

## The Early Eocene London Clay Formation mollusc fauna of the former Bursledon Brickworks, Lower Swanwick, Hampshire

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**Abstract:** Construction of the Civil Aviation Authority's new en-route centre on the site of the former Bursledon Brickworks at Lower Swanwick, during 1991-1992, re-exposed sections in the London Clay unavailable since this site fell into disuse in 1974. New material collected from the recent excavations has prompted a reappraisal of the mollusc fauna of this site. This is reviewed along with material collected during the working life of the brickworks and now held in the Natural History Museum, London. The mollusc fauna consists of 146 species and is listed in systematic order, with an indication of local stratigraphic range and palaeoecological interpretation. The taphonomy of the mollusc fauna is discussed, and a number of notes given detailing taxonomic revisions. Three new species of bivalve are described: *Semeloidea curryi*, *Siliqua kingi* and *Abra (Syndosmya) cygnea* and three gastropods: *Entomope semipunctata*, *Solariorbis lawsoni* and *Epalxis kempi*. Lectotypes are designated for *Eopleurotoma simillima crassilinea* and *Microdrillia tricincta*. The majority of the fauna is illustrated photographically, in most cases for the first time.

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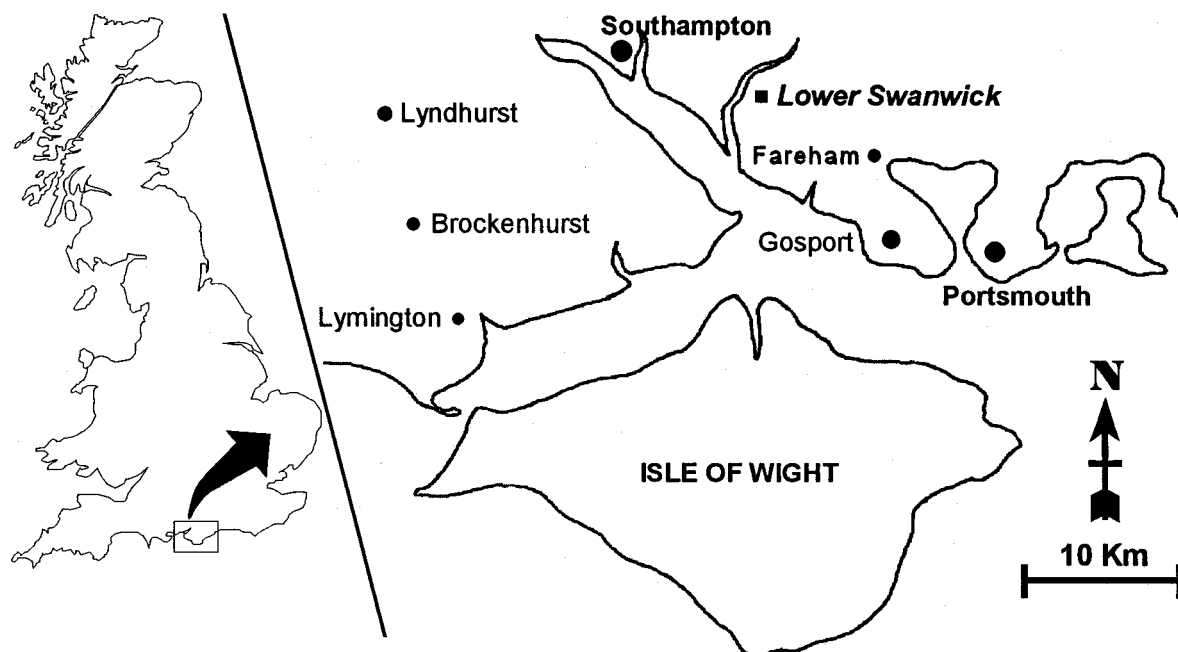
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### INTRODUCTION

This site overlooks the Hamble River, and lies just north of the settlements of Lower Swanwick and Bursledon, between the cities of Southampton and Portsmouth on the Hampshire coast, southern England.

The former Bursledon, or Lower Swanwick, Brickworks were founded in 1897 to exploit the London Clay for use in making bricks, tiles and terracotta pipes, and continued in use under a number of operators for nearly 80 years. The last active pit commenced working in 1957, and was extended northwards in 1971. The site ceased operation in 1974 and lay largely unused, except for recreation.

In 1991 work started on the construction of a new en-route centre for the Civil Aviation Authority. A large part of the old workings, at approximately SU 504 097, have been re-developed as the result of this, giving rise to temporary exposures during the excavation of trenches for main services, piling-holes for foundations, and landscaping and levelling of the site. Some previously flooded pits were drained and/or landscaped. The remainder of the site now comprises a series of more or less overgrown and flooded pits about the area of grid reference SU 50 10. The south-west corner of the site is bisected by the M27 motorway, which opened in 1975.



**Text-fig. 1** Location map of the Lower Swanwick area, Hampshire.

Much new material was collected from the latest temporary exposures by the authors, Dr. C. King, and others; and a study of this prompted a reappraisal of all published and unpublished material from this site. Those parts of the works of Wrigley (1949) and Curry & King (1965), which deal with the fossil mollusc fauna were critically reviewed, revised, and incorporated with additional records of material collected by various workers and held in the collections of the Natural History Museum, London, (NHM).

#### PREVIOUS RESEARCH

This site was first mentioned in a geological context by Clement Reid (1902), although Reid noted: "... no fossils could be found in either [pit] at the time of my visit.". The first faunal list for this site was given by Wrigley (1949), and included 49 species of mollusc, probably all collected from the area now occupied by the CAA development. Curry & King (1965) examined the stratigraphy and faunas of the various pits, and in particular gave a composite list of the fauna from the 1951 and 1957 holes which included 46 species of mollusc. James (1974) gave a detailed account of the whereabouts of the pits referred to by Curry & King and others in the literature on this site. The 'Wrigley South Pit', 'Wrigley North Pit', '1948 hole', '1951 hole' and '1955 hole' all fall within the area affected by the CAA development; the 'Wrigley South Pit' and '1955 hole' were also impinged on by the M27 motorway. King (1981) gave details of the stratigraphy of the brickworks, and the sections exposed by construction of the M27 motorway. Kemp & King (1995) gave a detailed account of the stratigraphy of the London Clay exposed during the redevelopment of the disused brickworks.

#### STRATIGRAPHY

This site has exposed from time to time, Divisions B, C and D of the Early Eocene London Clay Formation (Thames Group of King, 1981), plus the base of the overlying Wittering Formation (Bracklesham Group). The recent workings re-exposed sandy, silty clays and clayey, silty sands with occasional pebble horizons attributed to divisions B2 and C1 of the London Clay Formation. The *Barnea* bed, at the top of Division B2, is herein treated separately, due to its distinctive fauna and lithology. Approximately 5m of division B2 (of which around 2m is *Barnea* bed) and 7m of division C1 was exposed. The full stratigraphy of this site was discussed by King (1981) and Kemp & King (1995).

#### MATERIALS

The specimens which provide the basis for this list were collected from sections exposed during the working-life of the brickworks and, more recently, during the construction of the new CAA centre at Lower Swanwick.

Examples from older collections, collected while the brickworks were still active, come from all parts of the workings. The majority of material came from divisions B2 and C1. Much was surface-picked and so the stratigraphic localisation of specimens is sometimes less accurate than for recently collected material, and occasionally may be absent altogether. Sieving of bulk samples from the 1957 pit, collected in the early 1970's by Tertiary Research Group members, has yielded some additional records of minute taxa.

Material collected during the construction of the new CAA centre was often found *in situ*, and so is well localised stratigraphically. Examples collected *ex situ* from spoil tips are less well localised, although familiarity with *in situ* sections, and the tipping of spoil from different horizons in discrete areas, allowed the authors to estimate the horizon of origin. Such records cannot however be considered wholly reliable, and an indication is given in the main systematic list when a record is *ex situ*.

The only published record from above C1 is given by Curry and King (1965) who record "*Ostrea* sp." from a level probably in C2. An external cast, probably of *Semimodiola elegans* (J. Sowerby, 1812), labelled as '?Lower Bagshot, lignitic band above London Clay' in the King collection at the NHM, probably came from a similar level. King (1981: 80-83, text-fig. 27) noted a number of occurrences from the lower part of B2 and below from borehole samples.

Miscellaneous collections examined in the NHM, London, include those of D. A. Bone, J. Cooper, A. G. Davies, J. J. Hooker, J. P. James, D. J. Kemp, C. King, D. P. Mawson, M. H. Morgan, F. C. Stinton, E. M. Venables, D. J. Ward and A. Wrigley. Additional material in the Gosport Museum, Hampshire was checked; and one specimen not represented elsewhere was borrowed from the private collection of Mr. P. Clasby. All register numbers refer to specimens housed in the Natural History Museum, London, unless otherwise stated.

#### THE FAUNAL LIST

This comprises 146 species-group records, 23 of which represent the first recorded occurrence in the British Palaeogene. Records are grouped in systematic order, under family-name headings. The arrangement of bivalves follows that of Vaught (1989), while the arrangement of gastropods follows Ponder & Warén (1988), Vaught (1989), and Tracey *et al.* (1993); the arrangement of conacean gastropods follows Taylor *et al.* (1993), who have moved many taxa formerly placed in the family Turridae into the Conidae.

Each species record is accompanied by an indication of its stratigraphic range at the site and an estimate of its relative abundance at that stratigraphic level. Additionally, an interpretation of that species' palaeoecology is given. This latter is based chiefly on Graham (1955), Yonge & Thompson (1976), Taylor in McKerrow (ed.) (1978) and Taylor *et al.* (1980). Some are inevitably somewhat conjectural, and are necessarily rather generalised as there is little direct evidence as to the life-habits of extinct molluscan species.

Each record noted by previous workers has been critically examined and the relevant specimens checked. Any nomenclatural changes, including new combinations or rejected records, are indicated in the taxonomic remarks that follow relevant species entries. Selective synonymies are given where there is a taxonomic revision or a change in name from previously published accounts of the Swanwick mollusc fauna. In this paper some of the "forms" and "varieties" of previous authors are elevated to subspecies rank, where it is felt they are sufficiently distinct to warrant such recognition.

## NOTES ON THE PALAEOECOLOGY OF THE MOLLUSC FAUNA

Interpretation of the ecology of the species listed herein is based partly on published records of the closest living relatives of the taxa represented, and to a lesser extent on observation of individuals found preserved in life position, in *in situ* exposures.

**Division B2:** Only the upper part of this division was seen *in situ*. Molluscs were mostly too scattered in occurrence for bulk-sampling to yield worthwhile results, although a sample from a turrillid-rich horizon near the middle of the sequence formerly exposed in the 1957 pit, yielded a number of records of minute taxa not found elsewhere.

Bivalves were generally uncommon, although the suspension-feeding bivalve *Arctica* was locally abundant. The deposit-feeder *Nucula* and the suspension-feeder *Venericor* were the least uncommon of the more widely distributed bivalves. In contrast a number of gastropod species were moderately abundant: the ciliary-feeding and detritivorous turrillid *Haustator circumdatus* and the detritivore *Tibia* were most numerous, with *H. circumdatus* occurring in drifts in one horizon. Turrillids collected from these drifts were frequently encrusted by small oysters, serpulid worms and bryozoans, suggesting a brief slowing or pause in sedimentation in this part of division B2. The predatory generalists or scavengers *Cantharus* and *Pseudoneptunea*, the molluscivore *Euspira*, and the vermivore *Eopleurotoma* also occurred frequently.

The composition of the mollusc fauna is consistent with a shallow shelf marine environment having some deltaic input, as indicated by Wright's (1972) study of the Foraminifera. The scarcity of cemented epifaunal bivalves at this level suggests a generally high rate of sediment input. The top few metres of this division become increasingly sandy, with occasional pockets of current-winnowed shells, indicating the onset of the shallow subtidal conditions characteristic of the *Barnea* bed. This division has the greatest faunal diversity, with 89 species of mollusc, of which 21 (24%) are bivalves and 65 (73%) are gastropods. Of these, the most diverse types are infaunal suspension-feeding bivalves with 8 species (9%), and vermivorous gastropods with 18 species (20%).

The diverse assemblage of vermivorous gastropods, especially turrids, present in this unit suggests that a comparably diverse fauna of worms was originally present. Similarly, the presence of gastropods which were carnivorous browsers on colonial organisms and predators of echinoderms indicate the former presence of soft-bodied or poorly-skeletonized organisms otherwise unknown in the fossil record at Swanwick.

**Barnea bed:** Bivalves become more abundant in this unit. *Cubitostrea* epifaunal on other shells is common, associated with encrusting cheilostome Bryozoa. *Cyrtopleura* ["*Barnea*"] with articulated valves occur, but are not as abundant as the name of this bed might suggest. Assuming their habitat preference was similar to related living pholadids, their presence in this bed is indicative of shallow subtidal conditions. As with the remainder of B2, *Tibia*, *Cantharus* and *Euspira* are abundant, but *Haustator circumdatus* is rare here. This is the only level at which hyposalinity-tolerant forms such as *Tympanotonos* and *Batillaria* occur, although they are uncommon. Their scarcity and frequently worn condition suggest they may

not have been autochthonous, but were derived from a nearby estuary, lagoon or mangrove swamp; perhaps by storms, floods, predators, or as the result of hermit-crab occupation (pagurization: see Walker, 1992). Certainly their ecologically anomalous distribution, their worn and sometimes extensively bored state, and frequent epibiont encrustation, lends some support to this last hypothesis.

*In situ* exposures of this bed showed occasional unbroken and unabraded bivalves in life position, suggesting a partial biocoenosis. The presence of cemented bivalves and encrusting Bryozoa suggests a reduced rate of sediment influx, while the presence of occasional heavily rolled and bored, reworked shells indicates periods of non-deposition and erosion. Out of 75 species of mollusc, the most diverse lifestyles are represented by infaunal suspension-feeding bivalves with 9 species (12%), and parasitic gastropods with 11 species (15%).

Gastropods which predated soft-bodied organisms are less diverse in this unit than in the remainder of B2, but the considerable variety of pyramidellid gastropods present, which are chiefly parasites of annelid worms and molluscs, suggests that a diverse, if differently constituted, soft-bodied fauna was originally present.

**Division C1:** The base of this unit is a thin bed of subrounded flint pebbles representing the final littoral phase of the shallowing indicated in the *Barnea* bed. This is overlain by approximately 3m of patchily indurated sandy, silty clays. Here large *Pycnodonte* are associated with frequent examples of the semi-infaunal suspension-feeding bivalve *Atrina* and larger infaunal suspension-feeding bivalves such as *Pitar*, *Panopea* and *Pholadomya*. The *Atrina* are sometimes found with the ciliary-feeding gastropod *Sigapatella* grouped near the ventral edge of the valves, apparently in life position, suggesting that the gastropods may have been commensal with the bivalves, benefitting from the inhalant or exhalant currents generated by them. This assemblage is notable for the large size of many individuals compared with other levels, indicating unusually favourable conditions for molluscan growth. The presence of epifaunal cemented and semi-infaunal filter-feeding bivalves with encrusting Bryozoa, occasional serpulids and the solitary scleractine coral *Paracyathus* suggests a low rate of sediment input; however the preservation of unbroken *Atrina* in life position, with *Sigapatella* also in life position on the sides of the *Atrina* valves, suggests inundation during episodes of rapid sedimentation, indicating an irregular pattern of sedimentation overall.

Higher in this division, the return of an assemblage similar to that last seen below the *Barnea* bed betokens a return to deeper water conditions and more stable rates of sedimentation. Specimens in a sample collected by Allan Lawson from an accumulation in the lee of a fossil log at this level show evidence of post-mortem transport and concentration. Out of 64 species of Mollusca in this division, the most diverse types are suspension-feeding infaunal bivalves, with 9 species (14%), and vermivorous gastropods with 9 species (14%).

Carnivorous browsing, echinivorous and vermivorous gastropods show some increase in diversity in this unit compared to the *Barnea* bed, suggesting a return to an overall faunal composition similar to that of division B2. A resumption of slightly deeper-water conditions following

the littoral phase at the top of the *Barnea* bed is probably the reason for this.

#### NOTES ON THE TAPHONOMY OF THE MOLLUSC FAUNA

Various biological agents have left evidence of their physical effect on the mollusc fauna, notably predators, shell boring endobionts and shell-encrusting epibionts.

Traces of predation upon the mollusc fauna of Lower Swanwick include boreholes indicative of gastropod predation, and repaired fractures to gastropod apertures, attributed to shell-peeling by crabs (Crustacea: Decapoda). Shell-crushing by durophagous fish and crabs is likely to be responsible for the small proportion of entirely fragmented shell material seen in *in situ* exposures, but it is difficult to attribute such material with any certainty. Crabs are the more likely source of such material, as a number of examples belonging to several species, are known from Lower Swanwick. The only evidence of durophagous fish is a single tooth of the ray *Myliobatis* sp. (Chondrichthyes: Batoidea) from division B2 of the 1957 pit.

A sample of over 250 specimens surface-collected from division B2 included one species of bivalve, *Pitar*, and seven species of gastropod: *Tibia*, *Euspira*, *Wrigleya*, *Turricula*, *Eopleurotoma*, *Bathytoma* and *Granosolarium*, affected by predatory shell-drilling. Of these *Tibia*, *Euspira* and *Eopleurotoma* were most often affected, with around 5% of specimens showing evidence of predation. Concave-sided circular boreholes referable to the ichnospecies *Oichnus paraboloides* Bromley, 1981 are by far the most abundant: of 37 bivalves and gastropods of differing species found with well-preserved boreholes, 36 were of this type. This trace is usually attributed to naticid predation. One example of *Tibia* was found with a straight-sided circular borehole, this is regular in form and so is tentatively referred to *Oichnus simplex* Bromley, 1981, which is usually attributed to muricid gastropods, rather than *O. ovalis* Bromley, 1993 which is more irregular, and attributed to octopod cephalopods. The rarity of drilled bivalves probably reflects the scarcity of suitable bivalve prey, of the commoner bivalves *Pycnodonte* and *Atrina* were probably too large, and *Arctica* and *Venericor* were probably both too large and thick-shelled for the commonest drilling gastropod *Euspira*, while *Pitar* probably burrowed too deeply to be available to naticid predators.

The relative abundance of borehole types correlates well with the occurrence of potential causative agents: naticaceans are represented by five species, four of which are rare, but one, *Euspira glaucinoides*, is almost ubiquitous in the gastropod assemblages. Considering the small size of the *O. paraboloides* boreholes found (0.5 - 2mm in diameter), it is the most likely causative agent. This is noteworthy in light of the presence of *O. paraboloides* boreholes in around 7% of a sample of 110 individuals of *E. glaucinoides*. Mostly, individuals in the size range 5.9 - 8.5mm (shell width), are affected (out of an overall size range of 1.8 - 20.0mm), while modal

borehole size is in the range 1.1 - 1.5mm in diameter. These figures suggest that larger individuals of *E. glaucinoides* were conspecific predators ("cannibals"); such naticid behaviour is discussed by Kitchell *et al.* (1981: 540-541), and Kelley (1991).

Drilled *E. glaucinoides* also show evidence for preferential drill-site selection, with all drilled examples being attacked on the apertural side of the last spire whorl, this may have coincided with the limit of the gastropod's retraction (Arua & Hoque, 1989: 58); but a more important factor is preferred manipulation of the prey by naticid predators, which align the prey's long axis with the long axis of their foot and cover the aperture of the prey with the anterior portion of their foot to prevent escape (Berg & Nishenko, 1975: 259-260).

Muricids are represented by only two species, both of which are rare. The larger of the two, *Poirieria subcristata*, is largely confined to the base of division C1, which is characterised by large epifaunal or semi-infaunal suspension-feeding bivalves, on which it probably preyed. The smaller of the muricids, *Paziella subcoronata*, is present in division B2 (*Barnea* bed), and is considered the more likely causative agent of the *O. simplex* trace.

Evidence for decapod predation is present mainly in larger gastropods, notably *Turricula*, *Wrigleya* and *Ispharina*. Unsuccessful attempts at predation are reflected by irregular interruptions to the growth of some individuals, representing repaired breaks in the shell wall caused by shell-peeling, a common mode of crab predation. In the case of the specimen of *Ispharina* illustrated in Plate 7, fig. 4 there is evidence of four such attempts in the life of the individual which nevertheless attained maturity. In another example of *Ispharina* the shell shows evidence of two attempts, both of which peeled back the body whorl for at least one volution, but which were nevertheless repaired, allowing the individual to survive to maturity. Paradoxically, here only those shells which were repaired in life have been unequivocally identified as having been subjected to crab attacks. This is because unrepaired broken apertures seen in fossil gastropods may also be caused by accidental mechanical damage prior to burial, compaction during diagenesis, or the mechanical processes leading to exposure.

Traces of shell-boring endobionts of five types were also noted. The first takes the form of a relatively large (8 x 5mm), irregular teardrop shaped opening, circular in cross-section, in the body whorl of a specimen of *Sycostoma* from division B2. This has the edges of the boring chamfered on the inner face of the whorl of the host gastropod. Similar borings are found in a variety of thicker-shelled molluscs in the British Eocene, where they are often found to contain the valves of their producer the carbonate-borer *Gastrochaena*. In these examples the shell wall of the host gastropod is sometimes too thin for the borer to immerse itself, instead it constructs a shelly 'flask' to cover the exposed portions. This may be preserved whole or with parts still adhering to the rim of the boring, or sometimes, as with the example



from Swanwick, only the boring remains; this boring is assigned to the ichnogenus *Gastrochaenolites* Leymerie, 1842. This record is significant in indicating the former presence in the Swanwick mollusc assemblage of an otherwise unknown taxon of carbonate boring bivalve.

The second type is a meandering, deroofed boring seen only on one valve of a specimen of *Arctica* from division B2. This trace is referable to the ichnogenus *Maeandropolydora* which is usually attributed to polydorid polychaetes.

The third type is seen in partly decorticated specimens of *Pycnodonte* from division C1, and consists of a complex of fine branching and criss-crossing tubes, usually less than 1 mm in diameter. These are confined to the lower part of the outer lamellar shell layer, not reaching the inner vesicular layer. Where the outer shell is unworn, all that is seen is a scattering of tiny circular holes. This trace may be referred to the ichnogenus *Talpina* which has been attributed to phoronid worms.

The fourth type consists of closely spaced circular borings covering the whole surface of a specimen of *Batillaria* and a valve of *Cubitostrea* formerly attached to it, from the *Barnea* bed. The holes at the shell surface lead to a network of linked chambers. These are confined to the thickness of the shell walls and extend throughout the shell structure. The chambers have a number of fine extensions to them and a microscopic ornament of surface pits. These chambers often anastomose to form larger, irregular chambers. These features are characteristic of the ichnogenus *Entobia*, a trace attributed to shell-boring clionid sponges.

The fifth type consist of a series of oval to irregularly elongate pits 0.3 - 0.7mm across and 0.7 - 2mm in length on the internal surface of the body whorl of the gastropod *Globularia splendida* from division B2. These pits are all roughly aligned parallel to the direction of coiling of the gastropod. Only a few of these pits have any expression on the outer surface of the shell wall, comprising a circular or ovate exit hole 0.3 - 0.75mm in diameter, some of these have been revealed or enlarged by erosion of the shell wall. These are referred to the ichnogenus *Rogerella* (P. D. Taylor, pers. comm.), which is attributed to acrothoracid barnacles. The sometimes extended-elongate shape of these borings is due partly to the coalescing of nearby pits, and partly to their unroofing as the result of shell erosion. The lack of accessory exits on the external surface of the shell wall in some acrothoracid borings was also noted by Baluk & Radwanski (1991), who suggested they were attributable to juvenile examples. According to Walker (1992) the presence of these pits is an excellent indicator of pagurized shells. The accompanying epifauna (Bryozoa and oysters) inside and outside the gastropod's aperture, and the presence of a possible wear-facet on the apertural side of the last spire whorl, all support this inference. The uniqueness of the occurrence of this gastropod species suggests that its preservation may be due to transport by its hermit crab occupant from a facies where fossils were otherwise rarely preserved.

With the exception of occasional pebbles and even rarer logs, mollusc shells provided almost the only hard substrate for encrusting organisms to attach to in the strata exposed at Lower Swanwick. Encrusting epibionts found attached to molluscan shells include a coral, Bryozoa, serpulid worms and oysters.

Only one example of the solitary scleractinian coral *Paracyathus* cf. *crassus* Edwards & Haime was present in the collections examined. This was attached to a fragment of *Atrina* shell from the basal C1 assemblage.

The Bryozoa are encrusting cheilostomes and are present throughout the sequence, notably in division C1. These require specialist study for accurate identification, and are outside the scope of this paper.

The serpulids include a small indeterminate species, found in association with bryozoans and oysters, encrusting the upper surfaces of *Haustator* from the turritellid drifts in B2. The gastropod's probable sedentary, suspension-feeding lifestyle would have also suited the worm's habitat requirements. The fact that the serpulids (and associated oysters and Bryozoa) are confined to the dorsal side of the turritellid shells, and also that the apertures of the turritellids are not encroached upon, suggests that the gastropods lived partly buried, much as extant forms do, and were encrusted when living. Rare larger serpulid specimens, probably *Serpula crassa* J. Sowerby, 1813, are occasionally found encrusting *Pycnodonte* in division C1. These may be conspecific with the specimen referred to *Sclerostyla perforata* by Wrigley (1951), which probably came from the same horizon. The precise identity of these serpulids is uncertain, as the known specimens either lack the diagnostic operculum, or if it is present, it is damaged or cemented in place by pyrite.

All three species of oyster present at Lower Swanwick encrusted shells. *Cubitostrea*, found in division B2 and the *Barnea* bed, encrusted most contemporary species of larger mollusc. *Crassostrea* is known by a unique specimen from the *Barnea* bed, which has for its point of attachment a shell of the uncommon gastropod *Batillaria*. *Pycnodonte* is often found attached to *Atrina* in division C1. Where seen *in situ* they are usually attached to the upper surface of horizontally orientated specimens, indicating attachment after the death and probable exhumation of the *Atrina*.

