

## 5. ANNELIDS

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### 5.1. CALCAREOUS TUBEWORMS

At least three families of extant annelids (Serpulidae, Sabellidae, Cirratulidae) inhabit calcareous tubes which preserve as fossils. All members of Serpulidae produce calcareous tubes, but only one genus of each of the other two families do so. The oldest records of fossil tubeworms in England go back to the 18th century when Robert Brookes (1763) published a pair of illustrations of so-called 'worm stones', but there were earlier mentions of European fossil annelids (e.g. Baier 1708). The first valid 'scientific' descriptions for English examples are those of J. and J. de C. Sowerby (1813, 1829) who described a number of fossil species in their classic *Mineral conchology of Great Britain*, and John Phillips (1829) in his *Geology of Yorkshire*.

Calcareous tubeworms are abundant at some levels of the Kimmeridge Clay Formation, with their presence first detected back in the 19th century in both England and France (J. de C. Sowerby 1829; Loriol and Pellat 1874). Since then, tubeworms have been reported from numerous localities in the Kimmeridge Clay over much of its outcrop in England (Phillips, 1871; Blake 1875; Davies 1907; Wignall 1990*a, b*; Oschmann 1994) and in the Boulonnais of France (Pellat 1880). At least ten species have been described from the Upper Jurassic of England, though only five of them have been reported for the Kimmeridge Clay Formation; however, this diversity looks poor when compared with the 37 species listed for the Late Jurassic of southwest Germany by Parsch (1956).

Among the three families of calcareous tubeworms listed above, only two occur in the Kimmeridge Clay. Most sabellids, or peacock worms, build organic-walled tubes often including sedimentary particles, but the genus *Glomerula* is known to secrete a simple unsculptured calcareous tube with rounded section and chaotic, often glomerate coiling.

Serpulids have the greatest preservation potential among all calcareous tubeworms, and their variously sculptured tubes enables differentiation between species and the easy recognition of the group's overall diversity. In addition, few genera also have a calcified operculum for closing the tube aperture (in most forms the operculum is organic; see ten Hove and Kupriyanova, 2009), that is also sometimes preserved in the fossil record (see Ippolitov *et al.* 2014).

Serpulids are of particular interest for paleoecology, a characteristic aspect is that most members of the family demonstrate clearly oriented growth against the paleo-current, helping to reconstruct the whole environment and general habitat characters. Traditionally calcareous tubeworms have been paid little attention by

palaeontologists, and currently they remain understudied in invertebrate palaeontology. In most reports published before the second half of the 20th century, only the generic name *Serpula* is employed to include all described fossil tubes. This genus was originally erected by Linnaeus (1758) for extant marine animals inhabiting calcareous tubes and belonging to 'worms'. In addition, *Serpula* also originally included gastropod and even foraminiferal species. However, as recent zoologists investigated in detail serpulid soft body morphology, they described increasingly more new taxa, with as many as ~490 species in 70 genera known today (Ippolitov *et al.* 2014), but paid scant attention to the tubes. Consequently, palaeontologists encountered difficulties in interpreting and classifying fossil serpulids. Aware of the problems of identifying serpulids and still assigning them to a single genus (Linnaeus's *Serpula*) Parsch (1956) erected five new subgenera (*Cycloserpula*, *Dorsoserpula*, *Hexaserpula*, *Pentaserpula* and *Tetraserpula*) based on the shape of the tube cross-section to classify fossil tubes. Despite that in general this classification concept has been abandoned, these subgenera are still sometimes encountered in recent literature dealing with Kimmeridge Clay fauna (e.g. Wignall 1990a, b; Oschmann 1994). Nowadays another approach, based on the comparison of tube morphology with Recent intra-generic tube variety is employed (e.g. Regenhardt 1961; Jäger 1983, 2005). It is now evident, that most Recent genera appeared during the Mesozoic, and have been progressively diversifying since the Triassic (Ippolitov *et al.* 2014), while most ancient unequivocal serpulids date back to the Permian (Sanfilippo *et al.* 2016). However, problems still persist with recognizing many extant genera in the fossil record because of their limited tube morphology or overlapping tube morphology in different genera (Ippolitov *et al.* 2014). There are new and promising results based on the study of tube microstructures, which display high variability (Vinn *et al.* 2008) and this may be well preserved in fossil tubes (e.g. Vinn, Jäger and Kirmsimäe 2008). This approach has already helped to reveal the non-annelid nature of some tubiculous fossils (e.g. Weedon 1994; Taylor and Vinn 2006) and to test the phylogenetic links between certain Recent and fossil forms with similar tube morphology showing their homeomorphy (Kupriyanova and Ippolitov 2015). To conclude, none of the fossil taxa referred to *Serpula* by previous workers really belong within this genus in its present interpretation, even though the name is still widely employed as an appellation for all fossil serpulids by a considerable number of geologists. Nevertheless, some calcareous 'worm' tubes may belong to groups other than Annelida including Foraminifera, Microconchida and Scaphopoda to name but a few (Taylor and Vinn 2006; Ippolitov *et al.* 2014). Even when 'worm' tubes have distinctive morphology, such as tight spirals, this may be attributed to convergence between highly dissimilar organisms.

