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The ichnofossil *Helicotaphrichnus commensalis* in the Korytnica basin (Middle Miocene; Holy Cross Mountains, Central Poland)

ABSTRACT: The ichnofossil *Helicotaphrichnus commensalis* is a morphologically distinct tube that is identical with modern tubes constructed by polychaetes in gastropod shells inhabited by hermit crabs. Its abundant occurrence in the Korytnica Clays (Middle Miocene; Holy Cross Mountains, Central Poland) extends both the stratigraphic range and the geographic distribution of this ichnospecies.

INTRODUCTION

The ichnofossil *Helicotaphrichnus commensalis* Kern, Grimmer & Lister, 1974 is a morphologically distinct fossil tube that occurs only in shells of gastropods. The living polychaetes *Polydora commensalis* Andrews, 1891 and *P. bioccipitalis* Blake & Woodwick, 1972 and one other unidentified species (Samuelson 1970, p. 40) construct apparently indistinguishable tubes in shells occupied by hermit crabs (*see also* Berkeley & Berkeley 1936; Blake 1969, 1971; and Blake & Evans 1975). The trace fossils have been reported previously only from Pliocene and Pleistocene rocks of western North America (Kern, Grimmer & Lister 1974), and their abundant occurrence in the Korytnica Clays of the Miocene Korytnica basin in Central Poland (*cf.* Bałuk & Radwański 1977, 1979) constitutes an extension of both stratigraphic range and geographic distribution.

The ichnofossil *Helicotaphrichnus commensalis* and the tubes of *Polydora commensalis* and *P. bioccipitalis* are of very characteristic form and are constructed only in the columella and adjacent internal chamber wall of gastropod shells (Text-fig. 1). From its aperture, which usually is just visible in the middle of the inner lip of the gastropod shell (Text-figs 2—3), the tube passes to the opposite side of the columella, where it turns and follows the through-like bottom of the inner chamber toward the shell's apex. Some tubes turn back on themselvs once or even twice to parallel their original course and follow "U"- or "S"-shaped paths. The tubes consist of grooves excavated in the gastropod shell and covered with a thin wall of calcium carbonate (cf. Text-fig. 3*A*), but this wall is broken out of many fossil specimens. Internally the tubes are regularly cylindrical with smooth walls.

THE KORYTNICA MATERIAL

The ichnofossil *Helicotaphrichnus commensalis* is very abundant in the Korytnica Clays and occurs in shells of a large number of gastropod species (Table 1). The morphology of these tubes (Text-fig. 3) is basically similar to that of the Pliocene to Recent specimens in North America (Text-fig. 2), but there are several significant differences in detail. The tube apertures of the former are more variable in size and reach larger maximum sizes, up to nearly 2.0 mm (Text-fig. 3) compared with the maximum of 1.0 mm in the North American specimens (Text-fig. 2). The greatest maximum diameters of the tubes themselves are approximately 1.5 mm in both cases. Further, the aperture and early-formed parts of the tubes are more variable in position and form in the Miocene specimens. Apertures may be higher or lower, or farther in or out of the shell's aperture, and some tubes pierce deeply through the columella to its opposite side, while others are shallow superficial grooves. The initial parts of some tubes, like those of the North American specimens, are perpendicular to the shell axis, while others follow an irregular path, some directed away from the shell apex until they pass into the trough of the internal chamber.

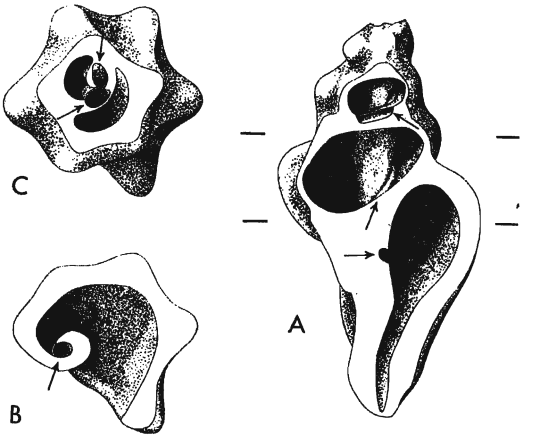

Fig. 1. Three cross-section views showing the position and morphology of *Helicotaphrichnus commensalis* in *Ocenebra foveolata* (Hinds, 1844) from California (*from* Kern, Grimmer & Lister 1974, Fig. 2); magnified twice