Table 1. Systematic list of the London Clay Mollusca of Lower Swanwick

Key: B2 = Division B2      Bb = Barnea Bed      C1 = Division C1      fdr, f = feeder      susp, s. = suspension  
 inf. = infaunal      detr. = detritivore      semi-inf. = semi-infaunal      pred. = predator  
 Rare: ♂      Uncommon: ♂      Common: ♂

Name	B2	Bb	C1	Palaeoecology
<b>BIVALVIA</b>				
<b>NUCULIDAE</b> <i>Nucula curvata</i> Wood, 1864	♂	♂		infaunal deposit fdr
<b>YOLDIIDAE</b> <i>Yoldiella oblata</i> (Wood, 1864)	♂	♂		infaunal deposit fdr
<b>MALLETIIDAE</b> <i>Mesosaccella partimstriata</i> (Wood, 1864)	?	♂		infaunal deposit fdr
<b>NUCINELLIDAE</b> <i>Nucinella</i> aff. <i>ovalina</i> Cossmann, 1887	♂			infaunal deposit fdr
<b>PARALLELODONTIDAE</b> <i>Cucullaria tumescens</i> (Wood, 1864)	♂			epifaunal susp. fdr
<b>GLYCYMERIDIDAE</b> <i>Glycymeris brevirostris</i> (J. de C. Sowerby, 1824)	♂		♂	infaunal susp. fdr
<b>MYTILIDAE</b> <i>Amygdalum</i> cf. <i>simplex</i> (J. de C. Sowerby in Dixon, 1850) " <i>Lithophaga</i> " <i>tubicola</i> (Wood, 1861)	♂		♂ ♂	epifaunal susp. fdr fissure-dwelling s. f.
<b>PTERIIDAE?</b> " <i>Pteria</i> " <i>papyracea</i> (J. de C. Sowerby, 1837)			♂	?epifaunal susp. fdr
<b>PINNIDAE</b> <i>Atrina affinis</i> (J. Sowerby, 1821)			●	semi-inf. susp. fdr
<b>OSTREIDAE</b> <i>Cubitostrea multicosata</i> (Deshayes, 1824) <i>Crassostrea</i> cf. <i>tenera</i> (J. Sowerby, 1819)	♂	● ♂		epifaunal susp. fdr "
<b>GRYPHAEIDAE</b> <i>Pycnodonte</i> cf. <i>gryphovicinus</i> (Wood, 1861)			●	epifaunal susp. fdr
<b>PROPEAMUSSIIDAE</b> <i>Cyclopecten duplicatus</i> (J. de C. Sowerby, 1824)	♂			epifaunal ?carnivore
<b>PECTINIDAE</b> <i>Lentipecten corneus</i> (J. Sowerby, 1818)			♂	epifaunal susp. fdr
<b>ANOMIIDAE</b> <i>Anomia anomialis</i> (Lamarck, 1819) <i>Heteranomia scabrosa</i> (Wood, 1861)	♂ ♂	♂	♂ ♂	epifaunal susp. fdr "
<b>LUCINIDAE</b> <i>Parvilucina seminulum</i> (Deshayes, 1857)		♂		inf. chemosymbiont
<b>LEPTONIDAE</b> <i>Semeloidea curryi</i> n. sp.		♂		?commensal
<b>CARDITIDAE</b> <i>Venericor brongiartii clarendonensis</i> (Wood, 1871)	●	●		infaunal susp. fdr

<b>CARDIIDAE</b> <i>Nemocardium nitens</i> (J. Sowerby, 1813) <i>Nemocardium semiasperum</i> (Deshayes, 1858)	?	♂		infaunal deposit fdr “
<b>SOLENIIDAE</b> <i>Solena (Eosolen) laversinensis</i> (Lefèvre & Watelet, 1877)	♂	♂		infaunal susp. fdr
<b>CULTELLIDAE</b> <i>Siliqua kingi</i> n. sp. <i>Cultellus affinis</i> (J. Sowerby, 1812)	♂	♂	♂	infaunal susp. fdr “
<b>TELLINIDAE</b> <i>Tellina</i> (s.l.) sp. 1 <i>Tellina</i> (s.l.) sp. 2	♂	♂		infaunal deposit fdr “
<b>SEMELIDAE</b> <i>Abra (Syndosmya) cygnea</i> n. sp. <i>Abra (Syndosmya) splendens</i> (J. de C. Sowerby, 1837)		♂	?	infaunal deposit fdr “
<b>ARCTICIDAE</b> <i>Arctica planata</i> (J. de C. Sowerby, 1841)	●		♂	infaunal susp. fdr
<b>KELLIPELLIDAE</b> <i>Lutetia parisiensis</i> Deshayes, 1860			♂	infaunal susp. fdr
<b>VENERIDAE</b> <i>Pitar (Calpitaria) sulcatarius</i> (Deshayes, 1825)	●	♂	♂	infaunal susp. fdr
<b>CORBULIDAE</b> <i>Varicorbula globosa</i> (J. Sowerby, 1818) <i>Bicorbula gallicula</i> (Deshayes, 1857) <i>Caestocorbula clarendonensis</i> (Wrigley, 1925)	♂	● ♂ ♂	♂	infaunal susp. fdr “ “
<b>HIATELLIDAE</b> <i>Panopea intermedia</i> (J. Sowerby, 1814)		♂	●	infaunal susp. fdr
<b>PHOLADIDAE</b> <i>Cyrtopleura levesquei</i> (Watelet, 1851) <i>Teredina personata</i> (Lamarck, 1806)	♂	● ?	?	infaunal susp. fdr xylophage/susp. fdr
<b>TEREDINIDAE</b> <i>Bankia</i> sp. <i>Teredo (Teredo) davisii</i> (Gale, 1995) <i>Nausitora wrigleyi</i> Gale, 1995			♂ ? ♂	xylophage/susp. fdr “ “
<b>PHOLADOMYIDAE</b> <i>Pholadomya (Pholadomya) virgulosa</i> J. de C. Sowerby, 1844 <i>Pholadomya (Bucardiomya) margaritacea</i> (J. Sowerby, 1821)			? ●	infaunal susp. fdr “
<b>THRACIIDAE</b> <i>Thracia oblata</i> (J. de C. Sowerby, 1826)			?	infaunal susp. fdr
<b>SCAPHOPODA</b> <b>DENTALIIDAE</b> <i>Antalis constricta</i> (Newton & Harris, 1894) <i>Antalis cf. angusta</i> (Deshayes, 1861)	● ♂	●	●	inf. det./foraminivore “
<b>GADILIDAE</b> <i>Cadulus</i> (s.l.) sp.			♂	inf. det./foraminivore

<b>GASTROPODA</b> <b>THIARIDAE</b> <i>Hemisinus pistati</i> (Cossmann, 1907)		♂		detritivore
<b>POTAMIDIDAE</b> <i>Tympanotonos (Eotympanotonus) cf. papalis</i> (Deshayes, 1833) <i>Batillaria (Vicinocerithium) subacuta</i> (d'Orbigny, 1850)		♂	♂	detritivore “
<b>TURRITELLIDAE</b> <i>Ispharina aff. sulcifera</i> (Deshayes, 1832) <i>Haustator dixoni</i> (Deshayes, 1861) <i>Haustator circumdatus</i> (Deshayes, 1861)	● ● ●	♂ ♂	● ♂	semi-inf. herbivore “ “
<b>RISSOIDAE</b> <i>Alvania</i> sp.		♂		detritivore
<b>IRAVADIIDAE</b> <i>Entomope semipunctata</i> n. sp.		♂	♂	?detritivore
<b>ADEORBIDAE</b> <i>Solariorbis lawsoni</i> n. sp. <i>Teinostoma</i> (s.l.) <i>intercallosum</i> (Gougerot, 1968) <i>Adeorbis planorbularis paucicostatus</i> (Deshayes, 1862)			♂ ♂ ♂	?detritivore “ “
<b>APORRHAIIDAE</b> <i>Aporrhais sowerbii constrictus</i> Wrigley, 1938 <i>Aporrhais clarendonensis</i> Wrigley, 1938		♂ ♂	♂	detritivore “
<b>STROMBIDAE</b> <i>Tibia (Eotibia) sublucida</i> (Edwards in Lowry, 1866)	●	●	●	detritivore
<b>CALYPTRAEIDAE</b> <i>Sigapatella echinulata</i> (J. Sowerby, 1815)		♂	♂	ciliary-feeder
<b>AMPULLOSPIRIDAE</b> <i>Ampullella adurni</i> (Wrigley, 1946) <i>Globularia splendida</i> (Deshayes, 1864) <i>Crommium lignitarum</i> (Deshayes, 1864)		♂ ♂	♂	molluscivore “ “
<b>NATICIDAE</b> <i>Euspira glaucinoides</i> (J. Sowerby, 1812) <i>Sigatica hantoniensis</i> (Pilkington, 1804)	● ♂	● ♂	♂ ♂	molluscivore “
<b>TRIVIIDAE</b> <i>Eratotrivia prestwichii</i> (Edwards, 1855)		♂		browser-ascidians
<b>FICIDAE</b> <i>Priscoficus smithii</i> (J. de C. Sowerby, 1827) <i>Ficopsis multiformis</i> (Wrigley, 1929)		♂ ♂	♂	predator-holothurians “
<b>CASSIDAE</b> <i>Galeodea (Mambrinia) gallica</i> Wrigley, 1934 <i>Sconsia augustana</i> (Wrigley, 1934)		♂ ♂	? ♂	echinivore “
<b>CERITHIOPSIDAE</b> <i>Cerithiopsis</i> aff. <i>discreta</i> Gougerot & Le Renard, 1981a <i>Seila mundula</i> (Deshayes, 1864)		♂ ♂	♂ ♂	porifivore “
<b>TRIFORIDAE</b> <i>Cerithiella elongata</i> (Wrigley, 1940)		♂	♂	?porifivore



<b>CONIDAE</b> <i>Domenginella tereticosta</i> (Edwards, 1861) <i>Bathytoma granata</i> (Edwards, 1861) <i>Microdrillia tricincta</i> (Edwards, 1861) <i>Amblyacrum leptocolpa</i> (Cossmann, 1889)	● ♂	? ♂	? ♂	vermivore " " "
<b>PYRAMIDELLIDAE</b> <i>Cossmannica agassizi</i> (Le Renard, 1994) <i>Odostomia lignitarum</i> Deshayes, 1861 <i>Odostomia</i> cf. <i>cuisensis</i> Cossmann, 1888 <i>Odostomia</i> sp. 1 <i>Odostomia</i> sp. 2 <i>Odostomia</i> sp. 3 <i>Odostomia</i> spp. <i>Brachystomia</i> sp. <i>Sinustomia</i> sp. <i>Syrnola</i> cf. <i>spina</i> (Deshayes, 1824) <i>Syrnola angusta</i> (Deshayes, 1861) <i>Anisocycla scalarina</i> (Deshayes, 1861) <i>Murchisonella emarginata</i> (Deshayes, 1861) <i>Turbonilla</i> (s.l.) sp.	♂ ♂    ?   ♂ ♂ ♂ ♂	♂ ♂ ● ♂ ♂ ? ♂ ♂ ♂ ♂ ♂ ♂ ♂	♂   ♂           ♂	parasite " " " " " " " " " " " " "
<b>ARCHITECTONICIDAE</b> <i>Stellaxis bistratus</i> (Deshayes, 1832) <i>Granosolarium pulchrum</i> (J. de C. Sowerby in Dixon, 1850)	♂	♂ ♂		browser-coelenterates "
<b>MATHILDIDAE</b> <i>Mathilda</i> sp.	♂			browser-coelenterates
<b>ACTEONIDAE</b> <i>Acteon</i> sp. <i>Crenilabium elongatum</i> (J. de C. Sowerby, 1824) <i>Tomatellaea simulata</i> (Solander in Brander, 1766)	♂ ♂ ♂		♂	vermivore " "
<b>RINGICULIDAE</b> <i>Ringicula turgida</i> (J. Sowerby, 1817)	●	●	♂	vermivore
<b>CYLICHNIDAE</b> <i>Scaphander</i> cf. <i>polysarcus</i> Cossmann & Pissarro, 1913 <i>Cylichna</i> cf. <i>angystoma</i> (Deshayes, 1824)	♂ ♂	♂ ●	♂ ♂	molluscivore "
<b>RETUSIDAE</b> <i>Volvulella oxyacrum</i> (Cossmann, 1889)		♂		vermivore
<b>LIMACINIDAE</b> <i>Limacina mercinensis</i> (Watelet & Lefèvre, 1880)	♂			pelagic ciliary feeder
<b>CEPHALOPODA</b> <b>NAUTILIDAE</b> <i>Euciphoceras regale</i> (J. Sowerby, 1822)?			♂	free-swimming pred.
<b>HERCOGLOSSIDAE</b> <i>Cimomia imperialis</i> (J. Sowerby, 1812) <i>Deltoidonautilus sowerbyi</i> (J. de C. Sowerby, 1843)	♂	♂	♂ ?	free-swimming pred. "

## SYSTEMATIC PALAEOONTOLOGY

\* = First recorded occurrence in British Palaeogene.

**Range:** Refers solely to occurrence at this locality.

## BIVALVIA

## Family NUCULIDAE

*Nucula curvata* Wood, 1864

Plate 2, figs 10-11.

**Range:** division B2 (common), *Barnea* bed (uncommon).

**Palaeoecology:** infaunal deposit feeder.

## Family YOLDIIDAE

*Yoldiella oblata* (Wood, 1864) comb. nov.

Plate 2, figs 7-8.

1864 *Leda oblata* Wood, p. 128, pl. 19, fig. 10.

1992 *Nuculana oblata* (Wood); Tracey, p. 158.

**Remarks:** This species lacks a rostral carina, escutcheon and lunule. The outline of the valve and its smooth surface give it a strong resemblance to the extant species *Yoldiella philippiana* (Nyst).

**Range:** division B2 (uncommon, *ex situ*), *Barnea* bed (uncommon, *in situ*).

**Palaeoecology:** infaunal deposit feeder.

## Family MALLETIIDAE

*Mesosaccella partimstriata* (Wood, 1864)

Plate 2, fig. 9.

1864 *Leda partim-striata* Wood, p. 129, pl. 17, fig. 1.

1965 *Nuculana amygdaloides* (J. de C. Sowerby); Curry & King, p. 33.

1965a *Mesosaccella partimstriata* (Wood, 1864); Glibert & Van de Poel, p. 29.

**Remarks:** The lack of a resilifer between the anterior and posterior hinge teeth separate this from the London Clay nuculanids. This form of hinge is characteristic of the Malletiidae, which is considered a better placement for this genus than the Nuculanidae to which it has previously been referred.

**Range:** division B2 (frequency uncertain), *Barnea* bed (uncommon).

**Palaeoecology:** infaunal deposit feeder.

## Family NUCINELLIDAE

*Nucinella* aff. *ovalina* Cossmann, 1887 \*

Plate 2, figs 1-6.

**Remarks:** This is evidently a new species, but the specimens from Swanwick are either too incomplete or too juvenile to serve as adequate types. This species will be described in a forthcoming paper.

**Range:** division B2 (uncommon).

**Palaeoecology:** infaunal deposit feeder.

## Family PARALLELODONTIDAE

*Cucullaria tumescens* (Wood, 1864)

Plate 2, figs 12-13.

1864 *Arca tumescens* Wood, p. 92, pl. 15, fig. 1.

1965 *Fossularca tumescens* (Wood); Curry & King, p. 33.

1984 "*Arca*" *tumescens* Wood 1864; Cooper, p. 5.

1992 *Cucullaria tumescens* (Wood); Tracey, p. 158.

**Remarks:** The quadrate shape, inflated valves and distinctive radial ornament of fine striae, resembling *Striarca*, distinguish this species from the rather similar *C. impolita* (J. de C. Sowerby) and *C. nitens* (J. de C. Sowerby).

**Range:** division B2 (uncommon).

**Palaeoecology:** epifaunal suspension feeder.

## Family GLYCYMERIDIDAE

*Glycymeris brevis* (J. de C. Sowerby, 1824)

Plate 2, figs 14-15.

**Range:** division B2 (uncommon), division C1 (uncommon).

**Palaeoecology:** infaunal suspension feeder.

## Family MYTILIDAE

*Amygdalum* cf. *simplex* (J. de C. Sowerby in Dixon, 1850)

Plate 3, fig. 1

1965 *Modiolus* cf. *simplex* (J. de C. Sowerby); Curry & King, p. 33

**Range:** division B2 (uncommon), division C1 (uncommon).

**Palaeoecology:** epifaunal suspension feeder.

"*Lithophaga*" *tubicola* (Wood, 1861)

Plate 3, fig. 2.

1861 *Modiola tubicola* Wood, pp. 73-74, pl. 13, fig. 12.

1949 *Modiolus tubicola* (Wood); Wrigley, p. 15.

1992 *Lithophaga tubicola* (Wood); Tracey, p. 166.

**Remarks:** *Lithophaga*, a genus of stone and shell-boring mytilid, would appear to be inappropriate for this species, which nestled in abandoned excavations of other organisms, commonly empty teredinid tubes. Its correct taxonomic assignment requires separated valves showing hinge and muscle scars, and such material has not yet come to light.

**Range:** division C1 (uncommon).

**Palaeoecology:** fissure-dwelling suspension feeder.

**Family PTERIIDAE?*****"Pteria" papyracea* (J. de C. Sowerby, 1837)**

Plate 3, fig. 3.

**Range:** division C1 (rare).**Palaeoecology:** probably an epifaunal suspension feeder.**Family PINNIDAE*****Atrina affinis* (J. Sowerby, 1821)**

Plate 3, figs 4-5.

1821 *Pinna affinis* J. Sowerby, p.10, pl. 313, fig. 2.1965b *Atrina affinis* (J. Sowerby); Glibert & Van de Poel, p. 9.1994 *Atrina affinis* (J. Sowerby); Pacaud & Marcomini, p. 41.

**Remarks:** Some examples in the NHM from Lower Swanwick contain pearls *in situ* near the umbo of the shell. Specimen L.51117 contains 14 visible pearls, some of which are attached to the shell wall; while LL.18747 contains 11 visible pearls. In both cases further pearls are probably concealed within the matrix infilling the bivalves' umbos. Both examples were figured by Thorne (1984).

**Range:** division C1 (common).**Palaeoecology:** semi-infaunal suspension feeder.**Family OSTREIDAE*****Cubitostrea multicostrata* (Deshayes, 1824)**

Plate 3, figs 6-7.

1965 *Ostrea multicostrata* Deshayes; Curry & King, p. 33**Range:** division B2 (uncommon), *Barnea* bed (common).**Palaeoecology:** epifaunal suspension feeder.***Crassostrea cf. tenera* (J. Sowerby, 1819)**

Plate 3, figs 6-7.

**Range:** *Barnea* bed (rare).**Palaeoecology:** epifaunal suspension feeder.**Family GRYPHAEIDAE*****Pycnodonte cf. gryphovicinus* (Wood, 1861)**

Plate 3, fig. 9.

1949 *Ostrea* ... like *O. gigantea* Solander; Wrigley, p. 14.

**Remarks:** Examples from Swanwick tend to be larger and flatter than typical specimens, with a larger attachment area. The narrow holotype of *gryphovicinus* may represent an individual that has grown in a restricted space, and a fuller study is needed to show the differences, if any, separating this species from *P. gigantea* (Solander in Brander, 1766)

**Range:** division C1 (common).**Palaeoecology:** epifaunal suspension feeder.**Family PROPEAMUSSIIDAE*****Cyclopecten duplicatus* (J. de C. Sowerby, 1824)**

Plate 4, fig. 1.

1965 *Pecten duplicatus* J. de C. Sowerby; Curry & King, p. 33.1992 *Cyclopecten duplicatus* (J. de C. Sowerby); Tracey, p. 167.

**Remarks:** Tentatively placed in *Cyclopecten* by virtue of its ornament and lack of true internal ribs, its ornament is rather stronger and its shell rather thicker than is typical of extant species assigned to this genus.

**Range:** division B2 (rare).**Palaeoecology:** epifaunal, ?carnivorous.**Family PECTINIDAE*****Lentipecten corneus* (J. Sowerby, 1818)**

Plate 4, fig. 2.

1818 *Pecten corneus* J. Sowerby, p. 1.1861 *Pecten corneus* var. *corneolus* Wood, [*non Pecten corneolus* Young & Bird, 1828].1949 '*Pecten*' *corneus* J. Sowerby [*corneolus* Wood]; Wrigley, p. 15.1965 *Amusium (Lentipecten) corneum* (Sowerby, 1818); Glibert & Van de Poel, p. 10.1965 *Pseudamusium* (s.s.) *coxi* nov. nom. Glibert & Van de Poel, p. 35.1970 *Palliolium coxi* Glibert & Van de Poel, p. 177.1984 *Lentipecten corneus* (J. Sowerby); Cooper, p. 6.

**Remarks:** On the characters of the varietal holotype *corneolus* was separated from *corneus* (s.s.) by its narrower form ("more ovate" Wood 1861: 40) and smaller size. Usually the only difference is in size, Bracklesham Group specimens growing up to one-third larger than London Clay examples. Most individuals are the same well-rounded shape as *corneus*.

Glibert & Van de Poel placed *corneus* and *corneolus* (renamed due to homonymy) in separate subfamilies without giving reasons. Their own examples came from the Thanetian deposits of Châlons-sur-Vesle (Aisne) near Reims, France, and this raises the possibility that the species they had before them were not the same as the English Early Eocene form.

**Range:** division C1 (uncommon).**Palaeoecology:** epifaunal suspension feeder.**Family ANOMIIDAE*****Anomia anomialis* (Lamarck, 1819)**

Plate 4, figs 3-4.

**Range:** divisions B2 to C1 inclusive (uncommon).**Palaeoecology:** attached epifaunal suspension feeder.***Heteranomia scabrosa* (Wood, 1861) comb. nov.**

Plate 4, figs 5-6.

1861 *Anomia scabrosa* Wood, p. 14, pl. 11, fig. 5a-c.1949 *Anomia scabrosa* Wood; Wrigley, p. 14.1965 *Anomia scabrosa* S.V. Wood; Curry & King, p. 33.



**Remarks:** The muscle scars are obscure and scarcely visible when viewed by SEM. Well preserved specimens reveal the left valve to have two contiguous muscle scars (byssal retractor and adductor muscle scars) as present in the Recent type species of *Heteranomia* rather than the three scars characterising *Anomia*. The ornament of tubular spines with herring-bone microstriae in the interspaces is a commonly occurring feature of *Heteranomia* and this species seems very close to the Middle Eocene *H. tubifera* (Vincent) and the spiny forms of the Neogene to Recent type species *H. squamula* (Linné) (J. Todd pers. comm.).

**Range:** divisions B2 and C1 (uncommon), no specimens known from the *Barnea* bed.

**Palaeoecology:** epifaunal suspension feeder.

#### Family LUCINIDAE

##### *Parvilucina seminulum* (Deshayes, 1857) \*

Plate 4, figs 7-10.

**Range:** known only from the *Barnea* bed (uncommon).

**Palaeoecology:** infaunal chemosymbiont (*vide* Hickman, 1994).

#### Family LEPTONIDAE Gray, 1847

##### Genus *Semeloidea* Bartrum & Powell, 1928

##### *Semeloidea curryi* n. sp.

Plate 5, figures 1-2.

**Derivatio nominis:** Named for Professor Dennis Curry, in recognition of his work at this site.

**Holotype:** LL 41613 a unique left valve, collected by A. Wrigley from the London Clay Formation at Lower Swanwick Brickworks, Hampshire.

**Diagnosis:** A small, somewhat inflated *Semeloidea*, rather thick-shelled for its small size, trigonal in outline, with an inconspicuous, slightly prosogyrate umbo and faint lateral radial riblets visible internally and externally. Distinguished from extant *Semeloidea* by the absence of a crest-like extension to hinge tooth 1.

**Description:** The only known specimen is small and trigonal, 4.9mm long by 4.3mm high, rather thick-shelled relative to its size. Its external surface is ornamented with concentric growth lines and fourteen or fifteen low lateral riblets, which occur in two equal groups separated by the smooth central portion of the shell. These are absent from the first one third of shell growth, developing only as the individual matures. The umbo is small, equilateral, and slightly prosogyrate. Internally the rather poorly defined adductor muscle scars are subequal and rounded inequilaterally subtriangular in shape; the pallial line is simple and confluent with the margin. The hinge is somewhat worn, but 4b is strong, oblique, tapering towards the umbo; the resilifer is oblique, acutely triangular; 2 obscured by wear, but probably divided into a blocky quadrate 2b<sub>2</sub> and peg-like 2b<sub>1</sub>; AII present, long, narrow. The inner margin of the valve is smooth except where the external riblets terminate. Here 14 or 15 denticles are developed which coincide with the interspaces between the external riblets.

**Distribution:** Known only from the type locality. The

specimen probably came from the *Barnea* bed (div. B2), but Wrigley labels it as from his Horizon L which includes the *Barnea* bed and part of the unit below.

**Comparisons:** *Semeloidea curryi* differs chiefly from the Pliocene-Recent type species (*S. donaciformis* Bartrum & Powell, 1928) in being thicker-shelled and in lacking the small crest-like prolongation of tooth 1. A smaller, slightly more strongly ribbed, undescribed species occurs in the Early Eocene Wittering Formation (Bracklesham Group) of East Wittering, Sussex, right valves of this species demonstrate the presence of a vestigial hinge tooth 3a which is absent in the type species; it is probable that this tooth was also present in *S. curryi*. *Semeloidea curryi* superficially resembles *Kellia ovooides* Cossmann, 1887 of the Bartonian of Valmondois, France, but differs in its more trigonal shape and coarser hinge.

**Remarks:** This is the first record of *Semeloidea* from the English Eocene.

**Palaeoecology:** possibly commensal.

#### Family CARDITIDAE

##### *Venericor brongniartii clarendonensis* (Wood, 1871)

Plate 5, figs 3-4.

1871 *Cardita Brongniartii* var. *Clarendonensis* Wood, p. 143, pl. 22, fig. 12a-b.

1965 *Venericor planicosta* (Lamarck); Curry & King, p. 33.

**Remarks:** Distinguished from typical *V. brongniartii* (J. de C. Sowerby, 1850) by the squarer, flatter profile of its costae; from *V. planicosta* by its smaller size and wider intercostal grooves; and from *V. planicosta suessoniensis* (d'Archiac, 1843) by its larger size, narrower, deeper intercostal spaces and more rounded shape. Representatives from Swanwick tend to reach a greater size than specimens from Bognor, Sussex, and to be higher from umbo to ventral margin in some individuals, but are otherwise difficult to separate.

**Range:** division B2, inclusive (common).

**Palaeoecology:** infaunal suspension feeder.

#### Family CARDIIDAE

##### *Nemocardium nitens* (J. Sowerby, 1813)

Plate 5, fig. 5.

**Range:** division B2, frequency uncertain.

**Palaeoecology:** infaunal deposit feeder.

##### *Nemocardium semiasperum* (Deshayes, 1858)

Plate 5, fig. 6.

1965 *Nemocardium hoernesii* (Deshayes); Curry & King, p. 33.

**Remarks:** Differs from *N. hoernesii* by its lack of an angular carina delimiting the siphonal area.

*Nemocardium* sp. as recorded by Wrigley, refers to incomplete shell material, too fragmentary to be determinable.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** infaunal deposit feeder.

### Family SOLENIDAE

*Solena (Eosolen) laversinensis* (Lefèvre & Watelet, 1877)\*

Plate 5, fig. 7.

**Range:** division B2, inclusive (rare).

**Palaeoecology:** infaunal suspension feeder.

### Family CULTELLIDAE Davies, 1935

Genus *Siliqua* Megerle von Mühlfeld, 1811

*Siliqua kingi* n. sp.

Plate 5, figures 9-12.

1963 "*Solen*" sp.; Venables, p. 263, [listed].

1992 "*Solen*" sp.; Tracey, p. 159, [listed].

**Derivatio nominis:** Named for Dr. Chris King, who collected the holotype of this species.

**Holotype:** LL 41610 (King coll.) (Pl. 5, fig 9) a single right valve on a block of matrix collected *in situ* from just below the *Barnea* bed, division B2, London Clay Formation at Lower Swanwick, Hampshire.

**Paratypes:** LL 41611 (Tracey coll.) (Pl. 5, figs 10-11) incomplete bivalved shell collected *in situ*, from the same horizon as the holotype at Lower Swanwick; L 53134 (Pl. 5, fig. 12) an internal cast of the left valve displaying the characteristic internal rib as a subumbonal groove, from the Soft Rock, division A3, London Clay Formation at Bognor Regis, West Sussex.

**Diagnosis:** A small, elongate, rather ovate *Siliqua*, with a prominent umbo, rather resembling *Oprisosolen* in outline but with a strong, nearly vertical internal rib.

**Description:** A compressed, elongate, unequally ovate shell, externally ornamented with faint concentric growth lines. The holotype is 8.7mm long and 4.6mm high; the largest individual (LL 41611) is 15.9mm long by 6.8mm high, but is incomplete; the internal cast from Bognor (L 53134) is 14.9mm long by 6.2mm high. The slightly prosogyrate umbo is more prominent and more nearly terminal than in most *Siliqua* species. Apart from the subumbonal rib, internal features are obscured by sediment infill. The internal rib is fairly thick and gently curved from a point just anterior of the umbo to a point almost vertically below, about three-quarters the height of the valve, the curvature being concave posteriorly. Pallial line and hinge not visible.

**Distribution:** So far known only from division B2, London Clay Formation at Lower Swanwick Brickworks, Hampshire; and the Soft Rock Bed, division A3, London Clay Formation of Bognor Regis, West Sussex.

**Comparisons:** Differs from *S. lamarcki* Deshayes, 1856 of the French Cuisian by its more nearly terminal and stronger umbo; from *S. berellensis* de Laubriere & Carez, 1880 of the French Cuisian by its more nearly terminal umbo, greater attenuation and stronger internal rib; from *S. laubrierei* Cossmann, 1886 of the French Lutetian again by its more nearly terminal umbo, stronger, longer internal rib and more elongate, less symmetrically ovate outline; from *S. papyracea* (Deshayes, 1824) of the French Lutetian by its more nearly terminal umbo and the direction of curvature of its internal rib, which curves posteriorly in *S. papyracea*.

From *S. angusta* Deshayes, 1856 of the French Bartonian it differs in its stronger umbones and lack of posterior inflation.

**Remarks:** This is the first recorded occurrence of the genus *Siliqua* from the London Clay.

**Palaeoecology:** infaunal suspension feeder.

### *Cultellus affinis* (J. Sowerby, 1812)

Plate 5, fig. 8.

**Range:** division C1 (uncommon).

**Palaeoecology:** infaunal suspension feeder.

### Family TELLINIDAE

*Tellina* (s.l.) sp. 1

Plate 5, fig. 14.

**Range:** division B2 - *ex situ* (rare).

**Palaeoecology:** infaunal deposit feeder.

*Tellina* (s.l.) sp. 2

Plate 5, fig. 13.

**Remarks:** Represented by a unique left valve encrusted with pyrite cemented sand, the umbo and hinge are not visible. Does not resemble any species known to the authors.

**Range:** *Barnea* bed (rare).

**Palaeoecology:** infaunal deposit feeder.

### Family SEMELIDAE Stoliczka, 1870

Genus *Abra* Lamarck, 1818

Subgenus *Syndosmya* Récluz, 1843

*Abra (Syndosmya) cygnea* n. sp.

Plate 5, figures 16-17.

**Derivatio nominis:** Latin, *cygnea* "pertaining to the swan", in allusion to the name of the type locality.

**Holotype:** LL 41612 (King coll.) a unique right valve, probably subadult, collected *in situ* from the *Barnea* bed, division B2 of the London Clay Formation at Lower Swanwick, Hampshire.

**Diagnosis:** A small, flattened, rostrate *Abra (Syndosmya)* characterised by delicate concentric lamellae, visible mainly on the later portion of growth, but which may have been present at earlier growth stages.

**Description:** A small ovate shell, little inflated, 7.3mm long by 5.0mm high, somewhat produced posteriorly; umbo equilateral, inconspicuous, pointed, orthogyrate; exterior largely smooth with faint concentric growth lines, but with a few low, thin, concentric lamellae on the later portion of growth. It is possible that these lamellae were originally developed on the juvenile growth increments, but being very delicate have subsequently been lost. Internally with well-

developed hinge: AI strong; 1 small, triangular; 3b bifid; ligament internal, in subtriangular resilifer; PI strong. Muscle scars subequal, poorly defined; pallial sinus deep - reaching two-thirds of the shell width, rounded, partly confluent. Shell margins smooth.

**Distribution:** So far known only from the *Barnea* bed, division B2 of the London Clay Fm. at the type locality.

**Comparisons:** The principle distinguishing feature of this species is its ornament of delicate concentric lamellae, which are not apparently known in any other contemporary species assigned to this genus. When compared with *A. (S.) splendens* (J. de C. Sowerby, 1837), which is widespread in the London Clay, particularly of the London Basin, this species is also seen to be more rostrate and less inflated. Of the French Cuisian species: *A. (S.) lamberti* (Deshayes, 1857) is more quadrate in outline; *A. (S.) suessoniensis* (Deshayes, 1857) is higher and less rostrate; *A. (S.) striatula* (Deshayes, 1857) is higher and more rounded in outline; and *A. (S.) macrodonta* (Deshayes, 1857) is considerably higher and more ovate.

**Remarks:** Further examples attributable to this species, from different London Clay localities, may exist in other collections, possibly misidentified as *A. splendens*.

**Palaeoecology:** infaunal deposit feeder.

*Abra (Syndosmya) splendens* (J. de C. Sowerby, 1837)

Plate 5, fig. 15.

**Range:** division C1 *ex situ* (frequency uncertain).

**Palaeoecology:** infaunal deposit feeder.

#### Family ARCTICIDAE

*Arctica planata* (J. de C. Sowerby, 1841)

Plate 5, figs 19-21.

1949 *Cyprina planata* J. de C. Sowerby; Wrigley, p. 15.