The historical focus of fossil serpulid studies has concentrated mainly on Upper Cretaceous material, while Kimmeridgian serpulid worms have scarcely been subjected to detailed systematic scrutiny and their taxonomy and systematics,

palaeoecology and biostratigraphic distribution remain largely unstudied. The only recent revisions of Middle and Late Jurassic serpulids, are those by Radwańska (2004) for the Late Oxfordian of Poland and Ippolitov (2007*a, b*) for the latest Callovian of the Russian platform. Fortunately, because serpulid species are often long-ranging, sometimes extending through several stages and even epochs (Jäger 2005), most species met within the Kimmeridge Clay Formation were redescribed in these papers.

Phylum ANNELIDA Lamarck, 1809

Class POLYCHAETA Grube, 1850

Order SABELLIDA Fauchald, 1977

Family SABELLIDAE Johnston, 1846

Genus GLOMERULA Brünnich Nielsen, 1931

**Comment.** Due to poor morphology, the classification of the *Glomerula* species in general and of *G. gordialis* in particular is very perplexed and equivocal, but useful reviews are provided by Jäger (2005) and Luci *et al.* (2013). The fossil members of this genus are probably among the most abundant Mesozoic fossil tubeworms, being known for a long time and traditionally described as serpulids, while their recent counterparts were not known until the end of 20th century, when a single relict species was described from the Great Barrier Reef in Australia (Perkins, 1991). Thus the genus *Glomerula* is a true “living fossil” among tubicolous annelids.

*Glomerula gordialis* (von Schlotheim, 1820)

Text-figure 5.1A

**Description.** Tubes are usually small to medium sized (1–2 mm diameter), irregularly coiled, long, rounded, lack longitudinal sculpture or obvious transverse growth lines, and do taper very slowly after the first few millimetres of growth, with tube length exceeding its diameter many dozen times. They are fixed to a firm substrate throughout their length and easily recognizable by glomerate, somewhat irregular coiling, but sometimes can be convoluted. They also bear very characteristic slight, irregular inflations, usually best observed at the bends. Cross section circular or slightly oval.

**Occurrence.** Occurs in the Lower Kimmeridge Clay of Dorset at Ringstead Bay and west of Osmington Mills. It is especially common in the basal shell bed of the Portland Cherty series on the Isle of Portland at the boundary between the Portland Stone Formation and the underlying Kimmeridge Clay Formation. Cosmopolitan for the Late Jurassic to Early Cretaceous, being recorded all over the Tethyan area and most adjacent epicontinental basins, including located in the Subboreal zone.

**Remarks.** Usually occurs encrusting oysters.

Family SERPULIDAE Rafinesque, 1815

Genus FILOGRANULA Langerhans, 1884

'*Filogramula*' *runcinata* (J. de C. Sowerby, 1829)