A — Axial section exposing the interior of the shell in each of three whorls. In the body whorl is the initial segment of the tube near its aperture, where the deposited part of its wall is broken away. The single tube is visible in the second whorl, and in the third whorl are two segments of the tube, one descending from the turnaround near the shell apex. Horizontal lines show position of transverse sections in *B* and *C*

B — Transverse section in anterior part of shell cuts the single tube

C — Transverse section in posterior part of shell cuts both segments of the tube

The greater irregularity in form and position of the tubes in the Miocene specimens from Korytnica suggests that this particular boring habit was newly evolving at that time and the boring behavior had not yet become stabilized. Additional evidence for this conclusion is provided by *Helicotaphrichnus commensalis* with irregular tube apertures in the gastropods *Scobinella costata* Conrad and *Bursa*

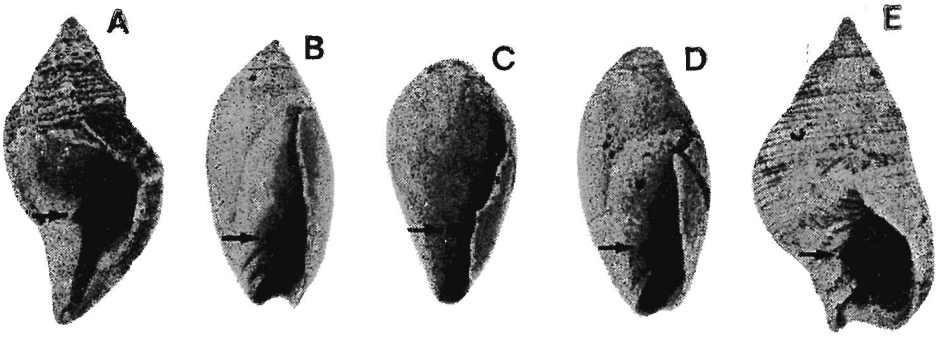

Fig. 2. *Helicotaphrichnus commensalis* and tubes of *Polydora commensalis* from California (*from* Kern, Grimmer & Lister 1974, Fig. 1); collection of the Department of Geology, University of California, Los Angeles (abbreviated as *ULCA*); all photos are twice actual size

A — Tube of *Polydora commensalis* in *Ceratostoma nuttalli* (Conrad, 1856); specimen *UCLA* no. 48140; intertidal, San Diego, California

B — Tube of *Polydora commensalis* in *Olivella biplicata* (Sowerby, 1856); specimen *UCLA* no. 48141; intertidal San Diego, California

C — Tube of *Polydora commensalis* in *Conus californicus* Hinds, 1844; specimen *UCLA* no. 48142; intertidal San Diego, California

D — *Helicotaphrichnus commensalis* in *Olivella biplicata* (Sowerby, 1856); holotype, specimen *UCLA* no. 48143; Pleistocene Bay Point Formation, San Diego, California

E — *Helicotaphrichnus commensalis* in *Nassarius grammatus* (Dall, 1917); specimen *UCLA* no. 48144; Pliocene San Diego Formation, San Diego, California