**Range:** divisions B2 (common) and C1 (uncommon), not recorded from the *Barnea* bed.

**Palaeoecology:** infaunal suspension feeder.

#### Family KELLIPELLIDAE

*Lutetia parisiensis* Deshayes, 1860

Plate 5, fig. 18.

**Range:** division C1 (rare).

**Palaeoecology:** infaunal suspension feeder.

#### Family VENERIDAE

*Pitar (Calpitar) sulcatarius* (Deshayes, 1825)

Plate 6, figs 1-4.

1949 *Pitaria tenuistriata* (J. de C. Sowerby *non* Lamarck.); Wrigley, p. 15.

**Range:** division B2 (common), *Barnea* bed (uncommon) and C1 (uncommon).

**Palaeoecology:** infaunal suspension feeder.

#### Family CORBULIDAE

*Varicorbula globosa* (J. Sowerby, 1818)

Plate 6, figs 5-8.

1965 *Corbula globosa* J. Sowerby; Curry & King, p. 33.

**Range:** division B2 (uncommon), *Barnea* bed (common) and C1 (uncommon).

**Palaeoecology:** infaunal suspension feeder.

*Bicorbula gallicula* (Deshayes, 1857)

Plate 6, figs 11-12.

**Range:** *Barnea* bed (rare).

**Palaeoecology:** infaunal suspension feeder.

*Caestocorbula clarendonensis* (Wrigley, 1925)

Plate 6, figs 9-10.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** infaunal suspension feeder.

#### Family HIATELLIDAE

*Panopea intermedia* (J. Sowerby, 1814)

Plate 6, fig. 13.

**Range:** *Barnea* bed (uncommon), division C1 (common).

**Palaeoecology:** infaunal suspension feeder.

#### Family PHOLADIDAE

*Cyrtopleura levesquei* (Watelet, 1851)

Plate 6, fig. 15.

1847 *Pholas Orbignyana* Levesque *in* Graves, pp. 282, 643, [*nom. nud.*].

1851 *Pholas Levesquei* Watelet, p. 117, pl. 1, figs 1-5.

1963 *Barnea* cf. *levesquei* (Watelet); Stinton, p. 68, pl. 8, figs 1-4; pl. 9 fig. 2.

1963 *Barnea cingulata* Stinton, p. 68, pl. 8, fig. 6.

**Remarks:** The nominal species of the *Barnea* bed. The specimens recorded from various Palaeocene and Eocene horizons in England, including Stinton's *cingulata*, all seem to fall well within the range of variation shown by typical examples from the Cuisian of France. In the *Barnea* bed at Swanwick articulated valves occur in life position in silty sand.

**Range:** division B2 (uncommon), *Barnea* bed (common).

**Palaeoecology:** infaunal suspension feeder.

*Teredina personata* (Lamarck, 1806)

Plate 6, fig. 14.

**Range:** *Barnea* bed and division C1 (frequencies unknown).

**Palaeoecology:** wood-boring xylophage and suspension feeder.

**Family TEREDINIDAE**

*Bankia* sp.

Plate 1, figs 1-2.

**Range:** division C1 (uncommon).

**Palaeoecology:** wood-boring xylophage and suspension feeder.

*Teredo (Teredo) davisii* (Gale, 1995) **comb. nov.**

[see Gale, 1995, fig. 1E.]

1995 *Teredothyra davisii* sp. nov. Gale, p. 139.

**Remarks:** Recent material, collected since the paper describing *T. davisii* was submitted for publication, has shown this species to be an example of *Teredo* (*s.s.*), rather than *Teredothyra* as originally thought. (A. S. Gale, pers. comm.)

**Range:** division C1 (frequency unknown).

**Palaeoecology:** wood-boring xylophage and suspension feeder.

*Nausitora wrigleyi* Gale, 1995

Plate 1, fig. 3.

**Range:** division C1 (rare).

**Palaeoecology:** wood-boring xylophage and suspension feeder.

**Family PHOLADOMYIDAE**

*Pholadomya (Pholadomya) virgulosa* J. de C. Sowerby, 1844

Plate 6, fig. 16.

**Range:** division C1 (frequency uncertain).

**Palaeoecology:** infaunal suspension feeder.

*Pholadomya (Bucardiomya) margaritacea* (J. Sowerby, 1821)

Plate 6, fig. 17.

1949 *Pholadomya dixonii* J. de C. Sowerby; Wrigley, p. 15.

**Remarks:** A search of the Wrigley collection at the NHM revealed no material labelled as *Pholadomya dixonii*, and none attributable to it, suggesting an earlier misidentification.

**Range:** division C1 (common).

**Palaeoecology:** infaunal suspension feeder.

**Family THRACIIDAE**

*Thracia oblata* (J. de C. Sowerby, 1826)

**Range:** division C1 (frequency unknown).

**Palaeoecology:** infaunal suspension feeder.

**SCAPHOPODA**

**Family DENTALIIDAE**

*Antalis constricta* (Newton & Harris, 1894)

Plate 15, figs 3-6.

1894 *Dentalium constrictum* n. sp. Newton & Harris, p. 64, unnumbered text-fig.

1894 *Entaliopsis annulata* n. gen., n. sp. Newton & Harris, p. 67, pl. 6, fig. 1; [not *Dentalium annulatum* Gmelin, 1791, nor Sandberger, 1842, nor Meyer, 1886; not *Entalis annulatum* Tate, 1887].

1949 ? *Siphonodentalium* sp. Wrigley, p. 15.

1965 *Antalis annulata* (Newton & Harris); Curry & King, p. 34.

1981 '*Dentalium*' *constrictum* Newton & Harris; King, pp. 81, 82, 157.

**Remarks:** Newton and Harris separated *E. annulata* and *D. constrictum* on the basis of their ornament and the presence or absence of an apical notch. *E. annulata* was said to be ornamented with regular incised annular grooves and to possess an apical notch. *D. constrictum* was said to possess an ornament of irregular annular grooves and to lack an apical notch. Much of the stated difference between these two species is attributable to their state of preservation. The types of *E. annulata* from Portsmouth are well preserved, especially the apices, but are small and represent only the early growth stages. The types of *D. constrictum* from Fareham are larger but have suffered extensive dissolution, especially to the early growth stages. Only one of the paratypes has the earlier part of the shell well-preserved, and this has the stronger, evenly-spaced, regular annulations of *E. annulata* on that portion, these grade into the weaker irregular annulations of *D. constrictum* on the later part of the shell.

Examination of a suite of more than 100 individuals from Lower Swanwick, mostly from division B2, showed both preservational modes to be present, along with intermediates whose sculpture varied in the strength, frequency and regularity of the annular ornament. Often this ornament is strong, regular and widely spaced on the early portion of the shell, but becomes finer, closer and more irregular on the later part of the shell. It is noteworthy that both nominal species occur in strata assigned to the same division as those from Lower Swanwick. Consequently, these two species are herein treated as synonymous. The specific name *constricta* is preferred to *annulata*, which is a potential junior homonym.

The notch sometimes present on well-preserved individuals is usually shallow, "V"-shaped and is placed on the ventral (convex) side of the shell. One individual (illustrated Pl. 15, fig. 5) shows the apical form that characterises *Antalis*.

**Range:** all horizons (common).

**Palaeoecology:** infaunal detritivore/foraminivore.

*Antalis cf. angusta* (Deshayes, 1861)

Plate 15, fig. 2.

**Range:** division B2 (rare).

**Palaeoecology:** infaunal detritivore/foraminivore.

**Family GADILIDAE**

*Cadulus* (s.l.) sp. \*

**Range:** division C1 (rare).

**Palaeoecology:** infaunal detritivore/foraminivore.

**GASTROPODA**

**Family THIARIDAE**

*Hemisinus pistati* (Cossmann, 1907) \*

Plate 7, fig. 1.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** detritivore.

**Family POTAMIDIDAE**

*Tympanotonos* (*Eotympanotonos*) cf. *papalis* (Deshayes, 1833) \*

Plate 7, fig. 3.

**Remarks:** Although worn, the unique specimen from the *Barnea* bed retains the proportions of *T. papalis* and compares well with similar examples from Cuise, France.

**Range:** *Barnea* bed (rare).

**Palaeoecology:** detritivore.

*Batillaria* (*Vicinocerithium*) *subacuta* (d'Orb., 1850) \*

Plate 7, fig. 2.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** detritivore.

**Family TURRITELLIDAE**

*Ispharina* aff. *sulcifera* (Deshayes, 1832)

Plate 7, fig. 4.

1949 *Turritella* aff. *terebellata* Lamarck; Wrigley, p. 15.

**Remarks:** This *Ispharina* more closely resembles *I. sulcifera* than *I. terebellata*, but is probably a new species. Study of this group is ongoing elsewhere.

**Range:** division B2 (common), *Barnea* bed (uncommon) and C1 (common).

**Palaeoecology:** semi-infaunal herbivore, detrital and/or ciliary suspension-feeder.

*Haustator dixonii* (Deshayes, 1861)

Plate 7, fig. 5.

1965 *Turritella* cf. *dixonii* Deshayes; Curry & King, p.

34.

**Remarks:** The representatives of this species at Lower Swanwick are highly variable and their identity is further confused by differing preservation due to weathering. Weathered individuals often lose the carinated outer shell layers and consequently come to resemble similarly weathered individuals of *H. circumdatus*.

**Range:** division B2 (common), *Barnea* bed (uncommon) and C1 (uncommon).

**Palaeoecology:** herbivore, detrital and/or ciliary suspension feeder.

*Haustator circumdatus* (Deshayes, 1861)

Plate 7, fig. 6.

**Range:** division B2 (common).

**Palaeoecology:** herbivore, detrital and/or ciliary suspension feeder.

**Family RISSOIDAE**

*Alvania* sp.

Plate 7, fig. 15.

**Range:** division B2 (uncommon).

**Palaeoecology:** detritivore.

**Family IRAVADIIDAE Thiele, 1928**

**Genus** *Entomope* Cossmann, 1888

*Entomope semipunctata* n. sp.

Plate 7, figure 7.

**Derivatio nominis:** Refers to the shell's incomplete ornament of punctae.

**Holotype:** GG 14542 (Tracey coll.) from the *Barnea* bed, division B2, London Clay Formation of Lower Swanwick.

**Paratypes:** GG 14543-4, 8 specimens, (Tracey coll.), and PI TG 1126-1128, 3 specimens, (King coll.) from the *Barnea* bed, division B2, London Clay Formation of Lower Swanwick. PI TG 1125, 1 specimen, (J. P. James coll.), horizon unknown, London Clay Formation of Lower Swanwick.

**Diagnosis:** A slender, long-spined and narrowly umbilicate *Entomope* with rather flattened whorls and shallow sutures, ornamented with rows of punctae which tend to become obsolete towards the periphery.

**Description:** Shell very small, ovately fusiform, height 3.1mm, width 1.6mm, height of last whorl 1.6mm. Protoconch domed, of about 2 smooth whorls with a distinct orthocline lip, seen in one juvenile, although worn in the holotype and considerably eroded on most paratypes. Teleoconch of about 4 smooth and polished whorls, enlarging regularly and relatively slowly, only slightly convex with very shallow impressed sutures. Periphery somewhat rounded, giving the shell a slightly subangular

profile. Spiral ornament of three rows of shallow oval punctae in the upper half of the whorl, the lower half with almost imperceptible collabral striae only. The punctae are obsolescent across a zone of variable width on the body whorl, but between 12 and 20 rows of distinct punctae emerge immediately below this unornamented area to cover the base. Aperture about half the shell height, ovate. Columella thin, forming a slightly pointed channel at its junction with the basal lip, straight below and slightly reflected over the narrow umbilicus which is situated in a narrow crescentic furrow bounded by a low rounded ridge. The columella curves to meet the oblique paries, which joins the lip at an acute angle. The outer lip is thin, damaged but apparently straight and slightly prosocline.

**Remarks:** Both the French Lutetian type species *Entomope klipsteini* (Cossmann, 1888) and an undescribed species from the English Middle Eocene have deeper sutures and are ornamented with incised spiral striae which may be partly or wholly lacking. A punctate basal ornament is however present in two species from the Late Cretaceous Coffee Sand Formation of Mississippi, U.S.A., *E. sp.* and *E. ponderi*, (Dockery, 1993). These both differ in their convex whorls, deeper sutures, shorter spires and usual absence of punctae on the spire, although one specimen was described as having the whorls covered in punctae. *E. reichli* Traub, 1989 from the Palaeocene of Austria, if correctly referred to this genus, is smooth and has deeper sutures than *semipunctata* and has a single cord in the suture of the later whorls. *Dissochilus lineatus* (Briart & Cornet, 1887) as figured by Glibert (1973: pl. 2, fig. 12) is very similar to *Entomope* but is more slender, grows much longer and has an ornament of simple incised striae. *D. lineatus* also has a variable parietal plication, a character weakly developed in some Middle Eocene *Entomope* (Tracey, in prep.). *E. semipunctata* shows a strong resemblance to the juvenile shell of the European Middle Eocene species *Cossmannia expansa* (Deshayes, 1861), which is almost certainly confamilial. It has a similar protoconch and punctate ornament, but also has flatter whorls.

In all the above species the whorls increase in height more rapidly than in *E. semipunctata*.

**Distribution:** Known only from Division B2 (inclusive) of the London Clay Formation at the type locality, where it is moderately common.

**Palaeoecology:** ?detritivore.

#### Family ADEORBIDAE Monterosato, 1884

##### Genus *Solariorbis* Conrad, 1865a

##### *Solariorbis lawsoni* n. sp.

Plate 8, figures 7-9.

**Derivatio nominis:** Named for Mr. Allan Lawson, who collected the holotype of this species.

**Holotype:** GG 14545 (Tracey coll.), a unique example, perhaps subadult, collected by A. G. Lawson from a log accumulation in division C1, London Clay Formation of Lower Swanwick.

**Diagnosis:** A small biconvex *Solariorbis* with regularly increasing whorls, an evenly rounded periphery, impressed sutures and an ornament of flat spiral ribbons divided by shallow, almost non-punctate, incised striae.

**Description:** Shell very small, discoidal, height 0.88mm, width max: 1.8mm, min: 1.5mm. Protoconch damaged but

of about three smooth whorls, 0.29mm in diameter. Teleoconch a little more than two whorls, rather similarly convex above and below the rounded periphery, but flattened in a wide band adjoining the suture on the apical surface. The suture is impressed where this platform meets the slightly elevated spire. The spiral ornament consists of 6 to 8 narrow flattened threads on the upper surface of the whorls, obsolete on the subsutural platform, but extending over base and numbering about 15 in all, separated by much narrower shallow grooves. Collabral ornament of faint striae, prosoclyt on the upper surface and orthocline on the base; these do not form punctuations in the spiral grooves, except somewhat obscurely on the base. The umbilicus occupies one quarter of the diameter of the base and its edge is rounded and thickened with callus. Aperture broken but approximately circular in cross section; growth lines suggesting a rounded backward-curving upper lip and relatively linear basal lip.

**Remarks:** Although the whorls of *lawsoni* are more stepped than those of typical *Solariorbis*, the characteristic form of the umbilicus shows that this is the correct genus. It resembles three more typical, as yet undescribed species from the London Clay (Division C), Selsey and Barton Clay Formations, each of which has a more domed spire and flattened base, shallower sutures and generally punctate spiral striae. *S. lawsoni* also resembles *S. ametabolus* Pilsbry & Olsson, 1952 (Recent, Peru, described by them as "a relatively primitive species"), although this differs in its smaller protoconch and smooth base. *S. lawsoni* has some indications of being transitional to the genus *Adeorbis*, which differs in having a more sunken spire, ornament of narrow spiral cords, and a wider umbilicus, not constricted by callus.

This is the first record of *Solariorbis* from the English Palaeogene, although several European Palaeogene species have recently been recognised (Tracey, in prep.).

**Distribution:** As yet known only from the holotype.

**Palaeoecology:** ?detritivore.

#### *Teinostoma* (s.l.) *intercallosum* (Gougerot, 1968) \*

Plate 8, figs 4-6.

1968 *Tinostoma* (*Megatyloma*) *intercallosa* Gougerot, p. 221, pl. 1, fig. 8.

**Remarks:** In most respects the single example from Lower Swanwick agrees closely with shells of *T. intercallosum* from English Middle and Late Eocene deposits. This belongs to a group of very small species characterised by the circular cross-section of the whorls, flaring at the aperture, and by a band of callus around the whorl near the aperture obscuring the ornament. This callus is typically thickened and extended to cover all or most of the umbilicus in adult shells, although this is a variable feature and is much reduced on the present specimen. The ornament of *T. intercallosum* varies dramatically from smooth and polished to spirally striate, often between shells from the same sample. Both forms of ornament may occur alternately on the same individual, as in the present example. The species was originally described from the late Ypresian and early Lutetian of Liancourt-Saint-Pierre, near Paris. A spirally striate form occurs later in the London Clay at Tanners Lane, Gosport, Hampshire (unpublished data).

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** ?detritivore.

*Adeorbis planorbularis paucicostatus* (Deshayes, 1862) \*

Plate 8, figs 1-3.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** ?detritivore.

#### Family APORRHAIIDAE

##### *Aporrhais sowerbii constrictus* Wrigley, 1938

Plate 7, figs 8-9.

1938 *Aporrhais sowerbii* form *constricta* Wrigley, p. 80, pl. 6, fig. 43.

1949 *Aporrhais sowerbii* (Mantell); Wrigley, p. 15 [in part].

1965 *Aporrhais sowerbii* (Fleming); Curry & King, p. 34 [in part].

**Remarks:** Five out of a suite of 30 specimens of *Aporrhais* from Swanwick proved to belong to *A. sowerbii constrictus*, which differs from the typical form of *A. sowerbii* by its more attenuated and turreted spire and stronger ornament, and is here elevated to subspecies rank.

**Range:** division B2 (uncommon).

**Palaeoecology:** detritivore.

##### *Aporrhais clarendonensis* Wrigley, 1938

Plate 7, figs 10-11.

1938 *Aporrhais sowerbii* form *clarendonensis* Wrigley, p. 80, pl. 6, fig. 42.

1949 *Aporrhais sowerbii* (Mantell); Wrigley, p. 15 [in part].

1965 *Aporrhais sowerbii* (Fleming); Curry & King, p. 34 [in part].

1992 *Aporrhais sowerbii clarendonensis* Wrigley; Tracey, p. 161.

**Remarks:** *A. clarendonensis* is the most abundant aporrhaid species from Lower Swanwick, with 25 out of a sample of 30 *Aporrhais* specimens belonging to this species. It is distinguished by its squat, inflated shape, small size, reduced spiral ornament and simple labral process, and is here elevated to species rank.

**Range:** division B2 (uncommon), division C1 (occurs, frequency uncertain).

**Palaeoecology:** detritivore.

#### Family STROMBIDAE

##### *Tibia (Eotibia) sublucida* (Edwards in Lowry, 1866)

Plate 7, figs 12-14.

**Range:** divisions B2-C1 inclusive (common).

**Palaeoecology:** detritivore.

#### Family CALYPTRAEIDAE

##### *Sigapatella echinulata* (J. Sowerby, 1815)

Plate 7, fig. 18.

1815 *Infundibulum echinulatum* J. Sowerby, p. 221, pl. 97, fig. 2.

1850 *Infundibulum suessoniensis* d'Orbigny, p. 320.

1965 *Calyptraea* cf. *aperta* (Solander); Curry & King, p. 34.

1992 *Sigapatella echinulata* (Sowerby); Tracey, p. 156.

**Remarks:** This species is most easily distinguished from *Sigapatella aperta*, to which it has sometimes been referred, by its better defined and more deeply incised sutures, its more convex whorl profile, and the more regular coiling of the whorls.

Comparison of the holotype of *echinulata* from the Early Eocene Blackheath Shell Bed of Plumstead, London, and other English specimens from the Late Palaeocene and Early Eocene, with French examples assigned to *suessoniensis* from Cuisian strata reveal no significant differences between the two nominal species, which are herein considered synonymous.

**Range:** divisions B2-C1 inclusive (uncommon).

**Palaeoecology:** ciliary feeder.

#### Family AMPULLOSPIRIDAE

##### *Ampullella adurni* (Wrigley, 1946) comb. nov.

Plate 9, fig. 3.

1946 *Globularia adurni* Wrigley, p. 91, fig. 10.

1965 *Globularia adurni* Wrigley; Curry & King, p. 34.

**Range:** division B2 *ex situ* (rare).

**Palaeoecology:** molluscivore.

##### *Globularia splendida* (Deshayes, 1864)

Plate 9, fig. 2.

**Range:** division B2 *ex situ* (rare).

**Palaeoecology:** molluscivore.

##### *Crommium lignitarum* (Deshayes, 1864)

Plate 9, fig. 1.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** molluscivore.

#### Family NATICIDAE

##### *Euspira glaucinoides* (J. Sowerby, 1812)

Plate 9, fig. 5.

**Range:** division B2 inclusive (common), division C1 (uncommon).

**Palaeoecology:** shell-drilling molluscivore.

##### *Sigatica hantoniensis* (Pilkington, 1804)

Plate 9, fig. 4.

**Range:** divisions B2-C1 inclusive (uncommon).

**Palaeoecology:** molluscivore.

**Family TRIVIIDAE**

*Eratotrivia prestwichii* (Edwards, 1855)

Plate 7, figs 16-17.

**Range:** division B2 (rare).

**Palaeoecology:** may have fed on compound ascidians.

**Family FICIDAE**

*Priscoficus smithii* (J. de C. Sowerby, 1827)

Plate 9, fig. 6.

**Remarks:** Also recorded as *Ficus londini* Wrigley, 1929 by Wrigley (1949) and Curry & King (1965), but the specimens so labelled at the NHM lack the elongation of that species.

**Range:** division B2 (uncommon), division C1 (uncommon).

**Palaeoecology:** possibly a predator of holothurians.

*Ficopsis multiformis* (Wrigley, 1929)

Plate 9, fig. 7.

1984 *Ficopsis multiformis* (Wrigley); Cooper, p. 7.

**Range:** division B2 inclusive (uncommon).

**Palaeoecology:** possibly a predator of holothurians.

**Family CASSIDAE**

*Galeodea (Mambrinia) gallica* Wrigley, 1934

Plate 9, figs 10-11.

1984 *Mambrinia gallica* (Wrigley); Cooper, p. 7.

**Range:** division B2 (uncommon), division C1 (frequency uncertain).

**Palaeoecology:** echinivore.

*Sconsia augustana* (Wrigley, 1934) **comb. nov.**

Plate 9, figs 8-9.

1934 "*Cassis*" *augustana* Wrigley, p. 118, fig. 21.

1949 '*Cassis*' *striata* J. Sowerby; Wrigley, p. 15.

**Remarks:** Although the specimens concerned are poorly preserved and incomplete, it is surprising that Wrigley failed to recognise his own species among material he had collected himself. The two species can be discriminated by the nature of the raised spiral sculpture: *S. striata* has one main spiral band while the subordinate spiral ornament is coarser than that of *S. augustana* which has four main spiral bands.

**Range:** divisions B2 and C1 (rare).

**Palaeoecology:** echinivore.

**Family CERITHIOPSIDAE**

*Cerithiopsis aff. discreta* Gougerot & Le Renard, 1981a\*

Plate 9, figs 12-13.

**Remarks:** A highly ornamented multispiral protoconch, sieved from a clay sample collected from an *in situ* exposure in the 1957 pit at Lower Swanwick, exhibits a granular quincunx pattern. The initial whorl is densely covered with spiral rows of granules. The second and subsequent whorls are ornamented with more spaced spiral rows of granules crossed by strongly prosocyrta raised granular striae, which are particularly prominent on the lower part of the whorl. These later whorls are also angulated by two narrow spiral cords in mid-whorl, the abapical one becoming a median keel and the adapical cord giving rise to a few collabral ridges which indicate the growth stages of the sinusigera lip. This unusual ornament appears close to the French Lutetian *C. discreta*, which is described as having two smooth initial whorls followed by 2.5 bicarinate whorls with a quincunx of granules on the shoulder, but with perhaps more orthocline fine costellae abapically. *C. discreta* is the only *Cerithiopsis* with this form of ornament recorded from the Paris Basin Palaeogene (Gougerot & Le Renard, 1981a). The quincunx pattern of granules is, however, characteristic of many living Indo-Pacific cerithiopsids (Marshall, 1978).

**Range:** division B2 (uncommon).

**Palaeoecology:** the Recent *Cerithiopsis tuberculata* lives among sponges, upon which it feeds (Fretter & Graham, 1982).

*Seila mundula* (Deshayes, 1864)

Plate 9, fig. 14.

**Range:** divisions B2 to C1 inclusive (uncommon).

**Palaeoecology:** probably a porifivore (feeding on sponges).

**Family TRIFORIDAE**

*Cerithiella elongata* (Wrigley, 1940) **comb. nov.**

Plate 9, fig. 15.

1940 *Orthochetus elongatus* Wrigley, pp.11, 17 [in part], fig. 14 [non figs 13, 15].

1949 *Orthochetus elongatus* Wrigley; Wrigley, p. 15.

**Remarks:** Wrigley's *elongatus* involves two distinct species, the holotype being a *Cerithiella* (Tracey, in prep.). Isolated protoconchs were found in a bulk sample of the *Barnea* bed.

**Range:** division B2 inclusive (uncommon), division C1 *ex situ* (uncommon).

**Palaeoecology:** probably a porifivore.

**Family EPITONIIDAE**



***Littoriniscala scalarioides* (J. de C. Sowerby in Dixon, 1850)**

Plate 9, fig. 16.

1984 *Littoriniscala scalarioides* (J. de C. Sowerby); Cooper, p. 7.**Range:** division B2 (rare), division C1 (rare).**Palaeoecology:** carnivorous browser: coelenterates.***Cirsotrema* sp. indet.****Range:** division C1 (rare)**Palaeoecology:** carnivorous browser: coelenterates.***Crassiscala subterranea* (Wrigley, 1940) comb. nov.**

Plate 9, fig. 18.

1891 *Turbonilla tenuiplica* Edwards MS; Newton, p. 182, [nom. nud.].1891 *Turbonilla sulcata* Edwards MS; Newton, p. 182, [nom. nud.].1891 *Turbonilla sulcata* var. *clarendonensis* Edwards MS; Newton, p. 182, [nom. nud.].1940 *Turbonilla subterranea* Wrigley, p. 7, figs 7-8.

**Remarks:** The reticulate ornament, broad varices and calcitic outer shell layer show this species to be an *Acirsa*-like epitoniid, for which the genus *Crassiscala* de Boury is most appropriate. The similar Barton species "*Turbonilla edwardsi* Glibert, 1938, to which Wrigley compared *subterranea*, is also congeneric. No protoconchs of either species have yet been recorded, despite the abundance of these taxa at some horizons; it is possible their mineral composition, microstructure, or even sculpture may make them more degradable than those of most epitoniids.

**Range:** division C1 (uncommon)**Palaeoecology:** carnivorous browser: coelenterates***Pliciscala (Rugatiscala) levesquei* (de Boury, 1887) \***

Plate 9, figs 17, 20.

**Remarks:** The adult shell illustrated in Pl. 9, fig. 17, is the first recorded from the English Palaeogene.

An isolated protoconch with distinctly epitoniid characters (Pl. 9, fig. 20) was found in a clay sample collected from an *in situ* exposure in the 1957 pit at Lower Swanwick. The ornament of very close, orthocline axial microstriae is very much like that seen in a number of living *Epitonium* species, and indicates the subfamily Epitoniinae. The lip is slightly concave and reflected posteriorly, forming a very shallow sinus. This possibly primitive feature is much reduced or absent in most epitoniids. There are no previous records of epitoniid protoconchs in the London Clay, where they are rarely preserved, and so the species indicated is uncertain. Among the protoconchs represented in the English Middle Eocene, those of *Acrilla* and *Cirsotrema* are generally narrower with more whorls, and are smooth or sinuously striate. However the protoconch of *Pliciscala* is shorter and ornamented with strong, opisthocline striae, resembling the present specimen. For this reason the

protoconch is tentatively assigned to *P. levesquei*.**Range:** division B2 (frequency uncertain).**Palaeoecology:** carnivorous browser: coelenterates.**Family EULIMIDAE***Melanella* (s.l.) sp.

Plate 9, fig. 19.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** all Recent species of *Melanella* for which the hosts are known are parasitic on holothurians (Warén, 1983: 57).

**Family MURICIDAE*****Paziella subcoronata* (d'Orbigny, 1850)**

Plate 10, fig. 1.

1948 *Murex subcoronatus* d'Orbigny; Wrigley, p. 106, pl. 10, fig. 13.1965 *Murex subcoronatus* d'Orbigny; Curry & King, p. 34.1971 *Paziella subcoronatus* d'Orbigny; Vokes, pp. 102, 135.

**Remarks:** The form of this species present at Swanwick differs from the typical form from Highgate, London, in its higher, somewhat more attenuated spire and fewer costae (6 per whorl as opposed to 7 in the typical form). The distinctive, almost flat shoulder ramp of the typical *subcoronata* is sloped in the Swanwick form.

**Range:** *Barnea* bed (uncommon).**Palaeoecology:** molluscivore.***Poirieria subcristata* (d'Orbigny, 1850)**

Plate 10, fig. 2.

1949 *Murex subcristatus* d'Orbigny; Wrigley, p. 104, pl. 10, figs 19-20.1971 *Poirieria subcristatus* d'Orbigny; Vokes, pp. 102, 135.**Range:** division B2 (rare), division C1 (uncommon).**Palaeoecology:** molluscivore.**Family BUCCINIDAE*****Wrigleya transversaria* (Wrigley, 1925)**

Plate 10, figs 3-4.

1925 *Euthriofusus transversarius* Wrigley, p. 242, fig. 9.1949 *Euthriofusus transversarius* Wrigley; Wrigley, p. 15.1963 *Euthriofusus (Wrigleya) transversarius* Wrigley; Glibert, p. 133.1965 *Euthriofusus transversarius* Wrigley; Curry & King, p. 34.1992 *Wrigleya transversaria* (Wrigley); Tracey, p. 157.**Range:** division B2 (uncommon), division C1 (uncommon).**Palaeoecology:** generalist predator and scavenger.***Wrigleya crebrilinea* (Wrigley, 1927)**

Pl. 10, figs 5-6.