Text-figure 5.1B-C

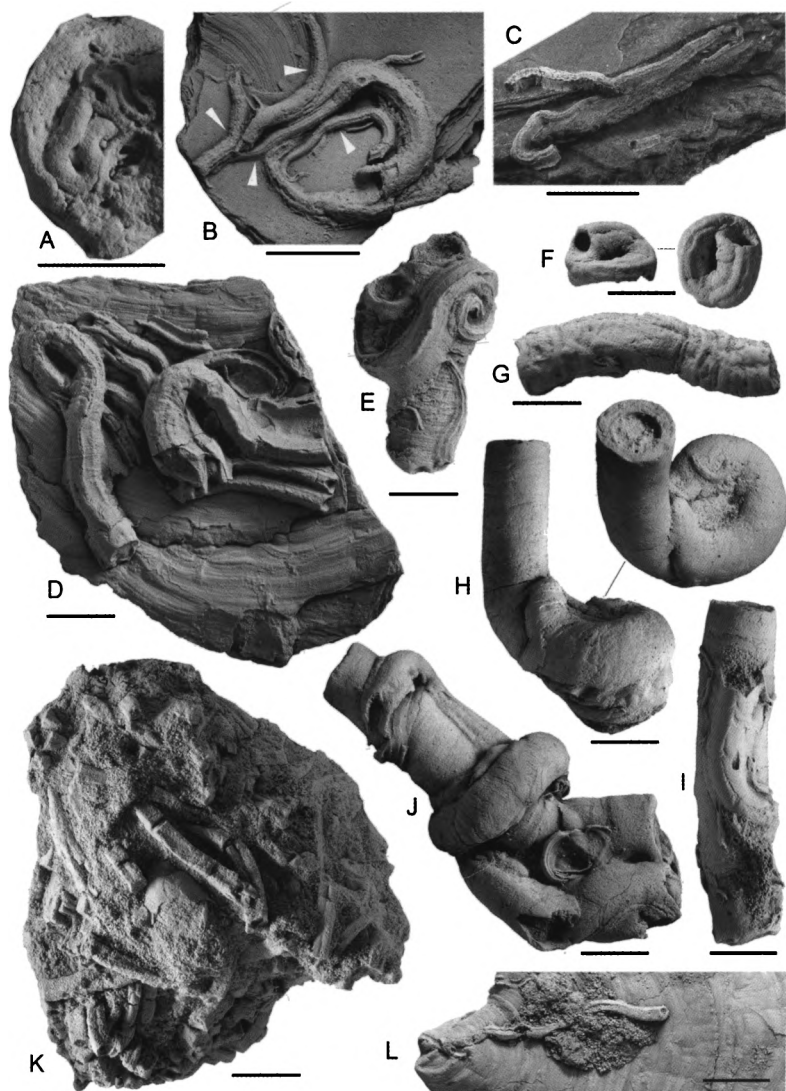
**Description.** Small to medium-sized (maximum diameter 2.5 mm) curved tubes with pentagonal or rounded pentagonal cross section, usually adhering to a substrate along entire length. Lateral folds carinate and slightly denticulate, making tube appear tricarinate with serrated keels when attached. The diameter grows quickly, and tube bends are often angular. Unlike other co-occurring serpulids, the tube often looks somewhat semi-transparent.

**Occurrence.** Widely spread in the Callovian to Oxfordian of Europe. In the British Isles the type series came from Shotover Hill, Oxfordshire from the top of the Corallian, and are thus of latest Oxfordian Age. Similar looking specimens occur at the base of the Kimmeridge Clay at Osmington Mills and rarely at Ringstead Bay and Weymouth.

**Remarks.** Despite this species together with the closely related Late Cretaceous *Serpula cincta* Goldfuss, 1831 were classified as *Filogramula* in some recent revisions (Jäger 1983, 2005; Ippolitov 2007a; Kočí and Jäger 2015), ultrastructural analysis has now revealed crucial difference with Recent members of the genus (Ippolitov and Kupriyanova 2013). Thus, the generic attribution of both fossil species is re-evaluated as uncertain here. '*F.*' *runcinata* is an opportunistic species which is non-selective to the substratum type, and normally forms mass occurrences, but in the Kimmeridge Clay it is uncommon, usually found adhering to oyster shells.

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TEXT-FIG. 5.1. Tubeworms from the Kimmeridge Clay Formation. All specimens are in A.P. Ippolitov's collection, housed in Geological Institute of Russian Academy of Sciences, Moscow. Scale bars: A – 5 mm, B to L – 10 mm. A, *Glomerula gordialis*, No. 52-RIN, 2 m above the sandstone at base of Kimmeridge Clay Formation, Ringstead Bay, Dorset. B–C, '*Filogramula*' *runcinata*, B, No. 14-WEY, specimens attached to oyster shell (indicated by white triangles), in association with *M. tricarinata*. C, without number, Martill collection. All collected from foreshore of the Fleet at Wyke Regis, Dorset. D–G, *Mucroserpula tricarinata*, D, No. 16-WEY, irregularly curved tubes attached to oyster shell. E, No. 62-WEY, three specimens of different growth stages attached to large *N. quadristriata* tube. F, No. 41-WEY, convoluted specimen views side and top views. G, No. 63-WEY, free indistinctly unsculptured anterior part of the tube. All collected from the shore of the Fleet at Wyke Regis, Dorset. H–J, *Neovermilia quadristriata*, H, No. 38-WEY, convoluted tube with arising anterior part. I, No. 46-WEY, young specimen showing indistinct median keel, fully attached to the tube of larger specimen. J, No. 39-WEY, typical bundle of tubes, attaching to each other. All collected from the shore of the Fleet at Wyke Regis, Dorset. K–L, *Tetraserpula tetragona*. K, No. 75a-WEY, an aggregation of tube growing upwards from shell debris; Upper Oxfordian, Weymouth. L, No. 01-RIN, an untypical single specimen fully attached to an oyster shell. Sandstone at base of Kimmeridge Clay Formation, Ringstead Bay, Dorset.



