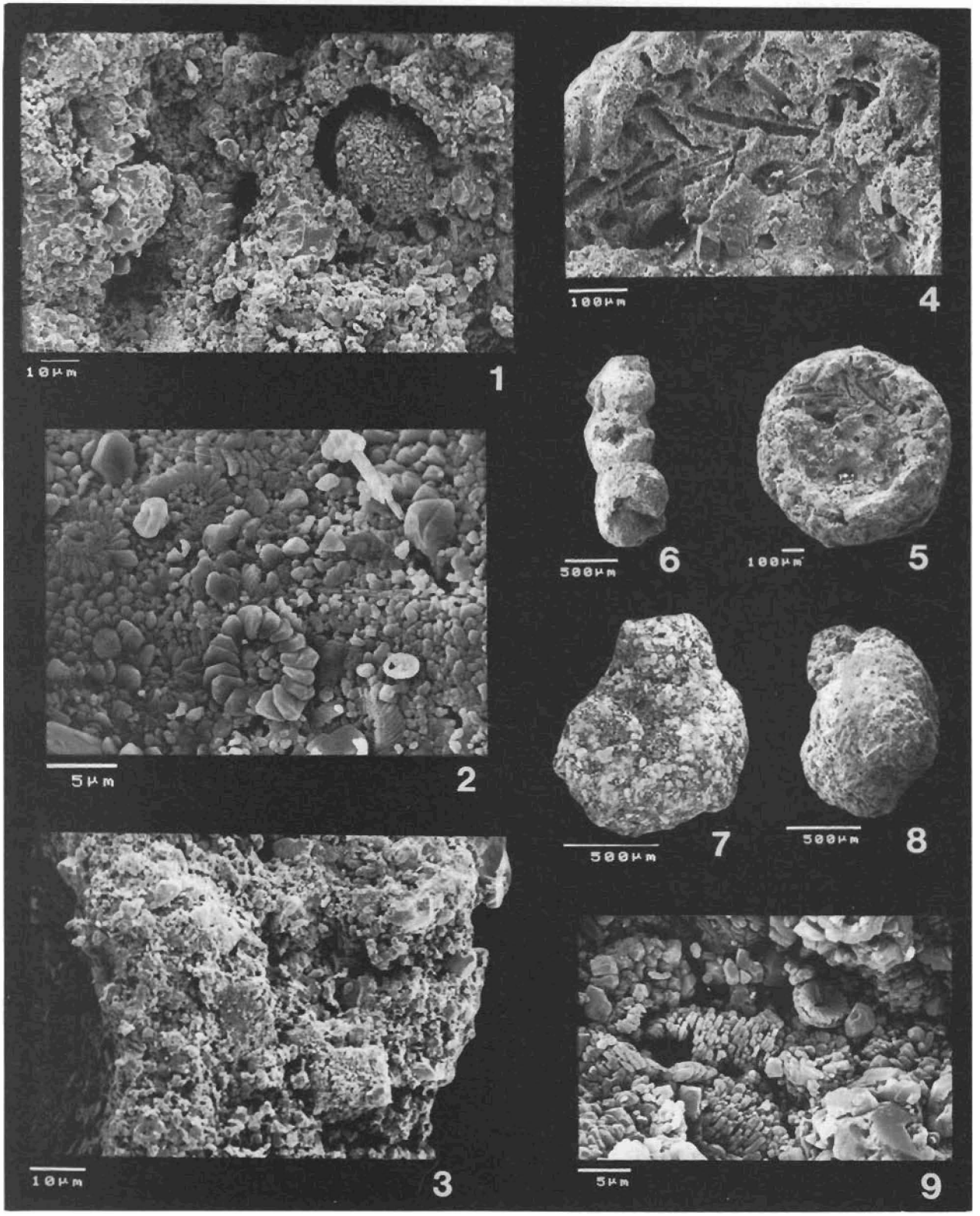

Plate 2. Figures 1-2, 7-9 are specimens of *L. southerhamense* from the Southerham Marl No.1, Mount Caburn, Sussex. Figures 3-6 are specimens from the lower part of the *Terebratulina lata* Zone, Beer Roads, Beer, S.E. Devon. **1.** Enlargement of the wall of the specimen (PF 53027) shown in Plate 1, Figure 5. This shows coccolith debris and a calcisphere. **2.** Enlargement of the wall of the specimen (PF 53024) shown in Plate 1, Figure 2. This shows a wide range of coccolith debris. **3.** Enlargement of the wall of a specimen from Beer showing some quartz grains and some coccolith debris. **4.** Enlargement of the edge of the specimen shown in Plate 2, Figure 5, showing one of the pores of the cribrate aperture and the spaces left by dissolution of sponge spicules. **5.** Inside view of a chamber face showing the cribrate aperture and spaces left by dissolution of sponge spicules, PF 53028. **6.** Broken specimen from the *Terebratulina lata* Zone of Beer, S.E. Devon. **7.** Initial coil of a broken specimen. **8.** Initial coil of a broken specimen, PF 53030. **9.** Enlargement of the wall shown in the broken specimen illustrated in Plate 1, Figure 4 (PF 53025).