- 1927 *Euthriofusus crebrilineus* Wrigley, p. 242, fig. 19.  
 1949 *Euthriofusus crebrilineus* Wrigley; Wrigley, p. 15.  
 1963 *Euthriofusus (Wrigleya) crebrilineus* Wrigley; Glibert, p. 133.  
 1965 *Euthriofusus crebrilineus* Wrigley; Curry & King, p. 34.  
 1992 *Wrigleya crebrilinea* (Wrigley); Tracey, p. 157.

**Range:** division B2 inclusive (uncommon).

**Palaeoecology:** generalist predator and scavenger.

***Cantharus (Eocantharus) morrisii* (Edwards in Lowry, 1866)**

Plate 10, figs 7-8

- 1866 *Pisania morissii* Edwards in Lowry, pl. 4.  
 1891 *Pisania morrisii* Edwards (MS); Newton, p. 161.  
 1949 *Pollia londini* (Wrigley); Wrigley, p. 15.  
 1949 *P[ollia]* sp., longer than *P. londini*; Wrigley, p. 15.  
 1963 *Cantharus (Eocantharus) morrisi* (Edwards), Glibert, p. 78.  
 1965 *Pollia morrisii* (Edwards); Curry & King, p. 34.

**Remarks:** see Tracey (1992: 163) for a discussion of this species.

**Range:** division B2 inclusive (common), division C1 (uncommon).

**Palaeoecology:** generalist predator and scavenger.

***Pseudoneptunea curta* (J. Sowerby, 1818)**

Plate 10, figs 9-10.

**Range:** division B2 (common).

**Palaeoecology:** generalist predator and scavenger.

**Family MELONGENIDAE**

***Cornulina minax* (Solander in Brander, 1766)**

Plate 10, fig. 17.

**Range:** *Barnea* bed (rare).

**Palaeoecology:** molluscivore.

***Sycostoma bulbiforme* (Lamarck, 1803)**

Plate 10, figs 15-16.

**Range:** division B2 inclusive (uncommon).

**Palaeoecology:** molluscivore.

**Family FASCIOLARIIDAE**

***Daphnobela juncea* (Solander in Brander, 1766)**

Plate 10, fig. 18.

**Range:** division B2 (rare).

**Palaeoecology:** molluscivore/vermivore.

***Streptolathyrus cymatodis* (Edwards in Lowry, 1866)**

Plate 10, figs 13-14.

**Range:** division B2 (uncommon), C1 (common).

**Palaeoecology:** molluscivore/vermivore.

***Clavilithes cf. parisiensis* (Mayer, 1877)**

Plate 10, fig. 19.

**Remarks:** A unique example from the *Barnea* bed at Lower Swanwick is tentatively assigned to this species. The specimen lacks the anterior canal and part of the body-whorl, and the protoconch and most of the teleoconch are encrusted with Bryozoa and oyster spat which could not be removed without harming the shell. Nevertheless the general aspect and proportions of the specimen agree with better preserved examples of this species. This is the first substantiated record of *Clavilithes* from the English Early Eocene, and the earliest from England.

**Range:** *Barnea* bed (rare).

**Palaeoecology:** molluscivore/vermivore.

***Surculites errans* (Solander in Brander, 1766)**

Plate 10, figs 11-12.

**Range:** divisions B2 and C1 (uncommon).

**Palaeoecology:** molluscivore/vermivore.

**Family VOLUTIDAE**

***Volutocorbis elevata* (J. de C. Sowerby, 1840)**

Plate 10, figs 20-21.

**Range:** division B2 inclusive (uncommon).

**Palaeoecology:** molluscivore.

**Family VASIDAE**

***Ptychatractus interruptus* (Pilkington, 1804)**

Plate 10, fig. 22.

**Range:** division B2 (uncommon).

**Palaeoecology:** vermivore.

**Family PSEUDOLIVIDAE**

***Pseudoliva laudumensis* (Defrance, 1826)**

Plate 10, figs 23-24.

**Range:** *Barnea* bed and division C1 (rare).

**Palaeoecology:** generalist predator and scavenger.

**Family OLIVIDAE**

***Amalda arenaria* (Cossmann, 1889)**

Plate 10, fig. 25.

- 1889 *Ancilla arenaria* Cossmann, p. 219, pl. 8. figs 8, 9.  
 1940 *Ancilla atrebatum* Wrigley, pp. 14, 17, fig. 21.  
 1960a *Ancilla (Baryspira) arenaria* Cossmann; Glibert, p. 13.

This is the first record of this species from Lower Swanwick, and the single relatively large adult example (Pl. 10, fig. 25) confirms Wrigley's suspicion (1940: 15) that his species was identical with that from the Cuisian of France.

Although this species resembles some *Ancillus* species in shape, it differs by the presence of a denticle on the anterior edge of the outer lip whose deformation of preceding growth-lines gives rise to a distinctive spiral band posterior to the main unvarnished band (Chavan, 1965: 104, 106), suggesting that it should be placed in the genus *Amalda* Adams & Adams, 1853 (p. 148).

**Range:** division B2 inclusive (rare).

**Palaeoecology:** molluscivore.

### Family CANCELLARIIDAE

#### *Bonellitia subevulsa* (d'Orbigny, 1850)

Plate 10, fig. 26.

**Range:** division B2 (common), *Barnea* bed (uncommon), division C1 (frequency uncertain).

**Palaeoecology:** some Recent cancellariids are thought to be opportunistic parasites of resting fish, others predators of various invertebrate types.

#### *Bonellitia laeviuscula* (J. Sowerby, 1822)

Plate 10, fig. 27.

**Range:** division B2 inclusive (uncommon).

**Palaeoecology:** parasite/predator.

#### *Sveltella carinata* Wrigley, 1935

Plate 10, fig. 28.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** parasite/predator.

#### *Sveltella cf. arenaria* Wrigley, 1935

Plate 10, fig. 29.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** parasite/predator.

### Family TURRIDAE

#### Genus *Turricula* (*Orthosurcula*):

The Neogene-Recent Indo-Pacific genus *Turricula* Schumacher, 1817 (type species: *Turricula flammea* Schumacher, 1817 [= *Murex tornatus* Dillwyn, 1817]), has

been used for the following group of larger English Eocene turrids: *Pleurotoma cochlis* Edwards, 1861, *P. crassa* Edwards, 1857, *P. helix* Edwards, 1857, *P. keelei* Edwards, 1857, *P. symmetrica* Edwards, 1857, *P. teretrium* Edwards, 1857, *P. teretrium* var. *nanodis* Edwards, 1857, *P. teretrium* var. *tuberculata* Edwards, 1857, *P. teretrium* var. *crebrilinea* Edwards, 1857 and *P. teretrium* var. *latimarginata* Edwards, 1857 (all Early Eocene London Clay Formation); *P. inarata* J. de C. Sowerby, 1850 and *P. planetica* Edwards, 1857 (Middle Eocene Selsey Formation); *Murex rostratus* Solander, 1766 and *Pleurotoma rostrata antiqua* Edwards, 1857 (Middle Eocene Barton Clay Formation); *Pleurotoma transversaria* var. *cypha* Edwards, 1857 (Late Eocene Headon Hill Formation).

*Turricula* (s.s.) has a smooth paucispiral protoconch and is characteristically an Indo-Pacific, Neogene-Recent genus. The English Palaeogene species have a multispiral protoconch of 2-3 smooth initial whorls followed by up to 1 whorl of irregular axial costae, and these and related taxa form a predominantly Palaeogene, Western European and North American group, distinct from *Turricula* (s.s.). A more appropriate taxon is the Eocene-Oligocene *Orthosurcula* Casey, 1904 (type *Pleurotoma longiforma* Aldrich, 1885, Oligocene, U.S.A.).

It is probable that the more-or-less strongly sculpted English Palaeogene species have not previously been referred to *Turricula* (*Orthosurcula*) because its type species has a mostly smooth teleoconch. In point of fact the reduction of sculpture in the type species develops only on the later whorls, the first four teleoconch whorls possess similar low opisthocline axial plicae and strong spiral cords as are found more fully developed in the English Palaeogene species. A comparable ontogenetic change in teleoconch sculpture is seen in the Selsey Formation taxon *Turricula* (*Orthosurcula*) *planetica*, in which only the first one to (rarely) five teleoconch whorls are plicate; its spiral ornament is a little coarser than in *T. (O.) longiforma*, but weaker than in the other taxa referred to, and consequently it is transitional in appearance to the mostly smooth type species of *Turricula* (*Orthosurcula*).

The London Clay taxa referred to this genus are strongly ornamented with spiral cords and axial costae, but in *T. (O.) helix*, *T. (O.) symmetrica* and in most forms of *T. (O.) teretrium* the axial costae are generally lost on or before the body whorl.

*Orthosurcula* is herein reduced in rank to a subgenus of *Turricula* because of its overall similarity in gross shell morphology, which includes a comparable range of variability in shell sculpture; although a separate identity is retained in view of its differing protoconch and distinct spatial and temporal ranges.

The superficially similar *Pleurotoma transversaria* Lamarck, 1804 (Lutetian, France), *Pleurotoma goniaea* Edwards, 1857 (Bracklesham Group, England), and *Pleurotoma cymaea* Edwards, 1857 (Solent Group, England), represent a different unnamed subgenus of *Turricula* characterised by a smooth, multispiral protoconch without axials, a somewhat angular whorl profile, and an absence of axials on the early teleoconch - although in *goniaea* and *cymaea* axials do develop on later teleoconch whorls.

#### *Turricula* (*Orthosurcula*) *crassa* (Edwards, 1857)

Plate 11, fig. 4.

1857 *Pleurotoma crassa* Edwards, p. 212, pl. 26, fig. 1a-d.

1984 *Turricula crassa* (Edwards, 1856); Cooper, p. 8.

**Range:** division B2 (uncommon).

**Palaeoecology:** most Recent turrids are vermivores, although a few other prey types, including other gastropods, are known to be taken (Miller, 1989: 173).

***Turricula (Orthosurcula) keelei* (Edwards, 1857)**

Plate 11, figs 7-8.

1857 *Pleurotoma keelei* Edwards, p. 219, pl. 26, fig. 6.

1949 *Turricula crassa* (Edwards); Wrigley, p. 16.

1960 *Turricula (Surcula) keelei* Edwards; Glibert, p. 30.

1974 *Crenaturricula keelei* (Edwards); James *et al.*, p. 54.

**Remarks:** *T. (O.) keelei* has been referred to *Crenaturricula* (James *et al.*, 1974), but its long, narrow anterior canal and the position of its sinus (set anteriorly, away from the suture) exclude it from that genus.

The form of this species at Lower Swanwick differs from topotypic specimens from Shenfield in having the shoulder of the whorl which bears the characteristic tuberculations situated above the median position it occupies in topotypic specimens. Representatives from Lower Swanwick often have more numerous (8 rather than 7), less pointed tubercles on the shoulders of the whorls. One individual in the Kemp collection at the N.H.M. (Pl. 11 fig. 7) has these nodes modified into plications, and thus rather resembles *O. crassa*.

**Range:** division B2 (uncommon), C1 (frequency uncertain).

**Palaeoecology:** vermivore.

***Turricula (Orthosurcula) teretrium crebrilinea* (Edwards, 1857)**

Plate 11, fig. 6.

1857 *Pleurotoma teretrium* var. *crebrilinea* Edwards, p. 210, pl. 25, fig. 8a.

1965 *Turricula teretrium* (Edwards); Curry & King, p. 34.

**Remarks:** This subspecies is the most abundant *Turricula (Orthosurcula)* at Lower Swanwick, and seems to replace *T. (O.) teretrium teretrium*, which is commoner elsewhere.

**Range:** division B2 (uncommon).

**Palaeoecology:** vermivore.

***Turricula (Orthosurcula) cochlis* (Edwards, 1861)**

Plate 11, fig. 5.

1861 *Pleurotoma cochlis* Edwards, p. 272, pl. 33, fig. 6.

1949 *Turricula cochlis* (Edwards); Wrigley, p. 16.

**Range:** division C1 (frequency uncertain).

**Palaeoecology:** vermivore.

***Eosurcula stena* (Edwards, 1857) comb. nov.**

Plate 11, figs 9-10.

1857 *Pleurotoma stena* Edwards, p. 207, pl. 25, fig. 4.

1949 *Turricula stena* (Edwards); Wrigley, p. 16.

1965 *Turricula stena* (Edwards); Curry & King, p. 34.

**Remarks:** Previous authors have placed this species in *Turricula* from which it differs by its smaller size, more attenuate shape, strong spiral sculpture and rather angular whorl profile. It closely resembles *Pleurotoma moorei* Gabb, 1860, the type species of *Eosurcula* Casey, 1904, from the Middle Eocene of Texas; differing only in the strength of its secondary spiral striations.

**Range:** division B2 (uncommon).

**Palaeoecology:** vermivore.

***Cochlespira gyrata* (Edwards, 1857)**

Plate 11, fig. 11.

1857 *Pleurotoma terebralis* var. *gyrata* Edwards, p. 233, pl. 27, fig. 10b-d.

1949 *Ancistrosyrinx gyrata* (Edwards); Wrigley, p. 16.

1965 *Turricula gyrata* (Edwards); Curry & King, p. 34.

1974 *Cochlespira gyrata* (Edwards); James *et al.*, p. 54.

1984 *Cochlespira gyrata* (Edwards); Cooper, p. 7.

1992 *Cochlespira gyrata* (Edwards); Tracey, p. 157.

**Remarks:** This species has been referred to *Ancistrosyrinx* Dall, 1881 from which it differs chiefly by the lack of a spiral lamina on the shoulder ramp. It differs from *Turricula* in a number of ways, notably by its small size, flat shoulder ramp and beaded peripheral carina.

**Range:** divisions B2 to C1 inclusive (uncommon).

**Palaeoecology:** vermivore.

***Cochlespira pulcherrima* (Edwards, 1857) comb. nov.**

Plate 11, fig. 12.

1857 *Pleurotoma terebralis* var. *pulcherrima* Edwards, p. 233, pl. 27, fig. 10e, g.

1960b *Ancistrosyrinx terebralis pulcherrima* Edwards, 1861; Glibert, p. 24.

**Remarks:** this species is distinguished from *C. gyrata* by its lack of tubercles on the peripheral carina and by the more numerous and finer spiral lineations extending over the body whorl and onto the anterior canal.

**Range:** division B2 (frequency uncertain).

**Palaeoecology:** vermivore.

***Gemmula macrobia* (Edwards, 1861)**

Plate 11, figs 17-18.

1974 '*Pleurotoma*' *macrobia* Edwards; James *et al.*, p. 54.

**Range:** division B2 inclusive (uncommon).

**Palaeoecology:** vermivore.

**Genus *Epaxlis* Cossmann, 1889**

***Epaxlis kempii* n. sp.**

Plate 11, figures 13-16.

**Derivatio nominis:** Named for Mr David J. Kemp, who collected many specimens featured in this paper.

**Holotype:** GG 14571 (Jeffery coll.) (Pl. 11, figs 13-14) the smallest but most complete specimen of the three examples known, collected from London Clay spoil from excavations for the new C.A.A. centre at Lower Swanwick, Hampshire.

**Paratypes:** GG 14573 (Jeffery coll.) (Pl. 11, fig. 15) a larger but less complete specimen from the same source; GG 14572 (Cooper & James coll.) (Pl. 11, fig. 16) the largest but least complete specimen, collected from the London Clay of the 1957 pit at Lower Swanwick.

**Diagnosis:** A small species of *Epalxis*, with numerous fine close-set ribs, and a spiral sulcus on the shoulder of the whorls.

**Description:** A small fusiform shell, the holotype is 5.9mm high and 2.2mm wide; the paratype GG 14572 is 6.8mm high and 2.7mm wide and the paratype GG 14573 is 6.6mm high and 2.6mm wide. The protoconch is somewhat decorticated in the holotype, but is conical, comprising approximately 3.5 smooth convex whorls followed by one with axial ribs. The teleoconch comprises up to four convex whorls ornamented with spiral and axial sculpture, of which the spiral threads are dominant. These commence below the suture with a pair of moderately strong, close-set cords which are beaded by the axial sculpture. These are followed by a sulcus which occupies approximately one-sixth the height of the whorl. In the holotype this contains a single fine thread which is not beaded. Below the sulcus there are 3 or 4 more-or-less beaded spiral cords. The first, which coincides with the apex of the sinus, is strongest, while the remainder diminish in strength towards the lower suture. On the body whorl these threads continue on to the siphonal canal, becoming finer, unornamented and more closely spaced. The axial sculpture consists of about 24-25 closely-spaced, flexuous costae per whorl which follow the growth lines, these vary in development in each of the type specimens, suggesting a degree of variability in the original population of this species. The axial sculpture is subordinate to the spiral sculpture and is less clearly defined. The axial ornament is reduced or absent across the sulcus and is reduced to growth lines on the siphonal canal. The broadly V-shaped sinus is placed just above the periphery of the whorl, and the sinus band is only weakly distinguished by ornament. The aperture is obliquely subrhomboidal, lacking internal thickening or plication, the inner lip is thinly enamelled.

**Distribution:** The only known examples of this species are all from division B2 of the London Clay Formation (probably below *Barnea* bed level), of Lower Swanwick.

**Comparisons:** This species most closely resembles *Pleurotoma boutillieri* de Boury, 1899(= *Pleurotoma cancellata* Deshayes non Eichwald) from the Thanetian to Cuisian of France, but is more coarsely ornamented with a stronger shoulder sulcus. The only other London Clay turrid which resembles *Epalxis* is *Eopleurotoma wetherellii*, (see Pl. 12, fig. 10) which is larger with coarser spiral cords and distinct gemmules on the periphery of the whorl. The sulcus on the shoulder of the whorl resembles a similar band seen in the disparate group of Eocene turrids sometimes assigned to *Asthenotoma*, but in those species the groove corresponds with the apex of the sinus. This resemblance may have some phylogenetic significance, since the *Asthenotoma* group is not apparently known in the London Clay, but the origins of that group are almost certainly polyphyletic.

**Remarks:** This is a rare but distinctive species. The apparent variability of the three known specimens is partly

due to preservational characteristics. In the case of the paratype (GG 14573) Pl. 11, fig. 15, damage to the last whorl has given it the appearance of possessing a longer anterior canal than is typical, while the other paratype (GG 14572) Pl. 11, fig. 16, has the canal foreshortened by damage to the shell. The relative strength of the spiral and axial ornament also varies slightly between the holotype and the paratypes, with the specimen illustrated in Pl. 11, fig. 15 having the strongest ornament.

**Palaeoecology:** vermivore.

**Genus *Eopleurotoma*:** In a sample of 40 specimens of *Eopleurotoma* from Lower Swanwick, 6 (15%) were *E. prestwichii*; 3 (7.5%) were *E. simillima*; and 31 (77.5%) were *E. simillima crassilinea*. *E. wetherellii* and *E. "selysi"* were not represented in the sample.

#### *Eopleurotoma prestwichii* (Edwards, 1861)

Plate 12, figs 1-2.

1965 *Eopleurotoma flexuosa* (Edwards); Curry & King, p. 34.

**Range:** division B2 (uncommon).

**Palaeoecology:** vermivore.

#### *Eopleurotoma simillima simillima* (Edwards, 1861)

Plate 12, figs 3-4.

1984 *Fusiturris simillima* (Edwards); Cooper, p. 7.

**Range:** division B2 inclusive (uncommon).

**Palaeoecology:** vermivore.

#### *Eopleurotoma simillima crassilinea* (Edwards, 1861)

Plate 12, figs 5-9.

**Remarks:** Edwards' var. *crassilinea* was never illustrated, only a short description in Latin was given and no type designated. This taxon is the most abundant turrid at Lower Swanwick and its distinctive appearance warrants its treatment as a subspecies of *E. simillima*. Consequently, one specimen of *crassilinea* in the Edwards collection from the London Clay (probably division B of King, 1981) at "Southampton" (most likely from the "town well" excavation on Southampton Common - SU 41 14 approx.), registered GG 14607, is herein selected as lectotype (Pl. 12, figs 7-8, dimensions: height 18.4mm, width 7.2mm), as it is the most complete specimen overall. The remaining 12 examples from that batch are designated as paralectotypes. One of the paralectotypes (GG 14608, Pl. 12, fig. 9, dimensions: height 15.4mm, width 6.1mm) is also illustrated, the remaining 11 specimens are registered as GG 14609 (all these specimens were previously registered as 71308A). This subspecies differs from *E. simillima* s.s. by the angulation of the periphery of the whorls, the shortening and thickening of the shoulder plicae into nodes, and by its coarser spiral ornament, in which the cords are less numerous. It is divisible into two forms, the typical form illustrated by the lectotype, and an extreme form illustrated in Pl. 12, figs 5-6 (PI TG 1131), which has an exaggerated

angulation to the whorl profile lending it a *Gemmula*-like appearance. This extreme form is uncommon at Lower Swanwick (2 out of a sample of 31 specimens), but in the London Clay of the London Basin, and also at Alum Bay, Isle of Wight, it is the dominant form.

**Range:** division B2 (common), *Barnea* bed (frequency uncertain).

**Palaeoecology:** vermivore.

***Eopleurotoma wetherellii* (Edwards, 1861)**

Plate 12, fig. 10.

1984 *Fusiturris wetherelli* (Edwards); Cooper, p. 7.

**Remarks:** Only one subadult example of this species is known from Swanwick. Being immature it differs somewhat in appearance to the types, which are adult and considerably larger. However, when compared with a suite of smaller topotypes from Highgate, it is possible to find individuals closely resembling the Swanwick specimen, confirming this identification.

**Range:** division C1 (uncommon).

**Palaeoecology:** vermivore.

***Trachelochetus* cf. *nodosarius* (Edwards, 1861) comb. nov.**

Plate 12, fig. 11.

cf. 1861 *Pleurotoma nodosaria* Edwards, p. 261, pl. 29, figs 8a-b.

cf. 1891 *Pleurotoma nodosaria* Edwards; Newton, p. 116.

**Range:** division C1 (rare)

**Palaeoecology:** vermivore.

**Family CONIDAE**

**Genus *Domenginella* Vokes, 1939** (Type: *Turris claytonensis* Gabb, 1864 by original designation. Early Eocene, California, U.S.A.)

A number of European Palaeogene conoideans, including *Murex conoides* Solander in Brander, 1766 and *Pleurotoma pyrgota* Edwards, 1861, have long been referred to the post-Palaeogene genus *Genota* H. & A. Adams, 1853, which has a greatly enlarged body whorl and a distinctive flat-topped protoconch. The radula of *Genota* allies it most closely with the Conorbiinae (Powell, 1966: 97). Species in the *conoides* group, on the other hand, are small and biconic with a conical protoconch and seem to be most closely related to the North and Central American genera *Scobinella* Conrad, 1848, *Moniliopsis* Conrad, 1865b and *Domenginella* Vokes, 1939. *Scobinella* is elongate and has a few more or less prominent columellar folds. No such folds are present in the European group of species, although weak ridge-like thickenings are sometimes seen in the same position on examples of *conoides*. *Moniliopsis* is similar to *Scobinella* but with a smooth columella and both genera have single or multiple spiral cords on the shoulder sinus band. *Domenginella* on the other hand is small and biconic with beaded spiral ornament and a smooth sinus band on the shoulder. The European species agree well with this diagnosis and the range of this genus is extended as follows:

Early Eocene of California (*claytonensis* Gabb, 1864), Texas (*D. sp.* (C. Garvie, pers. comm.)) and Alabama (*sculpturata* Aldrich, 1911); Palaeocene to Late Eocene of France and England (*staadti* Cossmann, 1913, *tereticosta* & *pyrgota* Edwards, 1861, *conoides* Solander in Brander, 1766, *lyra* Deshayes, 1834, *schlumbergeri* Raincourt, 1885, and *subconoides* d'Orbigny, 1852); Oligocene of Belgium and Germany (*barthi* and *roeveri* Von Koenen, 1890, *subconoides* d'Orbigny, 1852, and *monilifera* Philippi, 1847).

We would exclude from this genus the polyphyletic assemblage of species, *Pleurotoma microcheila*, *dissimilis*, *pupa* and *dilinum* all Edwards, 1861, tentatively referred here by Vokes (1939: 122)

***Domenginella tereticosta* (Edwards, 1861) comb. nov.**

Plate 12, figs 12-14.

1861 *Pleurotoma tereticosta* Edwards, p. 250, pl. 29, fig. 5a-b.

1861 *Pleurotoma tereticosta* var. *soror* Edwards, p. 250, pl. 29, fig. 5c-d.

1861 *Pleurotoma turpis* Edwards, p. 267, pl. 28, fig. 2a-c.

1861 *Pleurotoma tallavignesii* Rouault; Edwards, p. 270 [in part; pl. 33, fig. 9a only; *non* Rouault, 1848].

1965 *Drillia tereticosta* (Edwards); Curry & King, p. 34.

**Remarks:** When Edwards described *Pleurotoma tereticosta* he named a variety, *soror*, which he separated from the typical form on the basis of its spiral sculpture. The typical form was said to be characterised by the raised spiral bands being wider than the intervening grooves; while var. *soror* was said to be characterised by the spiral grooves being wider than the raised bands. This conclusion seems to have been based on only one specimen in the case of var. *soror*, and subsequent examination of a larger suite of specimens from Lower Swanwick and elsewhere shows that both forms are usually present alongside one-another, with intermediates, although the widely-grooved form is generally most abundant.

Examination of the holotype of *Pleurotoma turpis* reveals it to be a gerontic example of *D. tereticosta* in which the shoulder plicae have become obsolete on the last whorl. Likewise, examination of the two figured specimens attributed by Edwards to *Pleurotoma tallavignesii* shows one (pl. 33, fig. 9a) is a specimen of *D. tereticosta* in which the spire is rather corroded and the shoulder angle slightly more acute than in typical specimens. Consequently *P. tereticosta* var. *soror*, *P. turpis* and *P. tallavignesii* sensu Edwards, in part, are herein synonymised with *D. tereticosta*. This name is preferred as it has enjoyed the widest usage.

**Range:** division B2 (common), *Barnea* bed (frequency uncertain).

**Palaeoecology:** vermivore.

***Bathytoma granata* (Edwards, 1861)**

Plate 11, fig. 15.

1861 *Pleurotoma granata* Edwards, p. 308, pl. 31, fig. 7a-c.

1861 *Pleurotoma rotundata* Edwards, p. 307, pl. 31, fig. 9a-b.

1861 *Pleurotoma parilis* Edwards, p. 309, pl. 31, fig. 10a-

c.

1949 *Bathytoma* sp. between *B. granata* & *B. parilis*; Wrigley, p. 16.

1965 *Bathytoma granata* (Edwards); Curry & King, p. 34.

**Remarks:** The name *Pleurotoma granata* was applied by Edwards (1861) to a form which predominates in the higher parts of the London Clay at Highgate and Finchley, north London. This has a long subsutural collar which covers the lower half of the preceding whorl, so that the swollen peripheral band appears immediately above the suture. The growth ridges on the extended collar are orthocline, granular and often forked, and *granata* has strong nodular ornament around the periphery. The name *parilis* was given to a similar form, but with the peripheral nodules obsolete. At most other London Clay horizons and localities the form referred to *rotundata* (Pl. 12, fig. 15) occurs exclusively. This has a shorter subsutural collar with oblique growth lines and the peripheral band therefore appears in mid-whorl. The form and strength of the peripheral nodulation varies as much in this form as in *granata/parilis*. All these nominal forms are present with intermediates, however, at localities such as Tolworth, Aldershot and Highgate, which suggests that all three are forms of a single very variable species. It is therefore proposed to unite these species, for which the specific name *B. granata* is preferred, having received widest usage in the literature.

**Range:** division B2 (uncommon), division C1 (frequency uncertain).

**Palaeoecology:** vermivore.

***Microdrillia tricincta* (Edwards, 1861)**

Plate 12, fig. 16.

1861 *Pleurotoma tricincta* Edwards, p. 252, pl. 28, fig. 6a-b.

1991 *Microdrillia tricincta* (Edwards); Gatto, p. 242.

**Remarks:** No type was ever designated for this species so the example figured by Edwards (pl. 28, fig. 6a-b; reg. no. NHM GG 11127) is selected as lectotype. This species is represented at Lower Swanwick by a unique specimen in the A. G. Davies collection (NHM PI TG 1135). This is a rare species and all the representatives located have imperfect protoconchs. The best preserved specimen is the paralectotype which has most of the protoconch preserved, and although it is rather decorticated, it is just possible to see faint ribbing on part of the protoconch (R. Gatto, in litt.). This places this species in the genus *Microdrillia* Casey, 1903 which has an axially-ribbed protoconch, rather than the very similar genus *Cochlespirella* Casey, 1903 from the American Eocene which has a smooth protoconch.

Vaught (1989) gives *Microdrillia* as a synonym of *Drilliola* Cossmann, 1903, but these genera are distinguished by their protoconchs: in *Microdrillia* the protoconch has ribs, while in *Drilliola* it is bicarinate but otherwise smooth.

**Range:** *Barnea* bed (rare).

**Palaeoecology:** vermivore.

***Amblyacrum leptocolpa* (Cossmann, 1889) \***

1889 *Raphitoma leptocolpa* Cossmann, p. 291, pl. 9, fig.

43.

1981b *Raphitoma leptocolpa* Cossmann; Gougerot & Le Renard, p. 75, fig. 5.

**Remarks:** this species' range in mainland Europe is Early Eocene (Ypresian), Cuise, Verneuil, Liancourt-Saint-Pierre, (Paris Basin) France.

**Range:** division C1 (rare).

**Palaeoecology:** vermivore.

**Family PYRAMIDELLIDAE**

***Cossmannica agassizi* (Le Renard, 1994) \***

Plate 13, fig. 1.

1862 *Pyramidella eburnea* Deshayes, pp. 585-586; pl. 21, figs 26-27.

1994 *Tiberia* (*Cossmannica*) *agassizi* [nom. subst.] Le Renard, p. 38.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** the majority of Recent pyramidellids are ectoparasitic on a variety of invertebrates, most often annelid worms and larger molluscs (Fretter *et al.*, 1986: 645).