Genus MUCROSERPULA Regenhardt, 1961

*Mucroserpula tricarinata* (J. de C. Sowerby, 1829)

Text-figure 5.1D-G

**Description.** Calcareous worm tube of medium to large size (typically of 5–7 mm in diameter, reaching up to 11 mm) and thick-walled. Coiling mode is variable, from clearly convoluted with rectified anterior part to irregularly curved forms, fully attached to substrate. The tube widens gently and is characterised by a dorsal and two supralateral keels extending along the entire length of the tube, between which are gently meniscate growth lines. Cross-section of mature specimens is subpentagonal with wide basis, early growth stages have sub-triangular cross-section. Anterior parts, rising above the substrate, lose the distinct sculpture and look roughly rounded and angular.

**Occurrence.** Lower Kimmeridge Clay at Ringstead Bay and near Weymouth. The species is widespread in the Bathonian – Late Jurassic, occurring over most of Europe.

**Remarks.** Common on the surface of larger ammonites and the oyster *Deltoideum*. This species often forms complex intertwined associations of itself and also with *Neovermilia quadristriata*. Anterior fragments, growing away from substrate, lose their sculpture and become similar to those of co-occurring *N. quadristriata*, but still can be distinguished by their rougher surface and irregularly angular cross-section. May show infestations of the possibly hydroid symbiont *Protulophila gestroi* Rovereto, 1901 (see Chapter 19). Such infestations usually have the appearance of a series of small holes on the outer surface of the tube, but in exfoliated examples they may appear as an extensive branching network of stolons and flask-shaped polyp chambers surrounding the tube (see Scrutton 1975 for illustrations).

Genus NEOVERMILIA Day, 1961

*Neovermilia quadristriata* (Goldfuss, 1831)

Text-figure 5.1 H-J

**Description.** Smooth, large (reaching up to 12–13 mm in diameter) calcareous worm tube, lacking carina in late growth stages, and with low median carina in juveniles. Anterior parts usually grow away from the substrate. Their fragments can be found detached *post-mortem* from the substrate and then considered 'free'. Cross-section almost perfectly round or slightly oval. The base of the tube bears poorly seen lateral longitudinal hollows (tubulae), infilled with closely spaced transverse septae, typical for the genus.

**Occurrence.** Specimens referred to the taxon are recorded from many horizons in the Middle and Upper Jurassic of England, including the Oxford Clay Formation, Corallian Group and the Kimmeridge Clay Formation. It is also widespread in Europe in the same interval.

**Remarks.** Often forms complex intertwined associations of itself and also with *Mucroserpula tricarinata*. Large specimens may show infestations of the possibly hydroid symbiont *Protulophila gestroi* Rovereto, 1901 (see Chapter 19). This species is among the most common serpulids for the English Late Jurassic, previously known as *Serpula intestinalis* Phillips, 1829. However, Phillips' name is a primary homonym of *Serpula intestinalis* Gmelin, 1791 (extant form; now transferred to Vermetidae). Gmelin's species was not mentioned after 1899 as a valid combination, but still Phillips's name fails to satisfy the criteria listed in International Code for Zoological Nomenclature article 23.9.1.2 and thus cannot be retained as being in prevailing usage. Thus is replaced here by the oldest available synonym, *Serpula quadristriata* Goldfuss, 1831.

#### Genus TETRASERPULA Parsch, 1956

**Comment.** According to Jäger (2005), *Tetraserpula* is a junior synonym of *Nogrobs* de Montfort, 1808. Here we follow Kupriyanova and Ippolitov's (2015) suggestion, who discussed the relationship between these closely related genera, retaining them separate on the basis of clearly spirally coiled early stages in *Nogrobs* as opposed to the straightened condition in *Tetraserpula*.