***Odostomia lignitarum* Deshayes, 1861**

Plate 13, fig. 2.

**Range:** divisions B2 to C1 inclusive (uncommon).

**Palaeoecology:** parasite.

***Odostomia cf. cuisensis* Cossmann, 1888**

Plate 13, fig. 3.

cf. 1888 *Odostomia lignitarum* var. *cuisensis* Cossmann, p. 105, pl. 4, fig. 26.

**Range:** division B2 (uncommon)

**Palaeoecology:** parasite.

***Odostomia* sp. 1** - range: *Barnea* bed (common) Plate 13, fig. 6.

***Odostomia* sp. 2** - range: *Barnea* bed to Division C1 (uncommon) Plate 13, figs 7-8.

***Odostomia* sp. 3** - range: *Barnea* bed (uncommon) Plate 13, fig. 5.

**Remarks:** These are probably undescribed species, however the available material is too poor to allow their description on that basis alone. Study of these pyramidellids is ongoing elsewhere.

**Palaeoecology:** parasites.

***Odostomia* spp.**

**Range:** division B2 inclusive (frequencies unknown).

**Palaeoecology:** parasites.

**Remarks:** this encompasses a number of immature and incomplete *Odostomia* which cannot be satisfactorily assigned to any existing taxa nor readily distinguished from one-another, although several species-level taxa are probably present. Better material is required for more accurate determination.

***Brachystomia* sp.**

Plate 13, fig. 9.

**Range:** *Barnea* bed to division C1 (uncommon).

**Palaeoecology:** parasite.

***Sinustomia* sp.**

Plate 13, fig. 4.

**Range:** *Barnea* bed (common).

**Palaeoecology:** parasite.

***Syrnola* cf. *spina* (Deshayes, 1824) \***

Plate 13, fig. 10.

**Remarks:** A very small, narrow *Syrnola* with flattened whorls and smooth, almost flush sutures. This strongly resembles subadult examples of *S. spina* from the Middle Eocene Selsey Formation of West Sussex, but as the apex is eroded in all the Swanwick examples they cannot be fully compared.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** parasite.

***Syrnola angusta* (Deshayes, 1861)**

Plate 13, fig. 11.

**Range:** division B2 (uncommon).

**Palaeoecology:** parasite.

***Anisocyclus scalarina* (Deshayes, 1861) \***

Plate 13, fig. 12.

**Range:** division B2 (uncommon).

**Palaeoecology:** parasite.

***Murchisonella emarginata* (Deshayes, 1861) \***

Plate 13, fig. 13.

**Range:** division B2 (uncommon).

**Palaeoecology:** parasite.

***Turbonilla* (s.l.) sp.**

Plate 13, fig. 14.

**Remarks:** the single example from Lower Swanwick compares well with a specimen from the Early Eocene Harwich Formation of Upnor, Kent; differing only in its weaker costae.

**Range:** *Barnea* bed (rare).

**Palaeoecology:** parasite.

**Family ARCHITECTONICIDAE**

***Stellaxis bistratus* (Deshayes, 1832)**

Plate 14, figs 1-3.

**Range:** *Barnea* bed (uncommon).

**Palaeoecology:** carnivorous browser: coelenterates.

***Granosolarium pulchrum* (J. de C. Sowerby in Dixon, 1850)**

Plate 14, figs 4-6.

1965 *Architectonica pulchra* (J. de C. Sowerby); Curry & King, pp. 33-34.

**Range:** division B2 inclusive (uncommon).

**Palaeoecology:** carnivorous browser: coelenterates.

**Family MATHILDIDAE**

***Mathilda* sp.**

Plate 14, fig. 7.

**Range:** division B2 (uncommon).

**Palaeoecology:** carnivorous browser: coelenterates.

**Family ACTEONIDAE**

***Acteon* sp.**

Plate 14, fig. 8.

**Range:** division B2 (uncommon), division C1 (uncommon).

**Palaeoecology:** infaunal vermivore.

***Crenilabium elongatum* (J. de C. Sowerby, 1824)**

Plate 14, fig. 9.

**Range:** division B2 (rare).

**Palaeoecology:** infaunal vermivore.

***Tornatellaea simulata* (Solander in Brander, 1766)**

Plate 14, fig. 10.

**Range:** division B2 (rare)

**Palaeoecology:** infaunal vermivore.

**Family RINGICULIDAE**

***Ringicula turgida* (J. Sowerby, 1817)**

Plate 14, fig. 11.

**Range:** division B2 inclusive (common), division C1 (uncommon).



**Palaeoecology:** vermivore

**Family CYLICHNIDAE**

*Scaphander cf. polysarcus* Cossmann & Pissarro, 1913 \*

Pl. 14, figs 12-13.

**Remarks:** Sometimes identified in collections as *S. parisiensis*, a larger, narrower species.

**Range:** divisions B2 to C1 (uncommon).

**Palaeoecology:** infaunal molluscivore.

*Cylichna cf. angystoma* (Deshayes, 1824)

Plate 14, fig. 14.

**Range:** division B2 (uncommon), *Barnea* bed (common), division C1 (uncommon).

**Palaeoecology:** infaunal molluscivore.

**RETUSIDAE**

*Volvulella oxyacrum* (Cossmann, 1889)

Plate 14, fig. 15.

**Range:** *Barnea* bed (rare).

**Palaeoecology:** infaunal vermivore.

**LIMACINIDAE**

*Limacina mercinensis* (Watelet & Lefèvre, 1880)

Plate 15, fig. 1.

**Remarks:** the example illustrated (Pl. 15, fig. 1) consists only of the immature whorls of the shell, infilled with framboidal pyrite.

**Range:** division B2 (uncommon).

**Palaeoecology:** pelagic herbivorous ciliary-feeder.

**CEPHALOPODA**

**Family NAUTILIDAE**

*Euciphoceras regale* (J. Sowerby, 1822)?

**Remarks:** This record is based on a poorly preserved specimen from division C1 at Lower Swanwick, which is tentatively assigned to this species.

**Range:** division C1 (rare).

**Palaeoecology:** free-swimming predator.

**Family HERCOGLOSSIDAE**

*Cinomia imperialis* (J. Sowerby, 1812)

Plate 15, figs 7-8.

1949 *Nautilus imperialis* J. Sowerby; Wrigley, p. 16.

**Range:** divisions B2-C1 (uncommon).

**Palaeoecology:** free-swimming predator.

*Deltoidonautilus sowerbyi* (J. de C. Sowerby, 1843)

Plate 15, figs 9-10.

**Range:** division C1 (frequency uncertain).

**Palaeoecology:** free-swimming predator.

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**REFERENCES**

- ADAMS, H. & ADAMS, A. A. 1853. *The genera of recent Mollusca; arranged according to their organization*. London. Vol.1, xl, 484.
- ALDRICH, T. H. 1885. Notes on the Tertiary of Alabama and Mississippi, with descriptions of new species. *The Journal of the Cincinnati Society of Natural History*, 8(2): 145-155, pls 2-3.
- ALDRICH, T. H. 1911. New Eocene fossils from the southern Gulf states. *Bulletin of American Paleontology*, (No. 22), 5: 1-25, pls 1-5.
- ARCHIAC, E. J. d' 1843. Description géologique de l'Aisne. *Mémoires de la Société Géologique de France*, 5(2): 129-421, tabs A-D, pls A-K, 1 map.
- ARUA, I. & HOQUE, M. 1989. Predatory gastropod boreholes in an Eocene molluscan assemblage from Nigeria. *Lethaia*, 22(1): 49-59.
- BALUK, W. & RADWANSKI, A. 1991. A new occurrence of fossil acrothoracican cirrepedes: *Trypetesa polonica* sp. n. In hermitted gastropod shells from the Korytnica Basin (Middle Miocene; Holy Cross Mountains, Central Poland), and its bearing on behavioural evolution of the genus *Trypetesa*. *Acta Geologica Polonica*, 41(1-2): 1-36.
- BARTRUM, J. A. & POWELL, A. W. B. 1928. Mollusca from the Kaawa Creek beds, West Coast, South of Waikato River. *Transactions and Proceedings of the New Zealand Institute*, 59: 139-162, pls 25-31.
- BERG, C. J. & NISHENKO, S. 1975. Stereotypy of predatory boring behaviour of Pleistocene naticid gastropods. *Paleobiology*, 1(3): 258-260.
- BOURY, E. DE 1887. *Description de Scalidae nouveaux des Couches Eocènes du Bassin de Paris et Revision de quelques espèces mal connues*. Paris. 56pp.
- BOURY, E. DE 1899. Revision des pleurotomes Éocènes du Bassin de Paris. *La Feuille des Jeunes Naturalistes*, 339: 33-46, 62-65, 83-88, 103-107, 115-123, 130-134, 153-160, 172-174, pls 1-3.
- BRANDER, G. 1766. *Fossilia Hantoniensia collecta, et in Musaeo Britannica deposita*. London. i-vi, 43 pp., pls 1-9.
- BRIART, A. & CORNET, F.-L. 1887. Descriptions des fossiles du Calcaire Grossier de Mons. Quatrième Partie. Gastéropodes. Ordre I. - Prosobranches. Section B. - Holostomes. Ordre II - Pulmonés. Ordre III - Opisthobranches. *Mémoires de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique*, 47 (7): 1-128, pls 19-26.
- BROMLEY, R. G. 1981. Concepts in ichnotaxonomy illustrated by small round holes in shells. *Acta Geologica Hispanica*, 16(1-2):

55-64.

- BROMLEY, R. G. 1993.** Predation habits of octopus past and present and a new ichnospecies, *Oichnus ovalis*. *Bulletin of the Geological Society of Denmark*, **40**: 167-173.
- CASEY, T. L. 1903.** Notes on the Conrad collection of Vicksburg fossils, with descriptions of new species. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **55**(1): 261-283.
- CASEY, T. L. 1904.** Notes on the Pleurotomidae with descriptions of some new genera and species. *Transactions of the Academy of Science of St. Louis*, **14**(5): 123-170.
- CHAVAN, A. 1965.** Essai de reclassification des Olividae Ancillinae (Gastropodes). *Bulletin de la Société Géologique de France*, (7), **7**: 102-109.
- CONRAD, T. A. 1848.** Observations on the Eocene formation, and descriptions of one hundred and five new fossils of that period, from the vicinity of Vicksburg, Mississippi; with an appendix. *Journal of the Academy of Natural Sciences of Philadelphia*, (2nd series), **1**(2): 111-134, pls 11-14
- CONRAD, T. A. 1865a.** Catalogue of the Eocene and Oligocene Testacea of the United States. *American Journal of Conchology*, **1**(1): 1-35.
- CONRAD, T. A. 1865b.** Descriptions of new Eocene shells of the United States. *American Journal of Conchology*, **1**(2): 142-149, pls 10-11.
- COOPER, J. 1984.** A review of the London Clay (Eocene) Mollusca of the cliffs and shore of the Isle of Sheppey, Kent, England. *Tertiary Research*, **6**(1): 5-9.
- COSSMANN, M. 1886.** Catalogue Illustré des Coquilles Fossiles de l'Eocène des environs de Paris. 1. *Annales de la Société Royale Malacologique de Belgique*, **21**: 17-186, pls 1-8.
- COSSMANN, M. 1887.** Catalogue Illustré des Coquilles Fossiles de l'Eocène des environs de Paris. 2. *Annales de la Société Royale Malacologique de Belgique*, **22**: 3-214, pls 1-8.
- COSSMANN, M. 1888.** Catalogue Illustré des Coquilles Fossiles de l'Eocène des environs de Paris. 3. *Annales de la Société Royale Malacologique de Belgique*, **23**: 1-328, pls 1-12.
- COSSMANN, M. 1889.** Catalogue Illustré des Coquilles Fossiles de l'Eocène des environs de Paris. 4. *Annales de la Société Royale Malacologique de Belgique*, **24**: 3-381, pls 1-12.
- COSSMANN, M. 1903.** *Essais de Paléoconchologie Comparée* 5. Paris. 215pp, 16 figs, 9 pls.
- COSSMANN, M. 1907.** Catalogue Illustré des Coquilles Fossiles de l'Eocène des environs de Paris. Appendice 4. *Annales de la Société Royale Zoologique et Malacologique de Belgique*, **41**: 186-286, pls 5-10.
- COSSMANN, M. 1913.** Catalogue Illustré des Coquilles Fossiles de l'Eocène des environs de Paris. Appendice 5. *Annales de la Société Royale Zoologique et Malacologique de Belgique*, **49**: 19-238, pls 1-8.
- COSSMANN, M. & PISSARRO, G. 1910-1913.** *Iconographie complète des coquilles fossiles de l'Eocène des environs de Paris. Tome 2<sup>e</sup>: Scaphopodes, Gastropodes, Brachiopodes, Céphalopodes & Supplément*. Paris. 20pp, 65 pls.
- CURRY, D. & KING, C. 1965.** The Eocene Succession at Lower Swanwick Brickyard, Hampshire. *Proceedings of the Geologists' Association*, **76**(1): 29-35.
- DALL, W. H. 1881.** Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico, and in the Caribbean Sea, 1877-79, by the United States Coast Survey steamer "Blake," Lieutenant-Commander C. D. Sigsbee, U.S.N., and Commander J. R. Bartlett, U.S.N., Commanding. 15. Preliminary report on the Mollusca. *Bulletin of the Museum of Comparative Zoology at Harvard College, in Cambridge*, **9**(2): 33-144.
- DAVIES, A. M. 1935.** *Tertiary faunas. Volume 1. The composition of Tertiary faunas*. London. i-xi, 406 pp., text figs 1-568.
- DEFRANCE, J. L. M. 1816-1830.** *Dictionnaire des Sciences Naturelles* Paris & Strasbourg.
- DESHAYES, G. P. 1824-1837.** *Description des Coquilles Fossiles des Environs de Paris*. Paris. **1**(1-26): 392 pp., pls 1-65. **2**(2-46): 814 pp., pls 1-103.
- DESHAYES, G. P. 1856-1866.** *Description des Animaux sans Vertèbres découverts dans le bassin de Paris*. Paris. **1**(1-20): 912 pp., pls 1-87. **2**(21-44): 968 pp., pls 1-62. **3**(45-50): 658 pp., pls 63-107 & index etc.
- DILLWYN, L. W. 1817.** *A descriptive catalogue of Recent shells*. London. I-xii, 1092 pp.
- DIXON, F. 1850.** *The geology and fossils of the Tertiary and Cretaceous formations of Sussex*. London. xvi, 423 pp, 40 pls.
- DOCKERY, D. T. III 1993.** The streptoneuran gastropods, exclusive of the Stenoglossa, of the Coffee Sand (Campanian) of northeastern Mississippi. *Mississippi Department of Environmental Quality, Office of Geology, Bulletin*, **129**: 1-191.
- EDWARDS, F. E. 1855.** A Monograph of the Eocene Mollusca, or descriptions of shells from the older Tertiaries of England. Part 3, no. 1. Prosobranchiata. *Palaeontographical Society, (Monographs)*: 123-180, pls 16-23.
- EDWARDS, F. E. 1857-61.** A Monograph of the Eocene Mollusca, or descriptions of shells from the older Tertiaries of England. Part 3(2-3) Prosobranchiata (continued). *Palaeontographical Society, (Monographs)*: 181-330, pls 24-33.
- FRETTER, V. & GRAHAM, A. 1982.** The prosobranch molluscs of Britain and Denmark. Part 7 - 'Heterogastropoda' (Cerithiopsacea, Triforacea, Epitoniacea, Eulimacea). *The Journal of Molluscan Studies. Supplement 11*, 363-434, figs 257-309.
- FRETTER, V., GRAHAM, A. & ANDREWS, E. 1986.** The prosobranch molluscs of Britain and Denmark. Part 9 - Pyramidellacea. *The Journal of Molluscan Studies. Supplement 16*, 557-649, figs 377-451.
- GABB, W. M. 1860.** Descriptions of new species of American Tertiary and Cretaceous fossils. *Journal of the Academy of Natural Sciences of Philadelphia*, (2nd series), **4**(4): 375-406, pls 67-69.
- GABB, W. M. 1864.** Description of the Cretaceous Fossils. *Palaeontology of California*, **1**(4): 55-243, pls 9-32.
- GALE, A. S. 1995.** Taxonomy of London Clay (Eocene) Teredinidae (Mollusca, Bivalvia) from southeast England. *Proceedings of the Geologists' Association*, **106**(2): 137-143.
- GATTO, R. 1991.** *Paradrilliola* and *Helicodrillia*: two new genera of Turridae (Mollusca: Gastropoda) from the European Tertiary. *Memorie di Scienze Geologiche*, **43**: 233-259, 5 figs, pls 1-6.
- GLIBERT, M. 1938.** Faune malacologique des Sables de Wemmel, II: gastropodes, scaphopodes, céphalopodes. *Mémoires du Musée Royal d'Histoire Naturelle de Belgique*, **85**: 1-190, pls 1-4.
- GLIBERT, M. 1960a.** Les Volutacea fossiles du Cénozoïque étranger des collections de l'Institut Royal des Sciences Naturelles de Belgique. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique*, (2), **61**: 1-109.
- GLIBERT, M. 1960b.** Les Conacea fossiles du Cénozoïque étranger des collections de l'Institut Royal des Sciences Naturelles de Belgique. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique*, (2), **64**: 1-132.
- GLIBERT, M. 1963.** Les Muricacea et Buccinacea fossiles du Cénozoïque étranger des collections de l'Institut Royal des Sciences Naturelles de Belgique. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique*, (2), **74**: 1-179.
- GLIBERT, M. 1973.** Revision des Gastropoda du Danien et du Montien de la Belgique. 1. Les Gastropoda du Calcaire de Mons. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique*, (2), **173**: 1-116, pls 1-11.
- GLIBERT, M. & VAN DE POEL, L. 1965a.** Les Bivalvia fossiles du Cénozoïque étranger des collections de l'Institut Royal des Sciences Naturelles de Belgique. I Palaeotaxodontida et Eutaxodontida. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique*, (2), **77**: 1-112.
- GLIBERT, M. & VAN DE POEL, L. 1965b.** Les Bivalvia fossiles du Cénozoïque étranger des collections de l'Institut Royal des Sciences Naturelles de Belgique. II Pteronchida, Colloconchida et Isofilibranchida. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique*, (2), **78**: 1-105.

- GLIBERT, M. & VAN DE POEL, L. 1970.** Les Bivalvia fossiles du Cénozoïque étranger des collections de l'Institut Royal des Sciences Naturelles de Belgique. VI (fin) Oligodontina (2) Astartodontina et Septibranchida. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique*, (2), **84**: 1-185.
- GOUGEROT, L. 1968.** Quelques espèces nouvelles de Mollusques de l'Eocène du Bassin de Paris. (Colloque sur l'Eocène) *Mémoires du Bureau de Recherches Géologiques et Minières*, **58**: 221-243, 2 pls.
- GOUGEROT, L. & LE RENARD, J. 1981a.** Clefs de détermination des petits espèces de Gastéropodes de l'Eocène du Bassin Parisien. Part XIV - La famille Cerithiopsidae. *Cahiers des Naturalistes. Bulletin des Naturalistes Parisiens*, **36**(2): 17-38.
- GOUGEROT, L. & LE RENARD, J. 1981b.** Clefs de détermination des petits espèces de Gastéropodes de l'Eocène du Bassin Parisien. Part XV - les genres *Raphitoma* et *Mangelia*. *Cahiers des Naturalistes. Bulletin des Naturalistes Parisiens*, **36**(4): 69-82.
- GRAHAM, A. 1955.** Molluscan diets. *Proceedings of the Malacological Society of London*, **31**(3-4): 144-159.
- GRAVES, L. 1847.** *Essai sur la topographie géognostique du Département de l'Oise*. Beauvais. xv, 804 pp.
- GRAY, J. E. 1847.** A list of the genera of Recent Mollusca, their synonyms and types. *Proceedings of the Zoological Society of London*, **15**: 229-239.
- HICKMAN, C.S. 1994.** The Genus *Parvilucina* in the Eastern Pacific: making evolutionary sense of a chemosymbiotic species complex. *The Veliger*, **37**(1): 43-61.
- JAMES, J. P. 1974.** Report of Field Meeting to Lower Swanwick, Hampshire. October 7th, 1972. *Tertiary Times*, **2**(1): 23-28.
- JAMES, J. P., WARD, D. J. & COOPER, J. 1974.** A Temporary Exposure of Fossiliferous London Clay (Eocene) at Shinfield, Berkshire. *Proceedings of the Geologists' Association*, **85**(1): 49-64.
- KELLEY, P. H. 1991.** Apparent cannibalism by Chesapeake Group naticid gastropods: a predictable result of selective predation. *Journal of Paleontology*, **65**(1): 75-79.
- KEMP, D. & KING, C. 1995.** The London Clay Formation (Early Eocene) of the Civil Aviation Authority site, Lower Swanwick, Hampshire, England. *Tertiary Research*, **15**(4): 191-198.
- KING, C. 1981.** The stratigraphy of the London Clay and associated deposits. *Tertiary Research Special Papers*, **6**: 1-158.
- KITCHELL, J. A., BOGGS, C. H., KITCHELL, J. F. & RICE, J. A. 1981.** Prey selection by naticid gastropods: experimental tests and application to the fossil record. *Paleobiology*, **7**(4): 533-552.
- KOENEN, A. VON, 1890.** Das Norddeutsche Unter-Oligocän und seine Mollusken-Fauna. Part 2: Conidae - Volutidae - Cypraeidae. *Abhandlungen geologischen Specialkarte von Preussen und den Thüringischen Staaten*, **10**(2): 281-574, pls 24-39.
- LAMARCK, J. B. DE 1802-1809.** Mémoires sur les fossiles des environs de Paris. *Annales de Muséum National d'Histoire Naturelle*, **1-14**: 1-380, 28 pls.
- LAMARCK, J. B. DE 1815-1822.** *Histoire Naturelle des Animaux sans Vertèbres*. Paris. 7 vols.
- LAUBRIÈRE, L. DE & CAREZ, L. 1880.** Sur les Sables de Brasles, Aisne. *Bulletin de la Société Géologique de France*, (3rd Series), **8**(6): 391-413, pls 15-16.
- LEFEVRE, T. & WATELET, A. 1877.** Addition a la faune tertiaire du Bassin de Paris. Description de deux Solens Nouveaux. *Annales de la Société Malacologique de Belgique*, **12**: 1-7, pl. 1.
- LE RENARD, J. 1994.** Révision des mollusques Paléogènes du Bassin de Paris I - rectifications de nomenclature d'espèces. *Cossmanniana*, **3**(2): 35-40.
- LEYMERIE, M. A. 1842.** Suite de mémoire sur le terrain Crétacé du département de l'Aube. *Mémoires de la Société Géologique de France*, **5**: 1-34.
- LOWRY, J. W., ETHERIDGE, R. & EDWARDS, F. E. 1866.** *Figures of the characteristic British Tertiary Fossils, (chiefly Mollusca) stratigraphically arranged*. London.
- MANTELL, G. 1833.** *The geology of the south-east of England*. London. xix, 415 pp.
- MARSHALL, B. A. 1978.** Cerithiopsidae of New Zealand, and a provisional classification of the family. *New Zealand Journal of Zoology*, **5**(1): 47-120, figs. 1-19.
- MAYER, K. 1877.** Systematisches Verzeichniss der Versteinerungen des Parisian der Umgegend von Einseideln. *Beiträge zur Geologischen Karte der Schweiz*, **14**(2): 1-100, pls 1-4.
- MEGERLE VON MÜHLFELD, J. K. 1811.** Entwurf eines neuen System's der Schalthiergehäuse. *Magazin Gesellschaft Naturforschender Freunde zu Berlin*, **5**: 38-72.
- MILLER, J. A. 1989.** The toxoglossan proboscis: structure and function. *Journal of Molluscan Studies*, **55**(2): 167-181.
- MONTEROSATO, T. A. di 1884.** *Nomenclatura generica e specifica di alcune conchiglie Mediterranee*. Palermo. 152 pp.
- NEWTON, R. B. 1891.** *Systematic list of the Frederick E. Edwards collection of British Oligocene and Eocene Mollusca in the British Museum (Natural History), with references to the type-specimens from similar horizons contained in other collections belonging to the Geological Department of the Museum*. British Museum (Natural History). London. xxviii, 365 pp, 1 table.
- NEWTON, R. B. & HARRIS, G. F. 1894.** A Revision of the British Eocene Scaphopoda, with Descriptions of Some New Species. *Proceedings of the Malacological Society of London*, **1**(2): 63-77, pl. 6.
- ORBIGNY, A. D' 1850-1852.** *Prodrome de Paléontologie Stratigraphique universelle des animaux mollusques et rayonnés*. Paris, **2**: 428 pp. **3**: 196 pp.
- PACAUD, J.-M. & MARCOMINI, J.-L. 1994.** Présence d'*Atrina affinis* (Sowerby, 1821) (Mollusca: Bivalvia: Pinnidae), espèce de l'Eocène Anglais, dans l'Auvergnien du Bassin de Paris. *Cossmanniana*, **3**(2): 41-44, 5 figs.
- PHILIPPI, R. A. 1847.** Verzeichniss der in der Gegend von Magdeburg aufgefundenen Tertiärversteinerungen. *Palaeontographica*, **1**(1): 42-90, pls 7-10.
- PILKINGTON, W. 1804.** Description of some Fossil Shells found in Hampshire. *Transactions of the Linnaean Society of London*, **7**: 116-118, pl. 2.
- PILSBRY, H. A. & OLSSON, A. A. 1952.** Vitrinellidae of the Panamic Province: II. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **104**: 35-88, pls 1-13.
- PONDER, W. F. & WARÉN, A. 1988.** Classification of the Caenogastropoda and Heterostropha - a list of family-group names and higher taxa. In: Ponder, W. F. (ed.) *Prosobranch phylogeny: Proceedings of a Symposium held at the 9th International Malacological Congress, Edinburgh*. *Malacological Review, Supplement*, **4**: 288-328.
- POWELL, A. W. B. 1966.** The Molluscan families Speightiidae and Turridae. An evaluation of the valid taxa, both Recent and fossil, with lists of characteristic species. *Bulletin of the Auckland Institute and Museum*, **5**: 184 pp., pls 1-23.
- RAINCOURT, M. DE 1885.** Description d'espèces nouvelles ou incomplètement connues du bassin de Paris. *Bulletin de la Société Géologique de France, (3rd Series)*, **13**: 469-474, pl. 15.
- RÉCLUZ, C. A. 1843.** Monographie de genre *Syndosmya*, et examen des genres *Ligule*, *Abra* et *Amphidesme*. *Revue Zoologique par la Société Cuvierienne*, **6**: 292-299, 359-369.
- REID, C. 1902.** The Geology of the Country Around Southampton. *Memoirs of the Geological Survey. England and Wales*, i-iv, 70 pp.
- ROUAULT, A. 1848.** Description des fossiles du terrain Éocène des environs de Pau. *Mémoires de la Société Géologique de France, (2nd series)*, **3**(7): 457-502, pls 14-18.
- SCHUMACHER, H. C. F. 1817.** *Essai d'un nouveau système des habitations des Vers testacés*. Copenhagen. iv, 287 pp, 22 pls.
- SOWERBY, J. 1812-1822.** *The Mineral Conchology of Great Britain*. London. **1-4**(1-66): pls 1-383.
- SOWERBY, J. DE C. 1823-1846.** *The Mineral Conchology of Great Britain*. London. **4-7**(67-113): pls 384-648.

- SOWERBY, J. DE C. 1837.** Description of the new species and varieties figured in plates VIII and IX, in WETHERELL, T. H. Observations on a well dug on the south side of Hampstead Heath. *Transactions of the Geological Society of London*, (2nd series), **5** (1): 131-136, pls 8-9.
- STINTON, F. C. 1963.** On the occurrence of the genus *Barnea* in the English Eocene. *Proceedings of the Malacological Society of London*, **35**(2-3): 67-70, pls 8 & 9.
- STOLICZKA, F. 1870-1871.** Cretaceous fauna of southern India. The Pelecypoda, with a review of all known genera of this class, fossil and recent. *Memoirs of the Geological Survey of India. Palaeontologia Indica First Series*, **3**: I-xxii, 1-537, pls 1-50.
- SWAINSON, W. 1840.** *A treatise on malacology; or the natural classification of shells and shell-fish.* London. viii, 419 pp.
- TAYLOR, J. 1978.** Cenozoic. In McKerrow, W. S. (ed.) *The ecology of fossils an illustrated guide.* London, pp. 323-351.
- TAYLOR, J. D., MORRIS, N. J. & TAYLOR, C. N. 1980.** Food specialisation and the evolution of predatory prosobranch gastropods. *Palaeontology*, **23**(2): 375-409.
- TAYLOR, J. D., KANTOR, Y. I. & SYSOEV, A. V. 1993.** Foregut anatomy, feeding mechanisms, relationships and classification of the Conoidea (=Toxoglossa) (Gastropoda). *Bulletin of the Natural History Museum London (Zoology)*, **59**(2): 125-170.
- THIELE, J. 1928.** Revision des Systems der Hyrobiiden und Melaniiden. *Zoologische Jahrbücher, Abteilung für Systematik*, **55**: 351-402, tab. 8.
- THORNE, P. 1984.** The pearl as a fossil. *Jewelry Making, Gems and Minerals*, **555**: 14-15, 54-55, 68.
- TRACEY, S. 1992.** A review of the Early Eocene molluscs of Bognor Regis (Hampshire Basin), England. *Tertiary Research*, **13** (2-3): 155-175.
- TRACEY, S., TODD, J. A. & ERWIN, D. H. 1993.** Mollusca: Gastropoda, pp. 131-167 In Benton, M. J. (ed.) *The Fossil Record* 2. London. 845 pp.
- TRAUB, F. 1989.** Weitere Paläozän-Gastropoden aus dem Helvetikum des Haunsberges nördlich von Salzburg. *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie*, **29**: 85-104, pls 1-3.
- VAUGHT, K. C. 1989.** *A classification of the living Mollusca.* Melbourne, Florida. xii, 195 pp.
- VENABLES, E. M. 1963.** The London Clay of Bognor Regis. *Proceedings of the Geologists' Association*, **73**(3): 245-272, pl. 11.
- VOKES, H. E. 1939.** Molluscan faunas of the Domengine and Arroyo Hondo Formations of the California Eocene. *Annals of the New York Academy of Sciences*, **38**: 1-246, pls 1-22.
- VOKES, H. E. 1971.** Catalogue of the genus *Murex* Linné (Mollusca: Gastropoda); Muricinae, Ocenebrinae. *Bulletins of American Palaeontology*, (No. 268), **61**: 1-141.
- WALKER, S. E. 1992.** Criteria for recognising marine hermit crabs in the fossil record using gastropod shells. *Journal of Palaeontology*, **66**(4): 535-558.
- WARÉN, A. 1983.** A generic revision of the family Eulimidae (Gastropoda, Prosobranchia). *The Journal of Molluscan Studies. Supplement* **13**. 1-96, figs 1-230.
- WATELET, A. 1851.** Recherches dans les sables tertiaires des environs de Soissons. *Bulletin de la Société Historique, Archéologique et Scientifique de Soissons*, **5**: 113-126, pls 1-2.
- WATELET, A. & LEFEVRE, T. 1880.** Note sur des Pteropodes du genre *Spiralis* découverts dans le Bassin de Paris. *Annales de la Société Malacologique de Belgique*, **15**: 100-103, pl. 5.
- WOOD, S. V. 1861-77.** A Monograph of the Eocene Mollusca, or, descriptions of shells from the older Tertiaries of England. Bivalves. **1**(1-3): 1-182, pls 1-25 & supplement: I-ii, 1-24, pls A, B. *Palaeontographical Society, (Monographs)*.
- WRIGHT, C. A. 1972.** Foraminiferids from the London Clay at Lower Swanwick and their Palaeoecological Interpretation. *Proceedings of the Geologists' Association*, **83**(3): 337-347.
- WRIGLEY, A. 1925.** Notes on English Eocene and Oligocene Mollusca with descriptions of new species. *Proceedings of the Malacological Society of London*, **16**(5): 232-248.
- WRIGLEY, A. 1927.** Notes on English Eocene Mollusca with descriptions of new species. II. The Fusinidae. *Proceedings of the Malacological Society of London*, **17**(5-6): 216-249.
- WRIGLEY, A. 1929.** Notes on English Eocene and Oligocene Mollusca with descriptions of new species. III. Ficus. *Proceedings of the Malacological Society of London*, **18**(5): 235-251.
- WRIGLEY, A. 1934.** English Eocene and Oligocene Cassididae, with notes on the nomenclature and morphology of the family. *Proceedings of the Malacological Society of London*, **21**(2): 108-130, pls 15-17.
- WRIGLEY, A. 1935.** English Eocene and Oligocene Cancellariidae. *Proceedings of the Malacological Society of London*, **21**(6): 356-381, pls 32-35.
- WRIGLEY, A. 1938.** English Eocene and Oligocene Strombidae and Aporrhaidae. *Proceedings of the Malacological Society of London*, **23**(2): 61-88, pls 4-6.
- WRIGLEY, A. 1940.** Some Eocene Mollusca with descriptions of new species. *Proceedings of the Malacological Society of London*, **24**(1): 6-17.
- WRIGLEY, A. 1946.** English Eocene and Oligocene Ampullinids. *Proceedings of the Malacological Society of London*, **27**(2): 88-104.
- WRIGLEY, A. 1949.** The London Clay at Lower Swanwick, Hampshire. Appendix, 13-19. In THOMAS, H. D. & DAVIES, A. G., The Pterobranch *Rhabdopleura* in the English Eocene. *Bulletin of the British Museum (Natural History) (Geology)*, **1**(1): 1-29.
- WRIGLEY, A. 1951.** Some Eocene Serpulids. *Proceedings of the Geologists' Association*, **62**(3): 177-202.
- YONGE, C. M. & THOMPSON, T. E. 1976.** *Living marine molluscs.* London. 299 pp, 16 pls, 162 figs.
- YOUNG, G. & BIRD, J. 1828.** *A Geological Survey of the Yorkshire Coast.* Second Edition. Whitby. iv, 367 pp, 19 pls.

**PLATES:**

Pages 109 to 137

140 species-level taxa are figured photographically. The figures are a mixture of scanning electron micrographs (SEMs) and conventional light macrophotographs. The majority of SEMs were imaged using back-scattered electrons and were taken by the authors using an ISI ABT-55 scanning electron microscope with environmental chamber in the Natural History Museum's Electron Microscope Unit. The specimens were not coated. All SEM magnifications are approximate, within an indeterminate margin of error of  $c.\pm 5\%$

Figure 7, plate 7, and figures 7-9, plate 8 are secondary electron micrographs, taken by J. Todd at the Institute of Earth Studies, University of Wales, Aberystwyth, the specimens were sputter-coated with gold/palladium.

The light macrophotographs were taken by Mr. P. Crabb of the Natural History Museum's Photographic Unit.

A minority of specimens were dusted with ammonium chloride sublimate.

All figured specimens are from the London Clay Formation of Lower Swanwick unless otherwise stated.

**Key to abbreviations:**

**SEM:** scanning electron micrograph.

**LV:** left valve

**RV:** right valve

**Juv.:** juvenile.

**Div.:** Division.

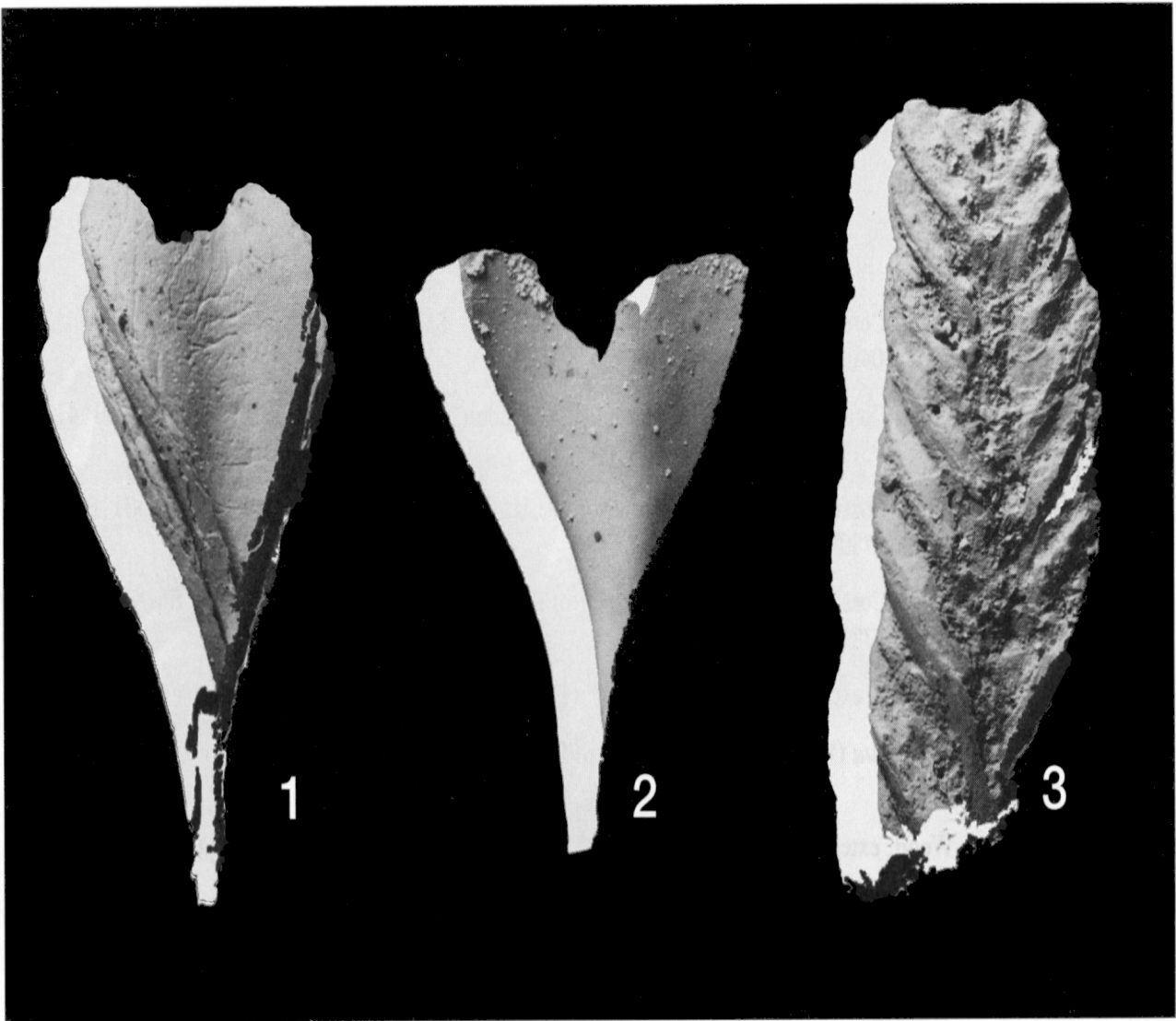
**Coll.:** collection.

**BMNH:** denotes the register number of specimens in the Department of Palaeontology, NHM, London.

**Neg#:** Refers to the negative number of SEMs, held by the Electron Microscope Section of the Photographic Unit at the NHM, London.

**Explanation of Plate 2****Figure:**

1. *Nucinella aff. ovalina* **Cossmann**, interior of incomplete RV, adult, SEM  $\times 50$ . Div. B2. BMNH PI TB 412, J. Cooper coll. Neg# 17804.
2. *Nucinella aff. ovalina* **Cossmann**, interior of incomplete LV, adult, SEM  $\times 50$ . Div. B2. BMNH PI TB 413, J. Cooper coll. Neg# 17805.
- 3, 5. *Nucinella aff. ovalina* **Cossmann**, interior and exterior of LV, subadult, SEM  $\times 50$ . Div. B2. BMNH PI TB 414, J. Cooper coll. Negs# 17803, 18762.
- 4, 6. *Nucinella aff. ovalina* **Cossmann**, interior and exterior of RV, subadult, SEM  $\times 50$ . Div. B2. BMNH PI TB 415, J. Cooper coll. Negs# 17802, 18761.
- 7, 8. *Yoldiella oblata* (**Wood**), exterior and interior of LV,  $\times 10$ . Div. B2. BMNH LL41632, E. M. Venables coll.
9. *Mesosaccella partimstriata* (**Wood**), exterior of crushed RV (of pair) on matrix block,  $\times 4$ . Div. B2. BMNH LL17698, C. King coll.
- 10, 11. *Nucula curvata* **Wood**, exterior and interior of RV,  $\times 2$ . Div. B2. BMNH LL17691, C. King coll.
- 12, 13. *Cucullaria tumescens* (**Wood**), exterior and interior of LV,  $\times 5$ . Div. B2. BMNH LL41614, P. Jeffery coll.
- 14, 15. *Glycymeris brevirostris* (**J. de C. Sowerby**), exterior and interior of RV,  $\times 2$ . Div. B2. BMNH LL41615, P. Jeffery coll.



#### Explanation of Plate 1

##### Figure

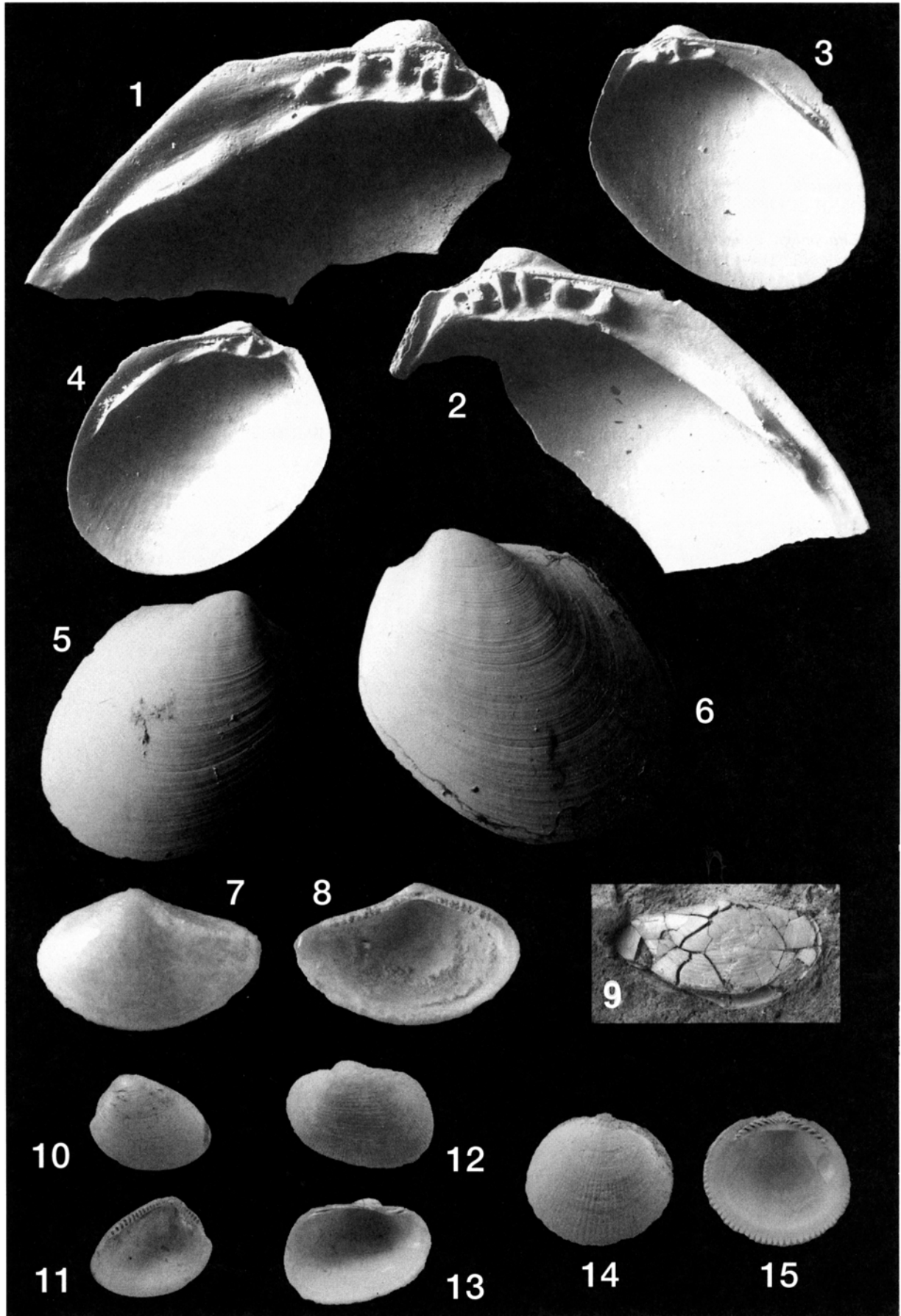
1. *Bankia* sp., internal face of incomplete pallet consisting of 2 elements. SEM x20. Div. C1. BMNH PI TB 435. A. Lawson coll. Neg# 22335.
2. *Bankia* sp., external face of incomplete pallet consisting of a single element. SEM x20. Div. C1. BMNH PI TB 436. A. Lawson coll. Neg# 22332.
3. *Nausitora wrigleyi* Gale, internal face of incomplete and abraded pallet, consisting of numerous fused elements. SEM x20. Div. C1. PI TB 434. A. Lawson coll. Neg# 22329.

## Explanation of Plate 3

## Figure:

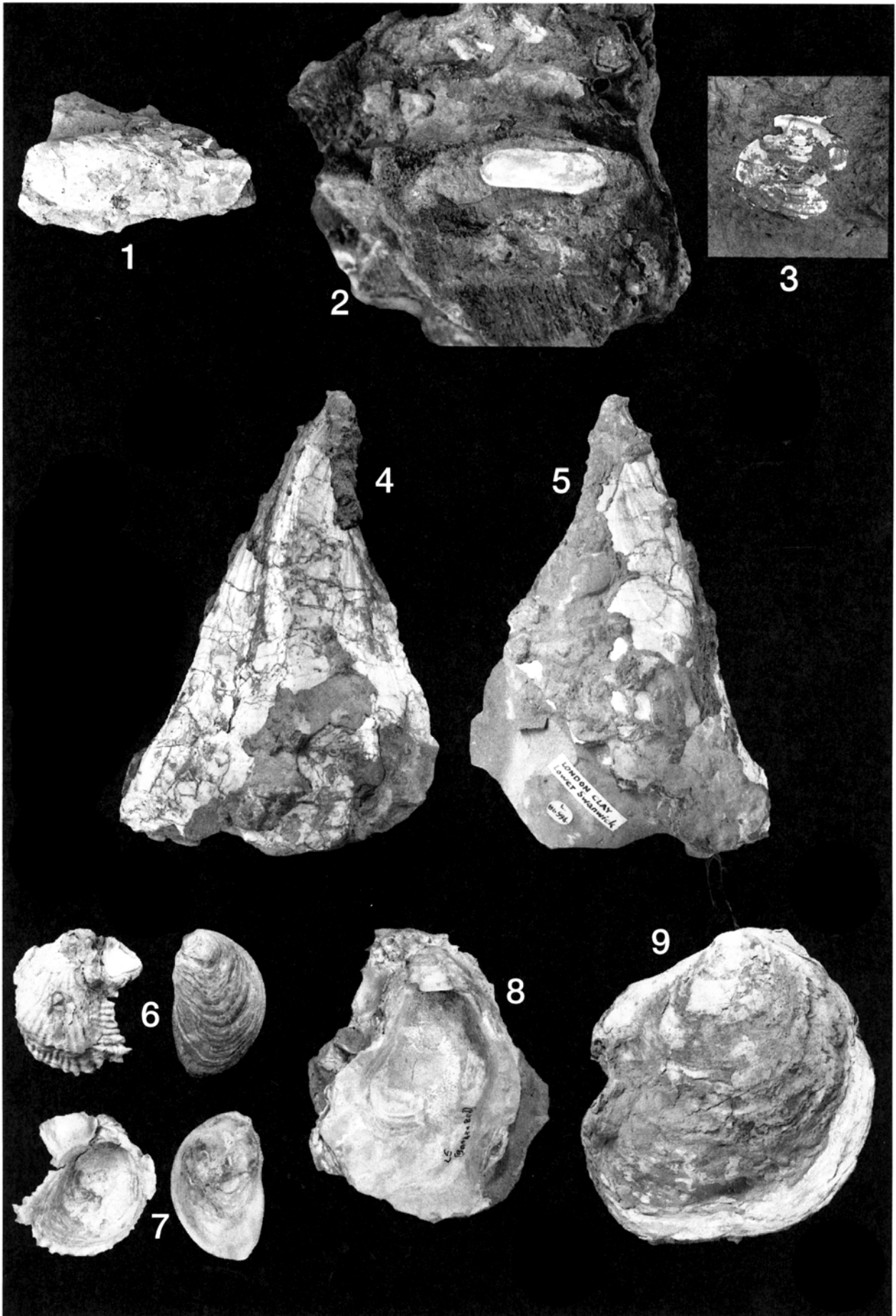
1. *Amygdalum* cf. *simplex* (J. de C. Sowerby), exterior of severely crushed LV (of pair) on matrix block, x1. Div. B2. BMNH LL17696, C. King coll.
2. "*Lithophaga*" *tubicola* (Wood), exterior of LV (of pair) *in situ* in a teredinid tube on a small block of bored lignitic wood, x2. Div. C1. BMNH LL41616, A. Wrigley coll.
3. "*Pteria*" *papyracea* (J. de C. Sowerby), interior of ?RV on a concretionary matrix block, x1. Div. C1. BMNH PI TB 416, D. Kemp coll.
- 4, 5. *Atrina affinis* (J. Sowerby), exterior of RV and exterior of LV, x0.5. Div. C1. BMNH L86596, A. Wrigley coll.
- 6, 7. *Cubitostrea multcostata* (Deshayes), exterior of RV & LV, and interior of RV and LV, x1. Div. B2. BMNH LL41631, J. P. James coll.
8. *Crassostrea* cf. *tenera* (J. Sowerby), interior of LV, x0.5. *Barnea* bed. BMNH PI TB 417, C. King coll.
9. *Pycnodonte* cf. *gryphovicinus* (Wood), exterior of RV in place on LV, x0.5. Div. C1. BMNH PI TB 418, D. Kemp coll.





**Explanation of Plate 4****Figure:**

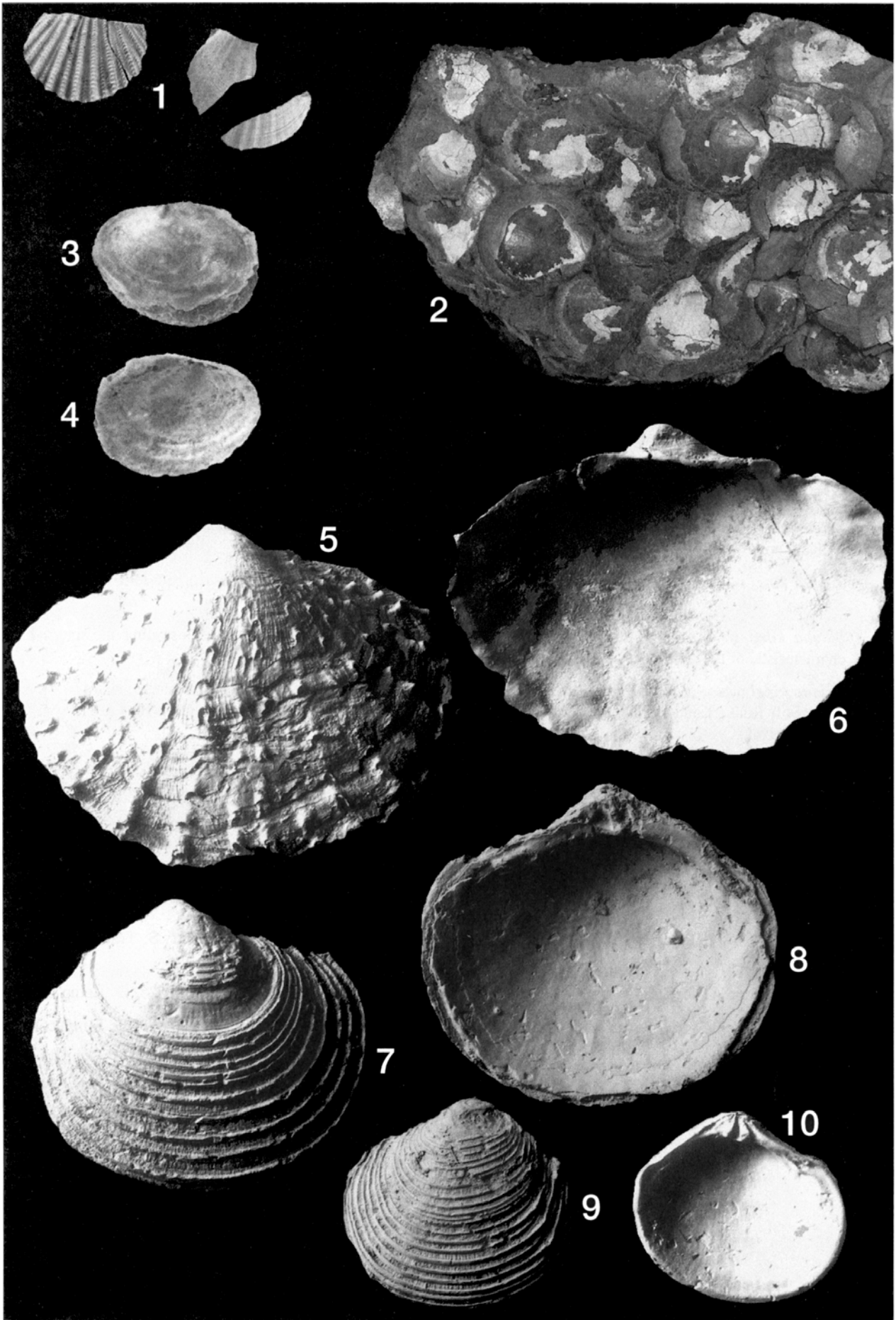
1. *Cyclopecten duplicatus* (J. de C. Sowerby), incomplete LV and RV,  $\times 2$ . Div. B2. BMNH PI TB 419, J. P. James coll.
2. *Lentipecten corneus* (J. Sowerby), shell plaster,  $\times 1$ . Div. C1. BMNH PI TB 420, A. Wrigley coll.
- 3, 4. *Anomia anomialis* (Lamarck), exterior and interior of LV,  $\times 5$ . Div. B2. BMNH PI TB 421, P. Jeffery coll.
- 5, 6. *Heteranomia scabrosa* (Wood), exterior and interior of LV, SEM  $\times 30$ . Div B2. BMNH PI TB 422, J. Cooper coll. Negs# 17793, 17978.
- 7, 8. *Parvilucina seminulum* (Deshayes), exterior and interior of RV, SEM  $\times 30$ . *Barnea* bed. BMNH PI TB 423, S. Tracey coll. Negs# 17795, 18759.
- 9, 10. *Parvilucina seminulum* (Deshayes), exterior and interior of LV, SEM  $\times 30$ . *Barnea* bed. BMNH PI TB 424, S. Tracey coll. Negs# 18760, 17796.



## Explanation of Plate 5

## Figure:

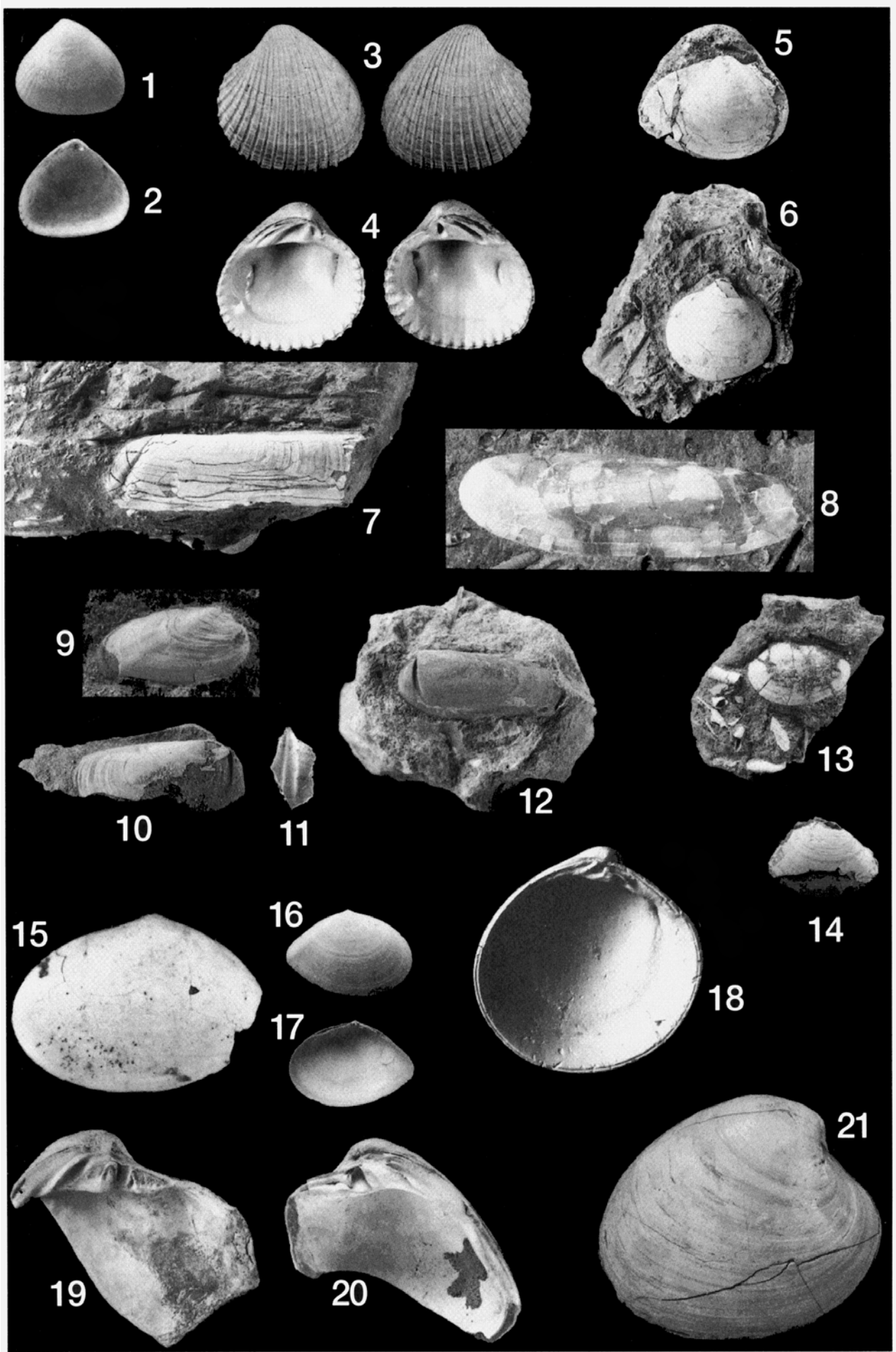
- 1, 2. *Semeloidea curryi* n. sp., holotype, exterior and interior of LV,  $\times 4$ . *Barnea* bed. BMNH LL41613, A. Wrigley coll.
- 3, 4. *Venericor brongniartii clarendonensis* (Wood), exteriors and interiors of LV & RV (from same individual),  $\times 1$ . Div. B2. BMNH LL41617, J. P. James coll.
5. *Nemocardium nitens* (J. Sowerby), exterior of damaged LV on matrix block,  $\times 2$ . Div. B2. BMNH LL17693, C. King coll.
6. *Nemocardium semiasperum* (Deshayes), exterior of damaged LV on matrix block,  $\times 1$ . *Barnea* bed. BMNH LL41623, C. King coll.
7. *Solena (Eosolen) laversinensis* (Lefèvre & Watelet), exterior of incomplete LV on matrix block,  $\times 1$ . *Barnea* bed. BMNH LL41618, C. King coll.
8. *Cultellus affinis* (J. Sowerby), exterior of RV on concretionary matrix block,  $\times 3$ . Div. B2. BMNH PI TB 425, D. Kemp coll.
9. *Siliqua kingi* n. sp., holotype, exterior of incomplete RV on a matrix block,  $\times 3$ . *Barnea* bed. BMNH LL 41610, C. King coll.
10. *Siliqua kingi* n. sp., paratype, exterior of incomplete RV on a matrix block,  $\times 2$ . *Barnea* bed. BMNH LL 41611, S. Tracey coll.
11. *Siliqua kingi* n. sp., paratype, interior of a fragment of the previous specimen, demonstrating the internal rib characteristic of the genus,  $\times 4$ . *Barnea* bed. BMNH LL41611, S. Tracey coll.
12. *Siliqua kingi* n. sp., paratype, internal cast of LV (of pair) on a matrix block, showing the internal rib as a groove,  $\times 2$ . Soft Rock, London Clay Formation, Division A3, Bognor Regis, West Sussex. BMNH L 53134, E. M. Venables coll.
13. *Tellina* (s.l.) sp. 2, exterior of LV on pyritic matrix block,  $\times 1$ . *Barnea* bed. BMNH LL41619, C. King coll.
14. *Tellina* (s.l.) sp. 1, exterior of incomplete RV (of pair),  $\times 1.5$ . Div. B2. BMNH LL41622, S. Tracey coll.
15. *Abra (Syndosmya) splendens* (J. de C. Sowerby), exterior of damaged LV (of pair),  $\times 10$ . Div. B2. BMNH PI TB 426, A. Wrigley coll.
- 16, 17. *Abra (Syndosmya) cygnea* n. sp., holotype, exterior and interior of RV,  $\times 3$ . *Barnea* bed. BMNH LL41612, C. King coll.
18. *Lutetia parisiensis* Deshayes, interior of LV, SEM  $\times 30$ . *Barnea* bed. BMNH PI TB 427, S. Tracey coll. Neg# 16005.
19. *Arctica planata* (J. de C. Sowerby), interior of incomplete LV,  $\times 1$ . Div. B2. BMNH LL41626, D. Kemp coll.
20. *Arctica planata* (J. de C. Sowerby), interior of incomplete RV,  $\times 1$ . Div. B2. BMNH LL41625, D. Kemp coll.
21. *Arctica planata* (J. de C. Sowerby), exterior of RV (of pair),  $\times 1$ . Div. B2. BMNH LL41624, D. Kemp coll.