#### *Tetraserpula tetragona* (J. de C. Sowerby, 1829)

Text-figure 5.1K-L

**Description.** Tube of small to medium size (1.5 – 2.5 mm in diameter), quadrangular cross-section, slowly tapering and gently meandering. Often forms aggregations of many specimens, and may be both found adherent on bivalves, especially Ostreacea, or growing away upwards from the substrate, which is usually some shell debris in high-energy environments.

**Occurrence.** In Kimmeridge Clay, there are mass occurrences near the base of the formation and in the Upper Oxfordian. Widely spread in the Middle and Late Jurassic of Europe, mainly within the Boreal area.

**Remarks.** The same species was previously described as *Serpula dollfussi* both from French (Loriol and Pellat 1874) and English (Wignall, 1990a, b) counterparts of the Kimmeridgian sedimentary basin.

## 5.2. AGGLUTINATED TUBEWORMS

Besides calcareous tubes, a number of polychaete families can build organic-walled tubes, sometimes armoured by including the sedimentary particles and available shell debris into it. There is one report of such tubes from the Kimmeridge Clay.

Order TERESELLIDA Rouse and Fauchald, 1997

Family TERESELLIDAE Johnston, 1846

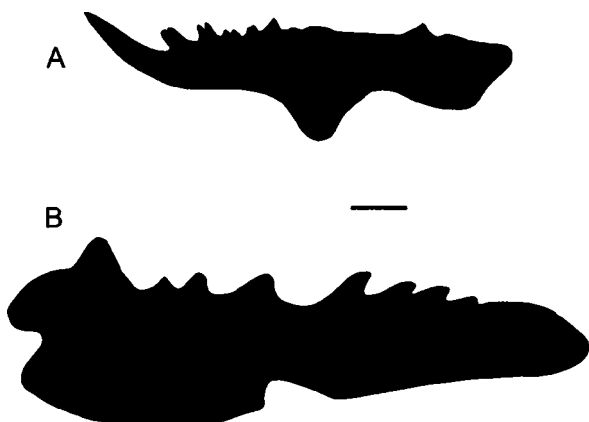
?Terebellidae indet.

(not figured)

**Comment.** Wignall (1990a, p. 62, fig. 47) identified a number of gently meandering traces in the Kimmeridge Clay Formation at Kimmeridge Bay (Elegans Zone) that were lined with both broken and complete shells of the bivalve *Protocardia morinica*. He tentatively assigned an origin for these traces to terebellid worms. The 'tubes' reach up to 150 mm in length.

### 5.3. SCOLECODONTS

A number of free-living polychaete worms bear chitinous jaws in their mouths called scolecodonts. These are multi-paired, usually elongate elements forming a complex 'dental' apparatus composed of highly resistant organic materials with a functional surface of often highly heteromorphous denticulate processes used for gripping and processing prey. They are encountered as fossils usually only in micro-palaeontological residues where they are commonly between 100 and 150 microns in length, but may reach almost 1 mm. They are usually tan coloured or very dark brown to black. There have been no published descriptions on scolecodonts from the English Kimmeridge Clay, but Kimmeridgian scolecodonts have been reported from the *Eudoxus* Zone of the French Jura by Courtinat (1998) who described two new species *Dualigenys erecta* and *Sinugenys robusta* (Text-fig. 5.2).



TEXT-FIG. 5.2. Scolecodonts of Kimmeridgian age. A, *Dualigenys erecta* Courtinat, 1998 B, *Sinugenys robusta* Courtinat, 1998. Both from the Kimmeridgian of the French Jura (*Eudoxus* Zone). Outlines drawn from Courtinat (1998). Scale bar = 10 microns.



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PALAEONTOLOGICAL ASSOCIATION  
FIELD GUIDE TO FOSSILS: Number 16

# Fossils of the Kimmeridge Clay Formation

Volume 1

Introduction, geology and invertebrate  
palaeontology

*Edited by*

DAVID M. MARTILL  
*and* STEVE ETCHES

*Pictures editor*

ROBERT F. LOVERIDGE

THE PALAEONTOLOGICAL ASSOCIATION  
LONDON  
2020

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ISBN 978-0-901702-74-6

ISSN 0962 5321

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Keele University, Keele,  
Staffordshire ST5 5BG, UK

*Front cover*

Upper Kimmeridge Clay at Chapman's Pool, Dorset. Insets: Top *Etcheslepas durotrigensis* Gale, from chapter 14. Middle, nacreous ammonite. Bottom, Brachiopod, *Ornithella lampas*, from chapter 7.

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# 1

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