## Explanation of Plate 6

## Figure:

- 1, 2. *Pitar (Calpitaria) sulcatarius* (Deshayes), exterior and interior of LV,  $\times 2$ . Div. B2. BMNH PI TB 428, J. Cooper coll.
- 3, 4. *Pitar (Calpitaria) sulcatarius* (Deshayes), exterior and interior of RV,  $\times 2$ . Div. B2. BMNH LL41620, J. P. James coll.
- 5, 6. *Varicorbula globosa* (J. Sowerby), exterior and interior of LV,  $\times 7$ . *Barnea* bed. BMNH PI TB 429, P. Jeffery coll.
- 7, 8. *Varicorbula globosa* (J. Sowerby), exterior and interior of RV,  $\times 7$ . *Barnea* bed. BMNH PI TB 430, P. Jeffery coll.
- 9, 10. *Caestocorbula clarendonensis* (Wrigley), exterior of LV and exterior of RV (of pair),  $\times 3$ . *Barnea* bed. BMNH LL41627, C. King coll.
- 11, 12. *Bicorbula gallicula* (Deshayes), exterior and interior of RV,  $\times 4$ . *Barnea* bed. BMNH PI TB 431, S. Tracey coll.
13. *Panopea intermedia* (J. Sowerby), exterior of LV of internal cast (some shell remaining),  $\times 1$ . Div. C1. BMNH PI TB 432, A. Wrigley coll.
14. *Teredina personata* (Lamarck), valves and calcareous tubes *in situ* in a concretionary/lignitic block,  $\times 1$ . Div. C1. BMNH PI TB 433, A. G. Davis coll.
15. *Cyrtopleura levesquei* (Watelet), exterior of incomplete RV (of pair) on a pyritic matrix block,  $\times 1$ . *Barnea* bed. BMNH LL41628, C. King coll.
16. *Pholadomya (Pholadomya) virgulosa* J. de C. Sowerby, exterior of LV (of pair),  $\times 1$ . Div. C1. BMNH LL41629, A. Wrigley coll.
17. *Pholadomya (Bucardiomya) margaritacea* (J. Sowerby), exterior of LV (of pair),  $\times 1$ . Div. C1. BMNH LL41630, A. G. Davis coll.

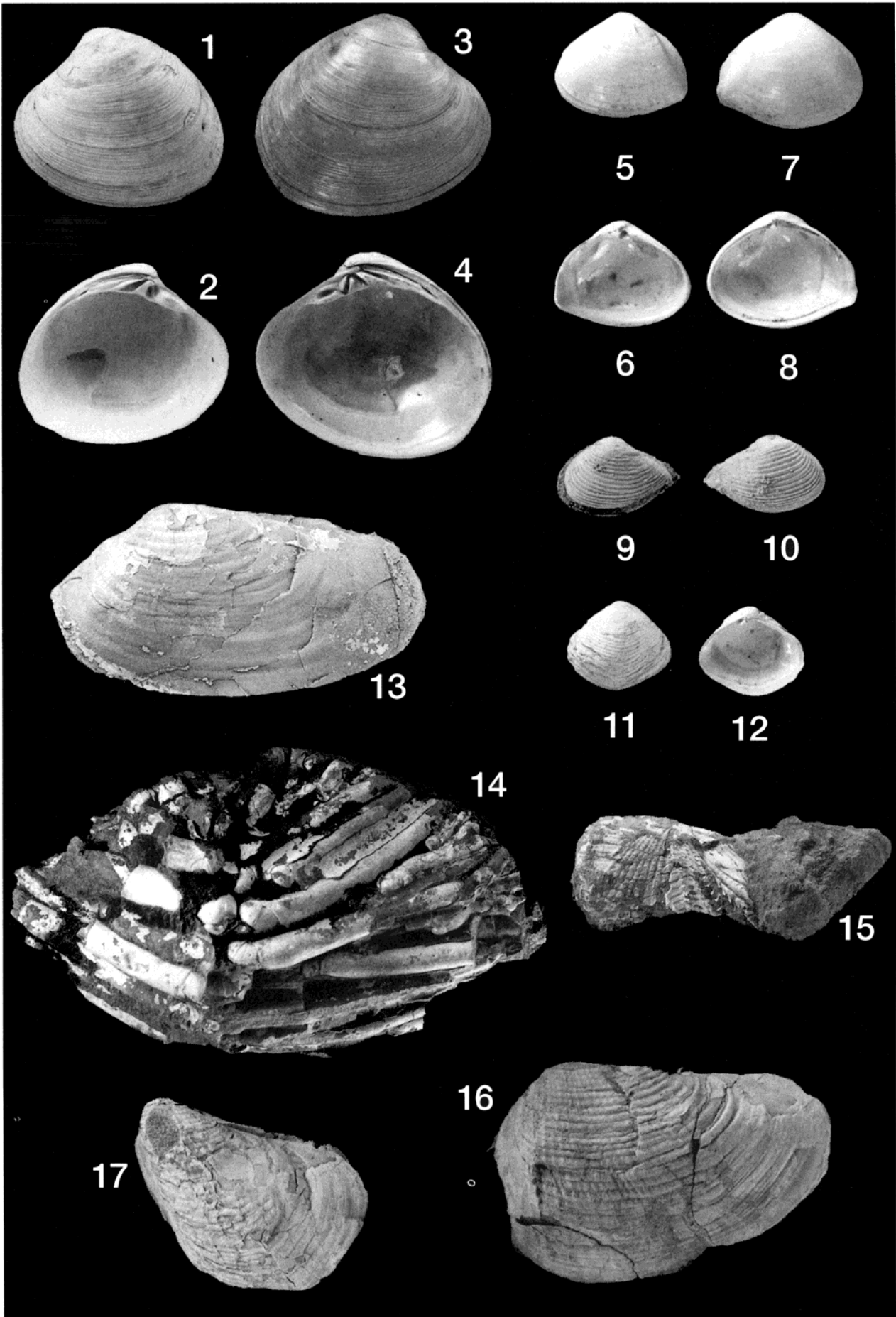


## Explanation of Plate 7

## Figure:

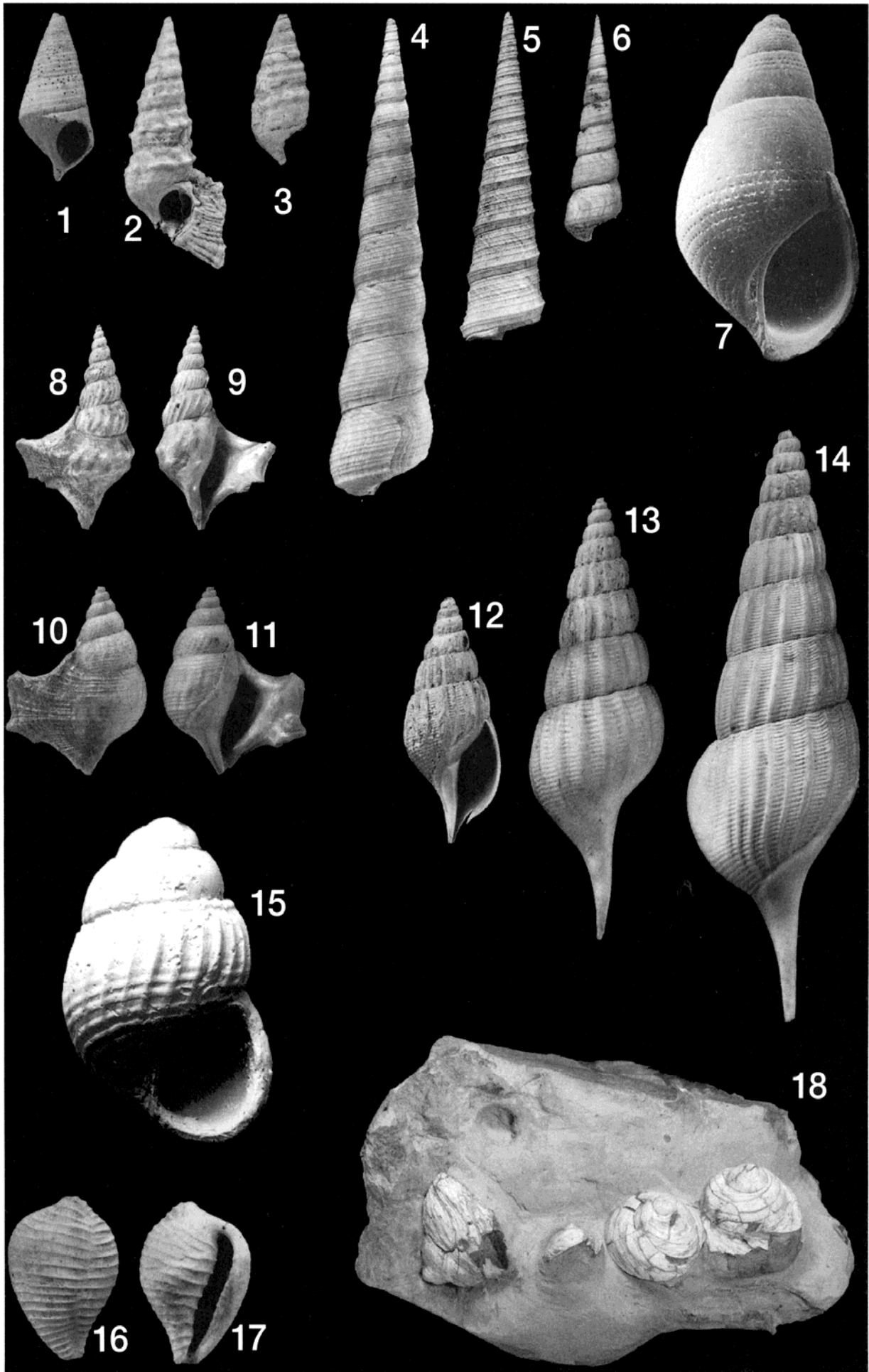
1. *Hemisinus pistati* (Cossmann), apertural view,  $\times 2$ . *Barnea* bed. BMNH GG14574, S. Tracey coll.
2. *Batillaria* (*Vicinocerithium*) *subacuta* (d'Orbigny), apertural view, with attached *Cubitostrea multicostrata*,  $\times 1$ . *Barnea* bed. BMNH GG14576, C. King coll.
3. *Tympanotonos* (*Eotympanotonus*) cf. *papalis* (Deshayes), apertural view (aperture largely absent),  $\times 1$  *Barnea* bed. BMNH GG14575, C. King coll.
4. *Ispharina* aff. *sulcifera* (Deshayes), abapertural view,  $\times 1$ . Div. B2. BMNH PI TG 1070, A. Wrigley coll.
5. *Haustator dixonii* (Deshayes), ?abapertural view (apertural region lost),  $\times 1.5$ . Div B2. BMNH PI TG 1071, J. Cooper coll.
6. *Haustator circumdatus* (Deshayes), abapertural view,  $\times 1$ . Div B2. BMNH PI TG 1072, A. Wrigley coll.
7. *Entomope semipunctata* n. sp., holotype, apertural view, SEM  $\times 20$ . *Barnea* bed. BMNH GG14542, S. Tracey coll.
- 8, 9. *Aporrhais sowerbii constrictus* Wrigley, abapertural and apertural views,  $\times 1$ . Div. B2. BMNH GG14577, J. Cooper coll.
- 10, 11. *Aporrhais clarendonensis* Wrigley, abapertural and apertural views,  $\times 2$ . Div. B2. BMNH GG14578, A. Wrigley coll.
12. *Tibia* (*Eotibia*) *sublucida* (Edwards), apertural view,  $\times 4$ . Div. B2. BMNH PI TG 1075, J. P. James coll.
13. *Tibia* (*Eotibia*) *sublucida* (Edwards), abapertural view,  $\times 4$ . Div. B2. BMNH PI TG 1074, A. Wrigley coll.
14. *Tibia* (*Eotibia*) *sublucida* (Edwards), apertural view of damaged specimen (most of aperture missing),  $\times 4$ . Div. B2. BMNH PI TG 1073, D. Kemp coll.
15. *Alvania* sp., apertural view, SEM  $\times 40$ . Div. B2. BMNH PI TG 1076, J. Cooper coll, Neg# 17971.
- 16, 17. *Eratotrivia prestwichii* (Edwards), abapertural and apertural views,  $\times 4$ . Div. B2. BMNH PI TG 1077, D. Bone coll.
18. *Sigapatella echinulata* (J. Sowerby), four individuals more-or-less in life position on a specimen of *Atrina* (this is largely obscured by the concretionary matrix, but a cross-section of parts of the ends of the valves is just visible at the bottom right of the matrix block),  $\times 0.5$ . Div. C1. BMNH PI TG 1078, D. Kemp coll.





**Explanation of Plate 8****Figure:**

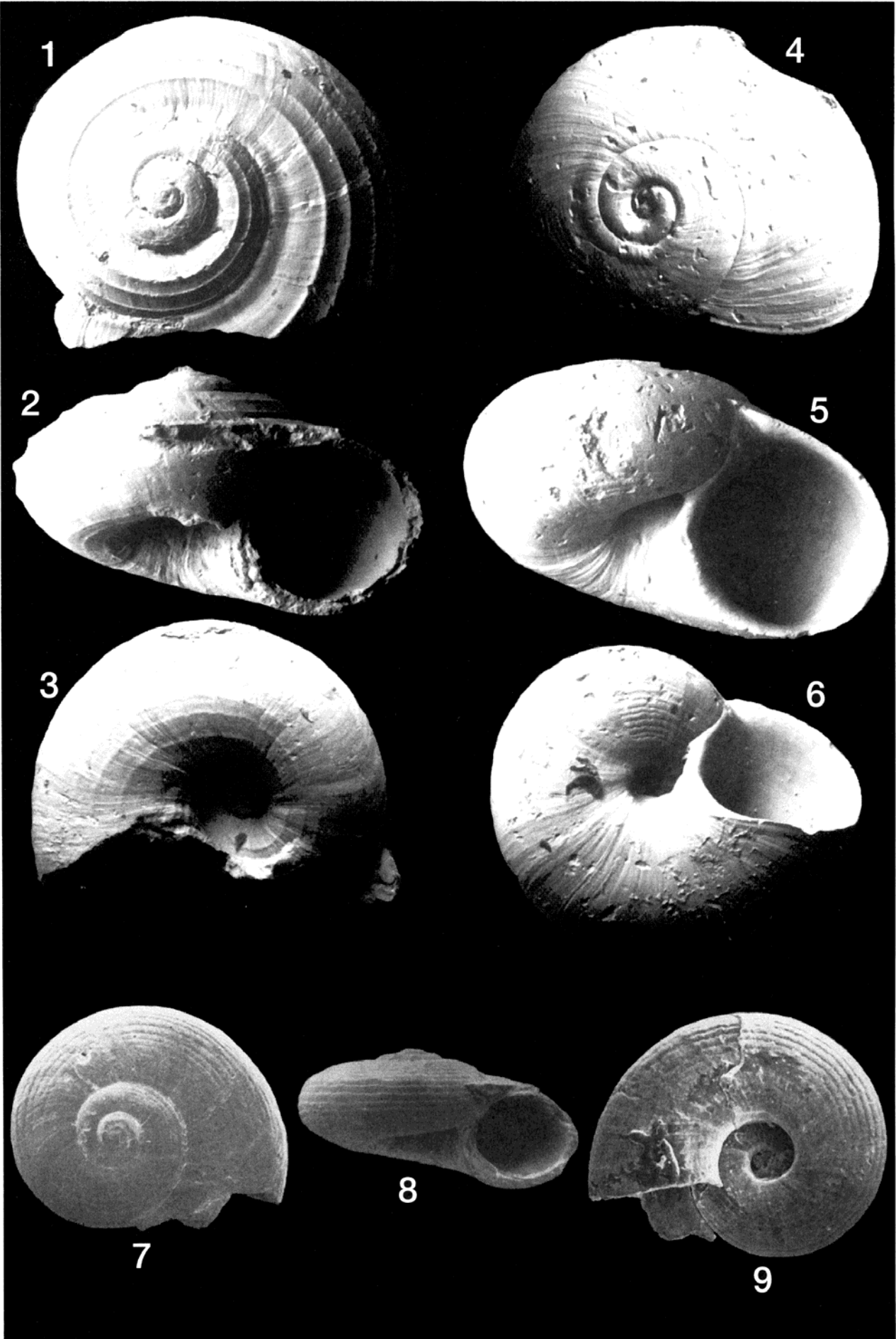
- 1 - 3.** *Adeorbis planorbularis paucicostatus* (Deshayes), apical, oblique apertural and basal views, SEM  $\times 35$ . *Barnea* bed. BMNH PI TG 1079, S. Tracey coll. Negs# 17994, 17969, 18006.
- 4 - 6.** *Teinostoma* (s.l.) *intercallosum* (Gougerot), apical, oblique apertural and basal views, SEM  $\times 60$ . *Barnea* bed. BMNH PI TG 1080, S. Tracey coll. Negs# 17996, 17970, 18007.
- 7 - 9.** *Solariorbis lawsoni* n. sp., holotype, apical, apertural and basal views, SEM  $\times 26$ . Div. C1. BMNH GG14545, S. Tracey coll.



## Explanation of Plate 9

## Figure:

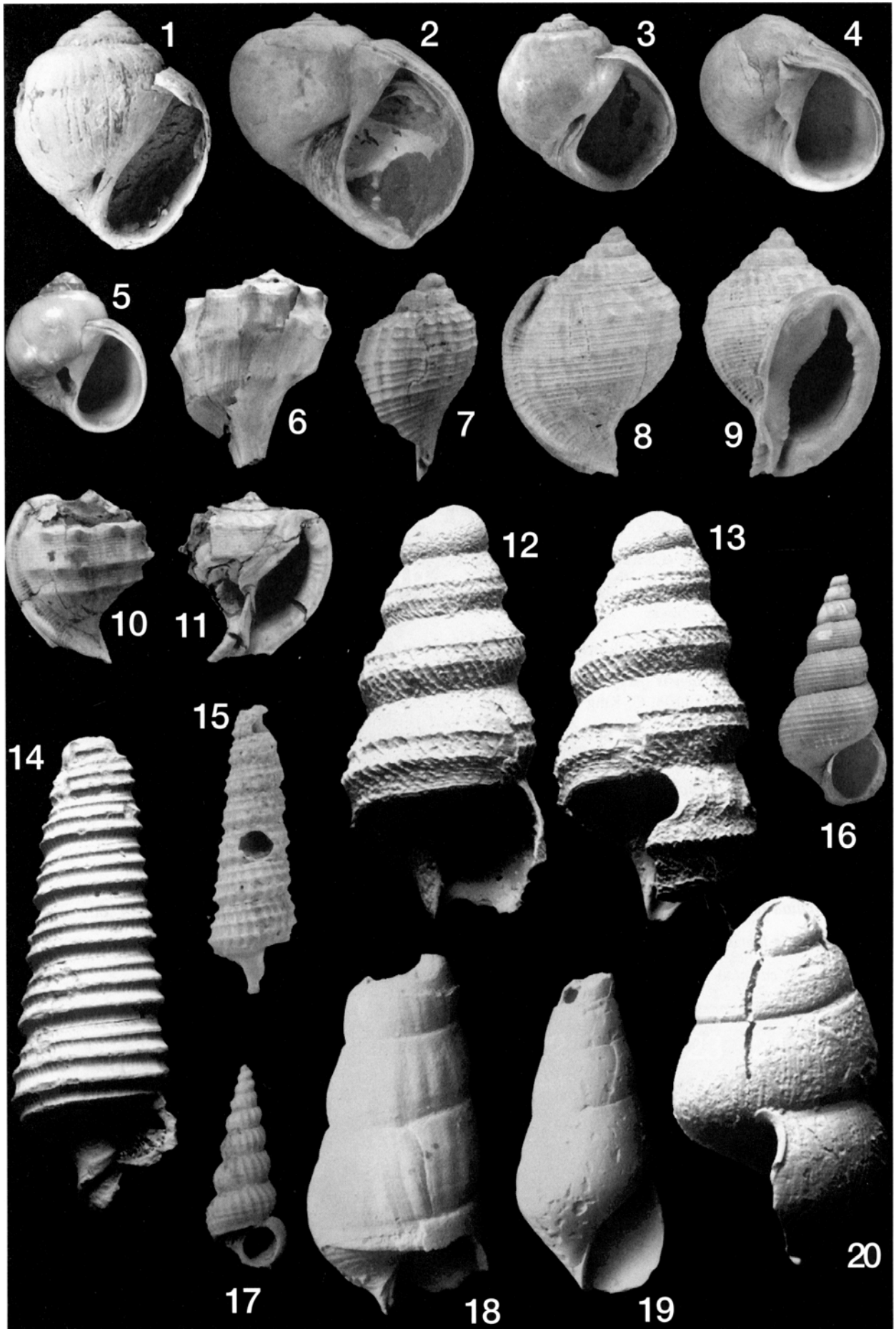
1. *Crommium lignitarum* (Deshayes), apertural view,  $\times 2$ . *Barnea* bed. BMNH PI TG 1081, P. Jeffery coll.
2. *Globularia splendida* (Deshayes), apertural view,  $\times 1$ . Div. B2. BMNH PI TG 1082, C. King coll.
3. *Ampullella adurni* (Wrigley), apertural view,  $\times 1$ . Div. B2. BMNH GG6992, C. King coll.
4. *Sigatica hantoniensis* (Pilkington), apertural view,  $\times 1$ . Div. B2. BMNH PI TG 1083, J. P. James coll.
5. *Euspira glaucinoides* (J. Sowerby), apertural view,  $\times 1.5$ . Div. B2. BMNH PI TG 1084, J. Cooper coll.
6. *Priscoficus smithii* (J. de C. Sowerby), apertural view (aperture largely lost),  $\times 0.5$ . Div. B2. BMNH PI TG 1085, D. Kemp coll.
7. *Ficopsis multiformis* (Wrigley), abapertural view,  $\times 4$ . Div. B2. BMNH PI TG 1086, J. P. James coll.
- 8, 9. *Sconsia augustana* (Wrigley), abapertural and apertural views,  $\times 2$ . Div. B2. BMNH PI TG 1087, D. Kemp coll.
- 10, 11. *Galeodea (Mambrinia) gallica* Wrigley, abapertural and apertural views of crushed specimen,  $\times 1$ . Div. B2. BMNH PI TG 1088, D. Kemp coll.
- 12, 13. *Cerithiopsis* aff. *discreta* Gougerot & Le Renard, apertural and lateral views of protoconch, SEM  $\times 100$ . Div. B2. BMNH PI TG 1089, J. Cooper coll. Negs# 17983, 18000.
14. *Seila mundula* (Deshayes), apertural view, SEM  $\times 30$ . Div. B2. BMNH PI TG 1090, J. Cooper coll. Neg# 17975.
15. *Cerithiella elongata* (Wrigley), abapertural view,  $\times 3$ . Div. B2. BMNH PI TG 1091, J. P. James coll.
16. *Littoriniscula scularioides* (J. de C. Sowerby), apertural view,  $\times 1$ . Div. B2. BMNH PI TG 1092, D. Kemp coll.
17. *Pliciscala (Rugatiscala) levesquei* (de Boury), apertural view,  $\times 5$ . Div. B2. BMNH PI TG 1093, E. M. Venables coll.
18. *Crassiscala subterranea* (Wrigley), ?lateral view (aperture mostly lost), SEM  $\times 26$ . Div. C1. BMNH PI TG 1094, S. Tracey coll. Neg# 15838.
19. *Melanella* (s.l.) sp., apertural view, SEM  $\times 26$ . *Barnea* bed. BMNH PI TG 1096, S. Tracey coll. Neg# 15839
20. *Pliciscala (Rugatiscala) levesquei* (de Boury)?, lateral view of protoconch, SEM  $\times 100$ . Div. B2. BMNH PI TG 1095, J. Cooper coll. Neg# 17999.



## Explanation of Plate 10

## Figure:

1. *Paziella subcoronata* (d'Orbigny), apertural view, ×2. Div. B2. BMNH PI TG 1097, C. King coll.
2. *Poirieria subcristata* (d'Orbigny), abapertural view, ×1. Div. B2. BMNH PI TG 1098, J. P. James coll.
- 3, 4. *Wrigleya transversaria* (Wrigley), abapertural and apertural views, ×1. Div. B2. BMNH PI TG 1099, J. Cooper coll.
- 5, 6. *Wrigleya crebrilinea* (Wrigley), abapertural and apertural views, ×1. Div. B2. BMNH PI TG 1100, J. P. James coll.
- 7, 8. *Cantharus (Eocantharus) morrisoni* (Edwards), abapertural and apertural views, ×2. Div. B2. BMNH PI TG 1101, P. Jeffery coll.
9. *Pseudoneptunea curta* (J. Sowerby), abapertural view, ×2. Div. B2. BMNH PI TG 1102, J. P. James coll.
10. *Pseudoneptunea curta* (J. Sowerby), apertural view, ×2. Div. B2. BMNH PI TG 1103, J. P. James coll.
- 11, 12. *Surculites errans* (Solander), abapertural and apertural views, ×1. Div. B2. BMNH PI TG 1104, D. Kemp coll.
- 13, 14. *Streptolathyrus cymatodis* (Edwards), abapertural and apertural views, ×2. Div. B2. BMNH PI TG 1105, J. Cooper coll.
- 15, 16. *Sycostoma bulbiforme* (Lamarck), abapertural and apertural views, ×1. Div. B2. BMNH PI TG 1106, D. Kemp coll.
17. *Cornulina minax* (Solander), abapertural view, encrusted by *Cubitostrea*, ×1. *Barnea* bed. BMNH PI TG 1107, C. King coll.
18. *Daphnobela juncea* (Solander), abapertural view, ×3. Div. B2. BMNH GG6981, C. King coll.
19. *Clavilithes cf. parisiensis* (Mayer), abapertural view of incomplete specimen encrusted with *Cubitostrea*, ×1. *Barnea* bed. BMNH PI TG 1108, C. King coll.
- 20, 21. *Volutocorbis elevata* (J. de C. Sowerby), abapertural and apertural views, ×1. Div. B2. BMNH PI TG 1109, A. G. Davis coll.
22. *Ptychatractus interruptus* (Pilkington), apertural view, ×3. Div. B2. BMNH PI TG 1110, P. Jeffery coll.
- 23, 24. *Pseudoliva laudunensis* (Defrance), juv., abapertural and apertural views, ×10. Div. C1. BMNH PI TG 1111, S. Tracey coll.
25. *Amalda arenaria* (Cossmann), apertural view, ×4. Div. B2. BMNH PI TG 1112, P. Jeffery coll.
26. *Bonellitia subevulsa* (d'Orbigny), apertural view, ×4. Div. B2. BMNH PI TG 1113, J. P. James coll.
27. *Bonellitia laeviuscula* (J. Sowerby), apertural view, ×4. Div. B2. BMNH PI TG 1114, J. P. James coll.
28. *Sveltella carinata* Wrigley, apertural view, ×6. Div. B2. BMNH PI TG 1115, J. Cooper coll.
29. *Sveltella cf. arenaria* Wrigley, apertural view, ×6. *Barnea* bed. BMNH PI TG 1116, S. Tracey coll.

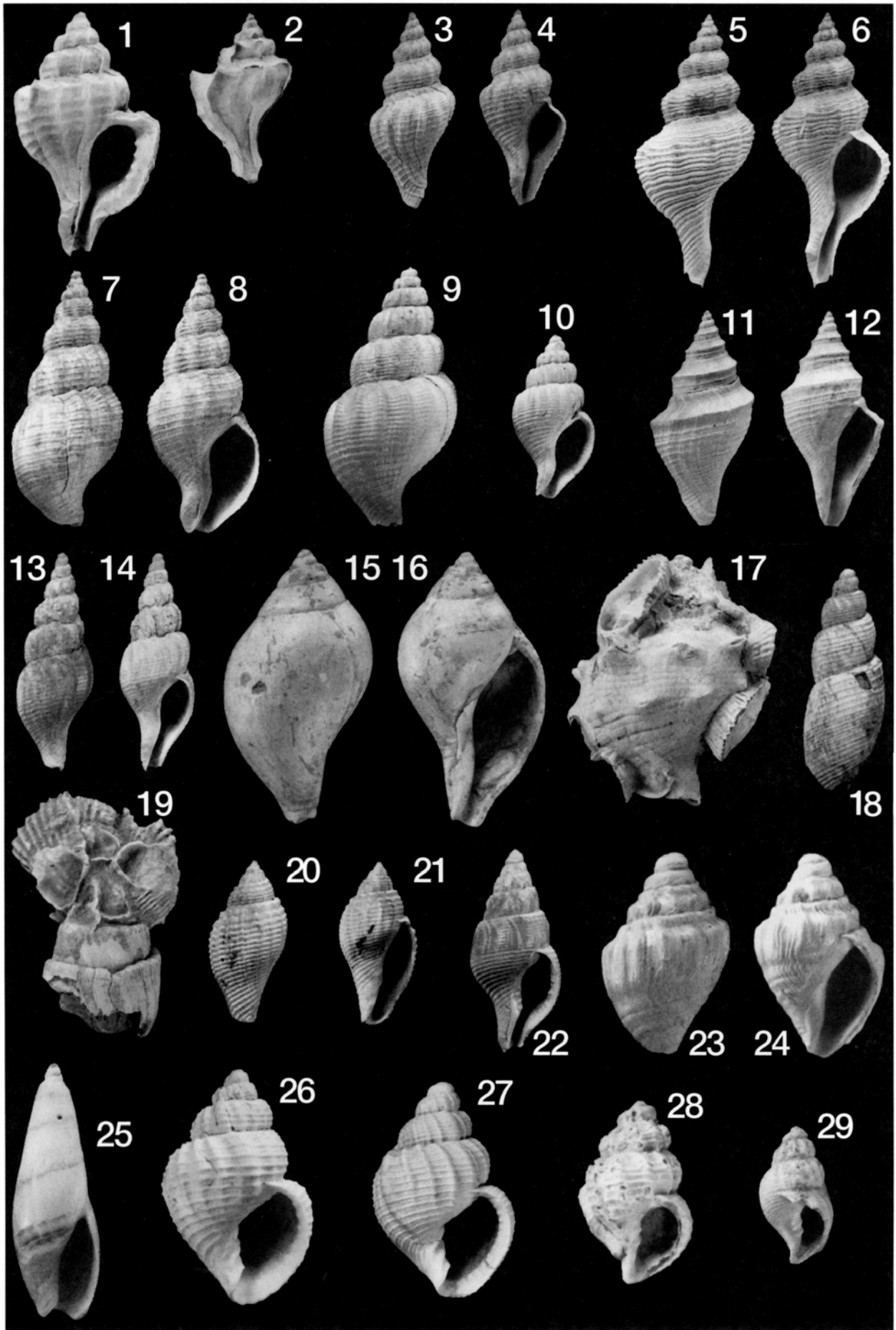


## Explanation of Plate 11

## Figure

1. *Turricula (Orthosurcula) rostrata* (Solander), holotype of *Murex rostratus* Solander in Brander, 1766, abapertural view, x1. Middle Eocene, Barton Clay Formation, "Hordwell" (Highcliffe or Barton on Sea), Hampshire. BMNH GG8284, G. Brander coll.
- 2, 3. *Turricula (Orthosurcula) rostrata* (Solander), figured by Edwards, 1857 as *Pleurotoma rostrata* (tab. XXVI, fig. 8 b-c). 2. lateral view to show profile of outer apertural lip; 3. apertural view. X1. Middle Eocene, Barton Clay Formation, Barton on Sea, Hampshire. BMNH 71228, F. E. Edwards coll.
4. *Turricula (Orthosurcula) crassa* (Edwards), abapertural view, x1. Div. B2. BMNH PI TG 1117, D. Kemp coll.
5. *Turricula (Orthosurcula) cochlis* (Edwards), abapertural view of incomplete shell, x2. Div. B2. BMNH PI TG 1118, A. Wrigley coll.
6. *Turricula (Orthosurcula) teretrium crebrilinea* (Edwards), apertural view, x1. Div. B2. BMNH PI TG 1119, D. Kemp coll.
7. *Turricula (Orthosurcula) keelei* (Edwards), abapertural view of form convergent on *O. (E.) crassa*, x1. Div. B2. BMNH PI TG 1120, D. Kemp coll.
8. *Turricula (Orthosurcula) keelei* (Edwards), abapertural view of more typical form, x1. Div. B2. BMNH PI TG 1121, D. Kemp coll.
- 9, 10. *Eosurcula stena* (Edwards), abapertural and apertural views, x1.5. Div. B2. BMNH PI TG 1122, A. Wrigley coll.
11. *Cochlespira gyrata* (Edwards), abapertural view, x2. Div. B2. BMNH PI TG 1123, P. Jeffery coll.
12. *Cochlespira pulcherrima* (Edwards), abapertural view, x2. Div. B2. BMNH PI TG 1124, J. Cooper coll.
- 13, 14. *Epalxis kempii* n. sp., holotype, abapertural and apertural views, x10. Div. B2. BMNH GG14571, P. Jeffery coll.
5. *Epalxis kempii* n. sp., paratype, abapertural view, x10. Div. B2. BMNH GG14573, P. Jeffery coll.
16. *Epalxis kempii* n. sp., paratype, abapertural view, x10. Div. B2. BMNH GG14572, J. Cooper coll.
- 17, 18. *Gemmula macrobia* (Edwards), abapertural and apertural views, x4. Div. B2. BMNH GG6983, C. King coll.

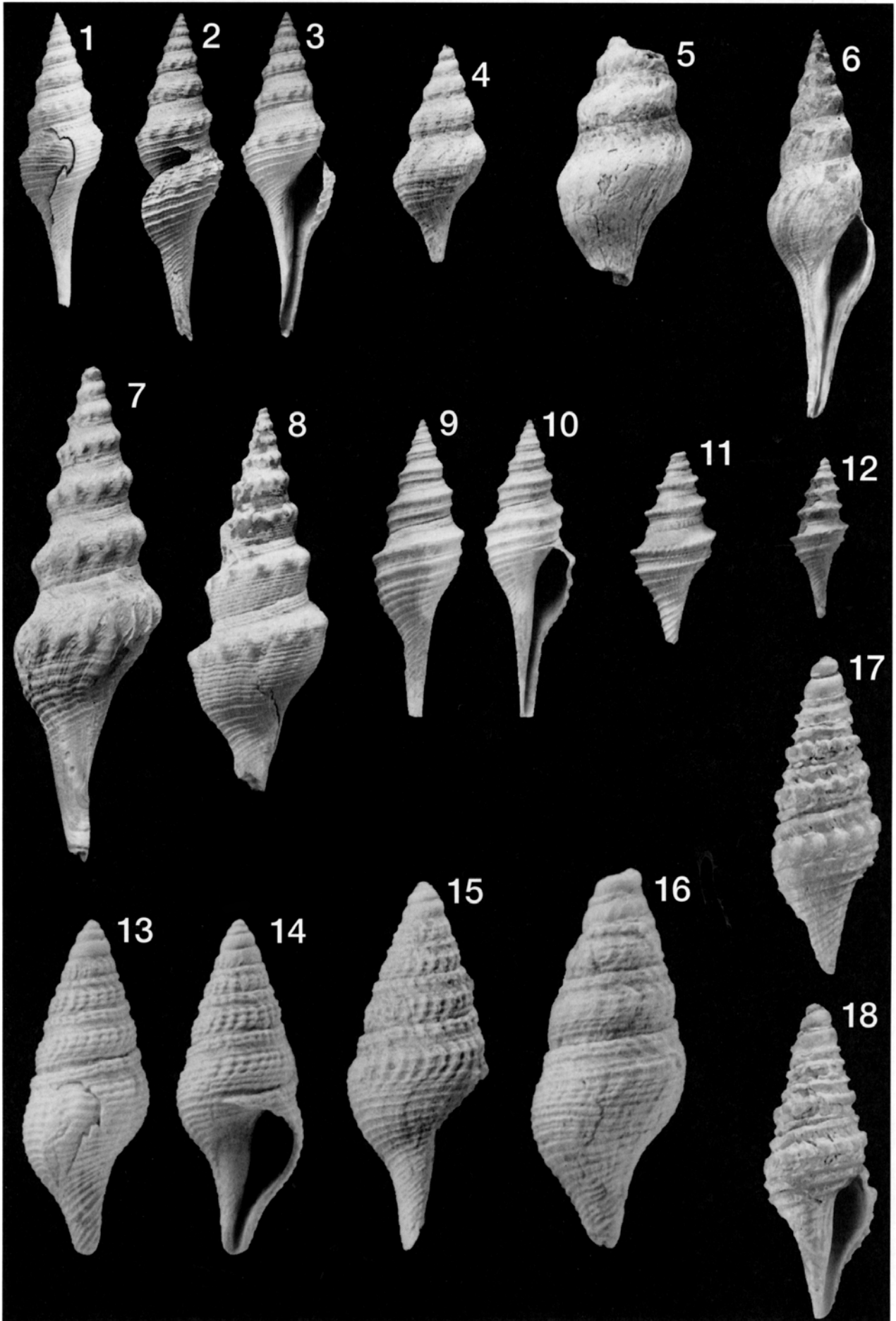




## Explanation of Plate 12

## Figure

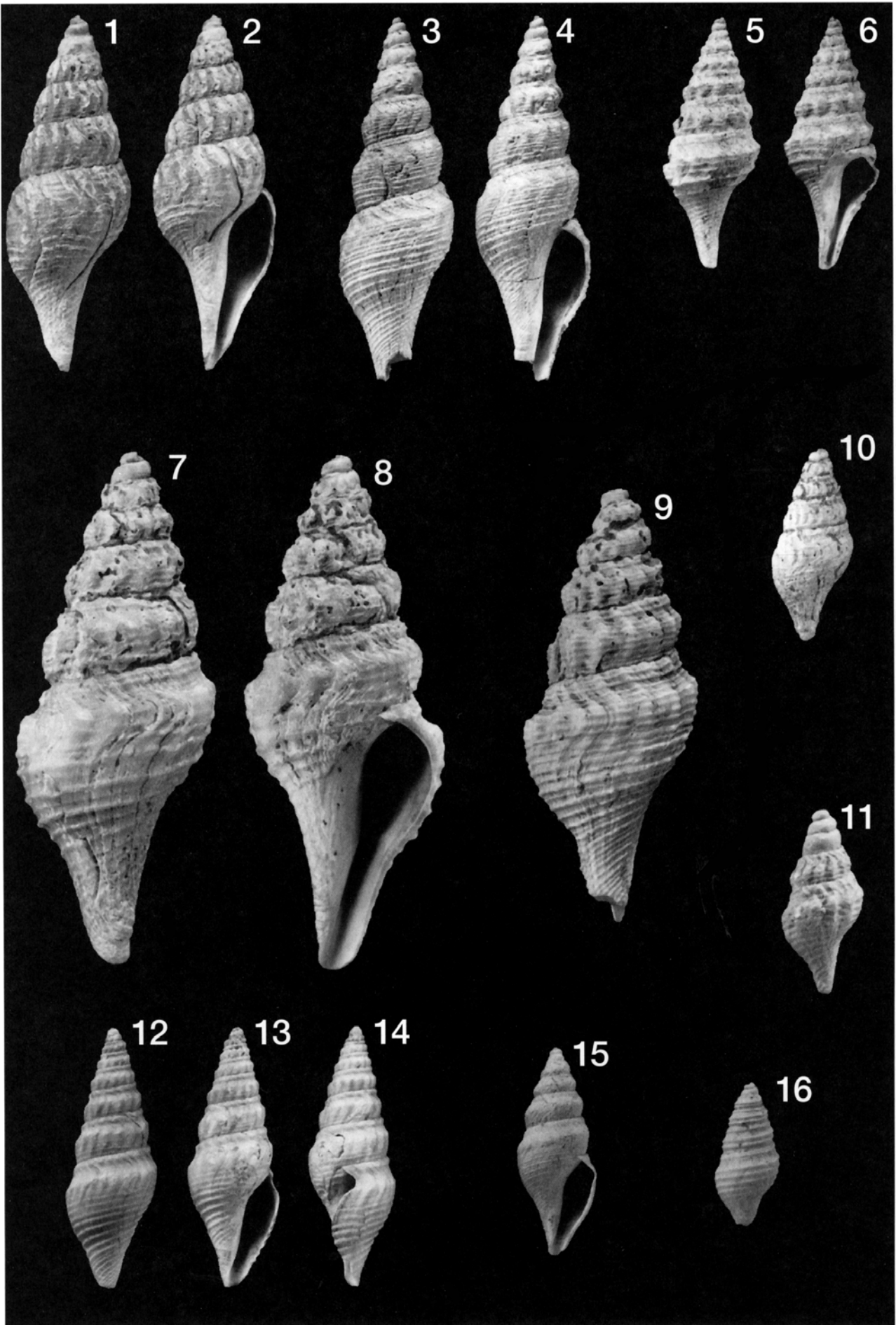
- 1, 2. *Eopleurotoma prestwichii* (Edwards), abapertural and apertural views,  $\times 3$ . Div. B2. BMNH PI TG 29, J. Cooper coll.
- 3, 4. *Eopleurotoma simillima simillima* (Edwards), abapertural and apertural views,  $\times 2$ . Div. B2. BMNH I TG 1130, J. Cooper coll.
- 5, 6. *Eopleurotoma simillima crassilinea* (Edwards), extreme form, abapertural and apertural views,  $\times 3$ . Div. B2. BMNH PI TG 1131, J. Cooper coll.
- 7, 8. *Eopleurotoma simillima crassilinea* (Edwards), lectotype, abapertural and apertural views,  $\times 5$ . London Clay Formation, Southampton, Hampshire. BMNH GG14607 [re-regd from 71308A], F. E. Edwards coll.
9. *Eopleurotoma simillima crassilinea* (Edwards), paralectotype, abapertural view,  $\times 5$ . London Clay Formation, Southampton, Hampshire. BMNH GG14608 [re-regd from 71308A], F. E. Edwards coll.
10. *Eopleurotoma wetherellii* (Edwards), abapertural view,  $\times 3$ . Div. C1. BMNH GG14582, A. Wrigley coll.
11. *Trachelochetus* cf. *nodosarius* (Edwards), abapertural view,  $\times 10$ . Div. C1. BMNH PI TG 1132, S. Tracey coll.
- 12, 13, 14. *Domenginella tereticosta* (Edwards), abapertural, apertural and lateral view (to show profile of outer apertural lip),  $\times 3$ . Div. B2. BMNH PI TG 1133, P. Jeffery coll.
15. *Bathytoma granata* (Edwards), apertural view,  $\times 2$ . Div. B2. BMNH PI TG 1134, J. P. James coll.
16. *Microdrillia tricincta* (Edwards), abapertural view,  $\times 4$ . Div. B2. BMNH PI TG 1135, A. G. Davis coll.



## Explanation of Plate 13

## Figure

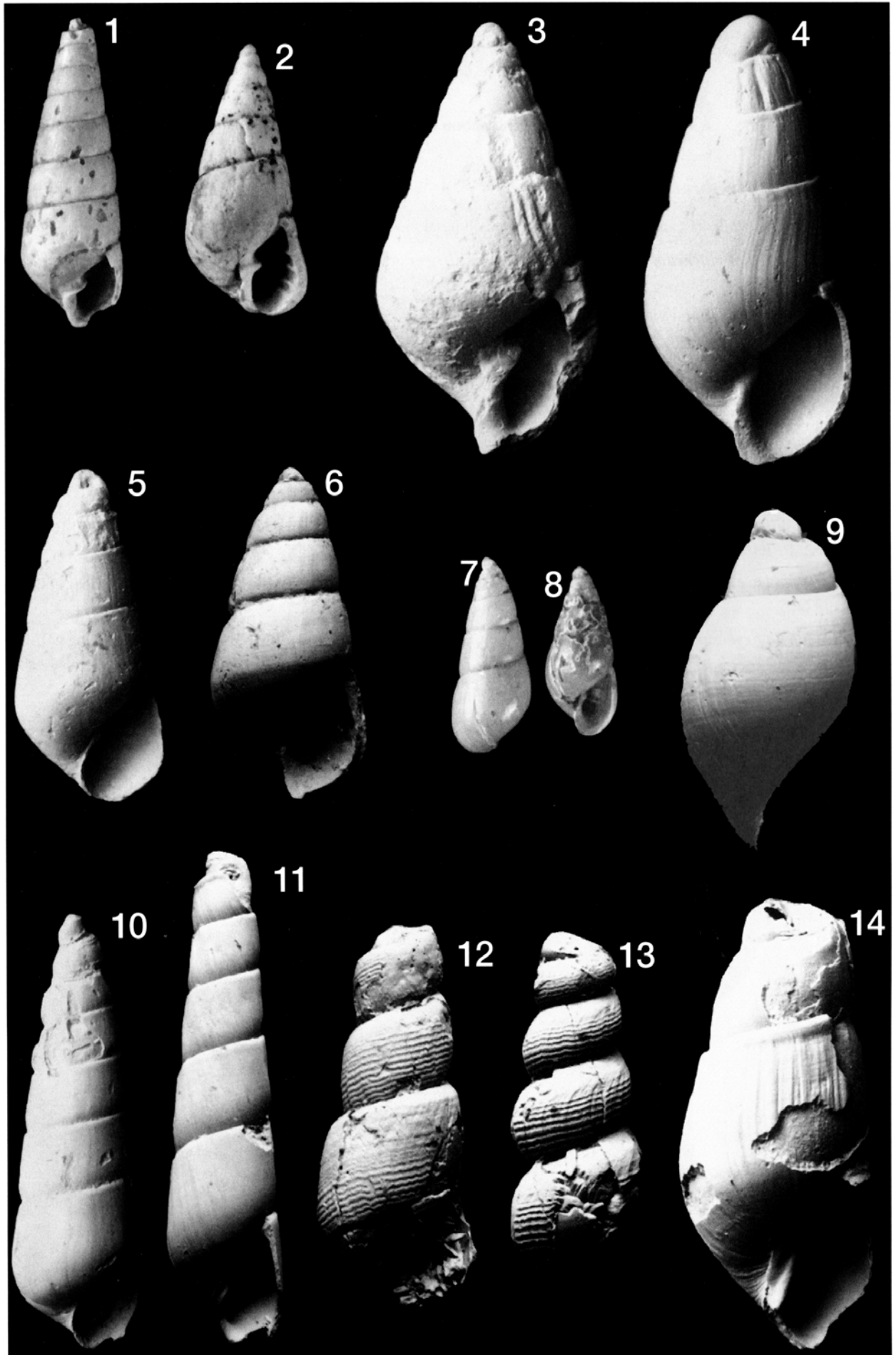
1. *Cossmannica agassizi* (Le Renard), apertural view,  $\times 10$ . *Barnea* bed. BMNH GG14581, S. Tracey coll.
2. *Odostomia lignitarum* (Deshayes), apertural view,  $\times 10$ . *Barnea* bed. BMNH GG14580, S. Tracey coll.
3. *Odostomia cf. cuisensis* Cossmann, apertural view, SEM  $\times 21$ . Div. B2. NHM PI TG 1136, P. Jeffery coll. Neg# 15843.
4. *Sinustomia* sp., apertural view, SEM  $\times 26$ . *Barnea* bed. BMNH PI TG 1137, S. Tracey coll. Neg# 15841.
5. *Odostomia* sp. 3, apertural view, SEM  $\times 26$ . *Barnea* bed. BMNH PI TG 1138, S. Tracey coll. Neg# 845.
6. *Odostomia* sp. 1, apertural view, SEM  $\times 26$ . *Barnea* bed. BMNH PI TG 1139, C. King coll. Neg# 18758.
7. *Odostomia* sp. 2, abapertural view,  $\times 10$ . Div. B2. BMNH GG14579, P. Jeffery coll.
8. *Odostomia* sp. 2, apertural view of a different specimen,  $\times 10$ . Div. B2. BMNH GG14579, P. Jeffery coll.
9. *Brachystomia* sp., apertural view of incomplete specimen (most of aperture missing), SEM  $\times 50$ . *Barnea* bed. BMNH PI TG 1140, S. Tracey coll. Neg# 17977.
10. *Syrnola cf. spina* (Deshayes), apertural view, SEM  $\times 26$ . *Barnea* bed. BMNH PI TG 1141, S. Tracey coll. Neg# 15844.
11. *Syrnola angusta* (Deshayes), apertural view, SEM  $\times 33$ . Div. B2. BMNH PI TG 1142, J. Cooper coll. Neg# 17973.
12. *Anisocyclus scalarina* (Deshayes), apertural view, SEM  $\times 60$ . Div. B2. BMNH PI TG 1143, J. Cooper coll. Neg# 17984.
13. *Murchisonella emarginata* (Deshayes), abapertural view, SEM  $\times 60$ . Div. B2. BMNH PI TG 1144, J. Cooper coll. Neg# 17987.
14. *Turbonilla* (s.l.) sp., apertural view, SEM  $\times 50$ . Div. B2. BMNH PI TG 1145, J. Cooper coll. Neg # 17986.



## Explanation of Plate 14

## Figure:

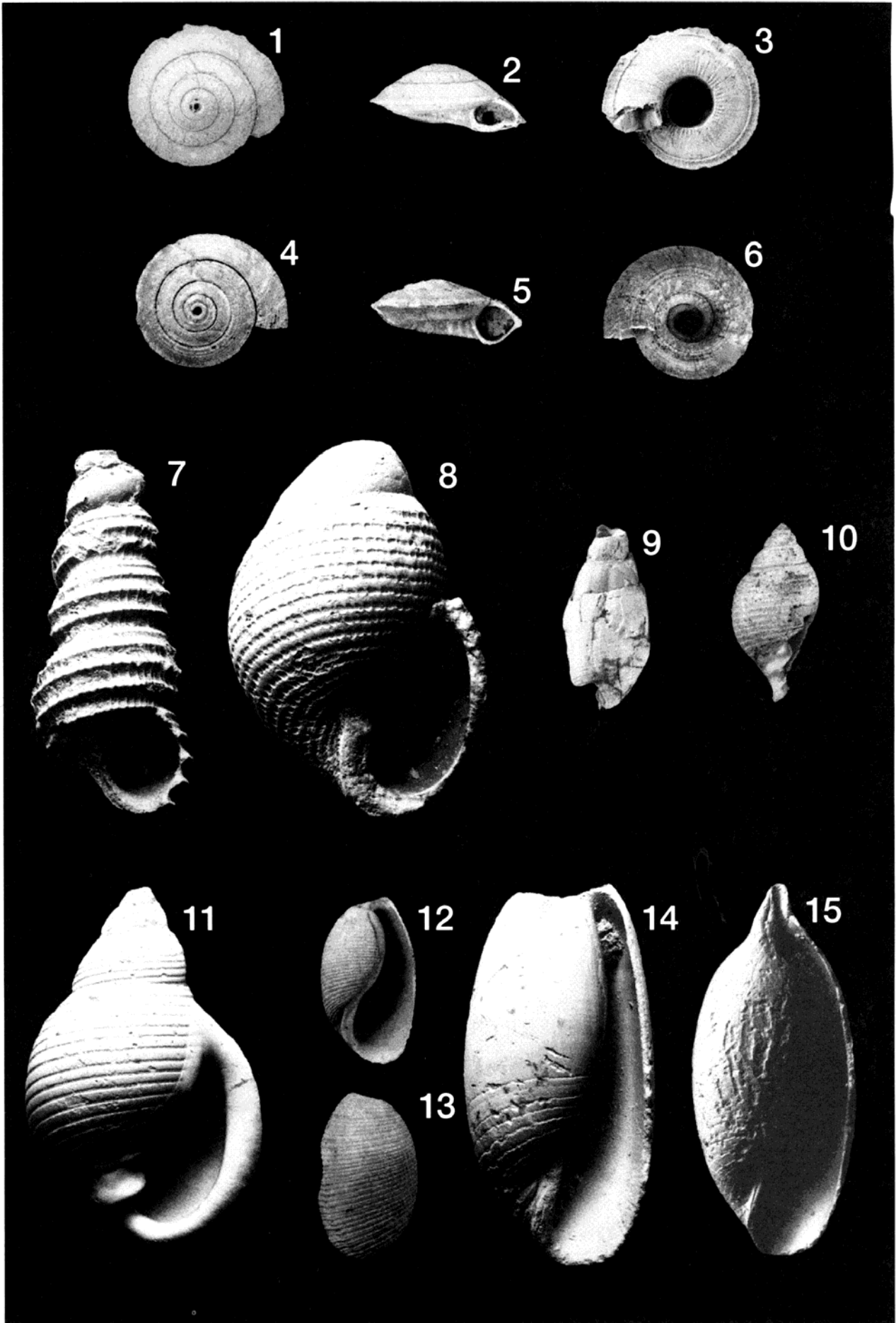
- 1 - 3. *Stellaxis bistratus* (Deshayes), apical, apertural and basal views,  $\times 2$ . *Barnea* bed. BMNH PI TG 1146, C. King coll.
- 4 - 6. *Granosolarium pulchrum* (J. de C. Sowerby), apical, apertural and basal views,  $\times 2$ . Div. B2. BMNH PI TG 1147, J. P. James coll.
7. *Mathilda* sp., apertural view, SEM  $\times 35$ . Div. B2. BMNH PI TG 1148, J. Cooper coll. Neg# 17974.
8. *Acteon* sp., apertural view, SEM  $\times 45$ . Div. B2. BMNH PI TG 1149, J. Cooper coll. Neg# 17966.
9. *Crenilabium elongatum* (J. de C. Sowerby), abapertural view of crushed specimen,  $\times 7$ . Div. B2. BMNH PI TG 1150, D. P. Mawson coll.
10. *Tornatellaea simulata* (Solander), lateral view of damaged specimen,  $\times 3$ . Div. B2. Private collection of P. Clasby.
11. *Ringicula turgida* (J. Sowerby), apertural view, SEM  $\times 22$ . Div. B2. BMNH PI TG 1151, J. Cooper coll. Neg# 17967.
- 12, 13. *Scaphander* cf. *polysarcus* Cossmann & Pissarro, apertural and abapertural views,  $\times 5$ . Div. B2. BMNH PI TG 1152, P. Jeffery coll.
14. *Cylichna* cf. *angstoma* (Deshayes), apertural view, SEM  $\times 30$ . Div. B2. BMNH PI TG 1153, J. Cooper coll. Neg# 17972.
15. *Volvulella oxyacrum* (Cossmann), apertural view, SEM  $\times 30$ . *Barnea* bed. BMNH PI TG 1155, C. King coll. Neg# 16004.



**Explanation of Plate 15****Figure:**

1. *Limacina mercinensis* (Watelet & Lefèvre), juv., apical view, SEM  $\times 100$ . Div. B2. BMNH PI TG 1154, J. Cooper coll. Neg# 17981.
2. *Antalis cf. angusta* (Deshayes), lateral view,  $\times 3$ . Div. B2. BMNH PI SC 1, S. Tracey coll.
- 3, 4. *Antalis constricta* (Newton & Harris). 3. slightly angled lateral view; 4. lateral view,  $\times 3$ . Div. B2. BMNH PI SC 2, D. Kemp coll.
5. *Antalis constricta* (Newton & Harris), ventral view of apex to show terminal notch and pipe,  $\times 10$ . Div. B2. BMNH PI SC 3, J. P. James coll.
6. *Antalis constricta* (Newton & Harris), lateral view of corroded mature individual,  $\times 3$ . Div. B2. BMNH PI SC 4, J. P. James coll.
- 7, 8. *Cimomia imperialis* (J. Sowerby), juv., apertural and ventral views of damaged specimen,  $\times 1$ . ?Div. C1. BMNH PI CN 9, E. M. Venables coll.
- 9, 10. *Deltoidonautilus sowerbyi* (J. de C. Sowerby), lateral and apertural views of damaged specimen (most of phragmocone missing),  $\times 0.5$ . Div. C1. BMNH PI CN 8, D. Kemp coll.





## Explanation of Plate 14

## Figure

- 1 - 3. *Stellaxis bistratus* (Deshayes), apical, apertural and basal views,  $\times 2$ . *Barnea* bed. BMNH PI TG 1146, C. King coll.
- 4 - 6. *Granosolarium pulchrum* (J. de C. Sowerby), apical, apertural and basal views,  $\times 2$ . Div. B2. BMNH PI TG 1147, J. P. James coll.
7. *Mathilda* sp., apertural view, SEM  $\times 35$ . Div. B2. BMNH PI TG 1148, J. Cooper coll. Neg# 17974.
8. *Acteon* sp., apertural view, SEM  $\times 45$ . Div. B2. BMNH PI TG 1149, J. Cooper coll. Neg# 17966.
9. *Crenilabium elongatum* (J. de C. Sowerby), abapertural view of crushed specimen,  $\times 7$ . Div. B2. BMNH PI TG 1150, D. P. Mawson coll.
10. *Tornatellaea simulata* (Solander), lateral view of damaged specimen,  $\times 3$ . Div. B2. Private collection of P. Clasby.
11. *Ringicula turgida* (J. Sowerby), apertural view, SEM  $\times 22$ . Div. B2. BMNH PI TG 1151, J. Cooper coll. Neg# 17967.
- 12, 13. *Scaphander* cf. *polysarcus* Cossmann & Pissarro, apertural and abapertural views,  $\times 5$ . Div. B2. BMNH PI TG 1152, P. Jeffery coll.
14. *Cylichna* cf. *angystoma* (Deshayes), apertural view, SEM  $\times 30$ . Div. B2. BMNH PI TG 1153, J. Cooper coll. Neg# 17972.
15. *Volvulella oxyacrum* (Cossmann), apertural view, SEM  $\times 30$ . *Barnea* bed. BMNH PI TG 1155, C. King coll. Neg# 16004.