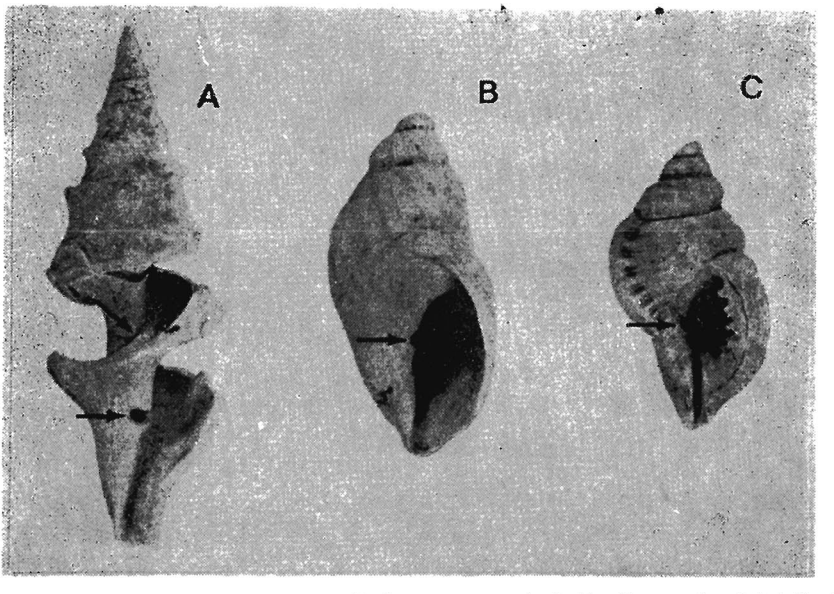

Fig. 3. *Helicotaphrichnus commensalis* in gastropod shells from the Middle Miocene Korytnica Clays, Holy Cross Mountains, Central Poland; photos are of actual size

A — Aperture (lower arrow) and outer wall (upper arrow) of tube of *Helicotaphrichnus commensalis* in shell of *Clavatula asperulata* (Lamarck, 1822) from which parts of shell have been removed to show interior

B and **C** — Apertures (arrows) of tubes of *Helicotaphrichnus commensalis* in shells of: B — *Sveltia inermis* (Pusch, 1837), C — *Triton affine* Deshayes, 1832

mississippiensis Conrad in Miocene rocks at Vicksburg and Red Bluff, Mississippi, U.S.A.

The living polychaete species that construct these tubes are known to live in nearshore waters of both coasts of the Atlantic and Pacific oceans to depths of 100 m.

Table 1

List of gastropod species from the Korytnica Clays, whose shells yield the ichnofossil *Helicotaphrichnus commensalis*

The gastropods are determined after Friedberg (1911—1928)

1. *Murex friedbergi* Cossmann & Peyrot, 1924
2. *Murex austriacus* Tournouër, 1875
3. *Ocenebra erinacea* (Linnaeus, 1766)
4. *Ranella marginata* (Martini, 1777)
5. *Triton nodiferum* Lamarck, 1822
6. *Triton affine* Deshayes, 1832
7. *Triton tarbellianum* Grateloup, 1840
8. *Fusus hoessi* Partsch, 1856
9. *Euthria intermedia* (Michelotti, 1847)
10. *Euthria puschi* (Andrzejowski, 1830)
11. *Trigonostoma puschi* (R. Hoernes & Auinger, 1879)
12. *Sveltia inermis* (Pusch, 1837)
13. *Ancilla glandiformis* (Lamarck, 1810); most commonly
14. *Clavatula asperulata* (Lamarck, 1822)
15. *Clavatula laevigata* (Eichwald, 1853)
16. *Clavatula camillae* (R. Hoernes & Auinger, 1879)

In the Korytnica Clays the investigated ichnofossil occurs in diverse horizons of the middle and upper part of the clay sequence that correspond to the time interval when the Communities *II* and *III* were spreading over the Korytnica basin (*cf.* Text-fig. 5 *in* Bałuk & Radwański 1977). At that time the Korytnica basin was successively shallowing because of its gradual filling with the clay occupied by seagrass vegetation (*cf.* Bałuk & Radwański 1977, Fig. 6) which provided environmental conditions especially favorable for the expansion of diversified biological life. Both the hermit crabs, the activity of which is recognizable also from their incisions in gastropod shells, as well as numerous epi- and endobionts of empty gastropod shells were inhabiting the shallowing basin which finally became filled with sediment almost up to sea level (*cf.* Bałuk & Radwański 1977, 1979). The polychaetes responsible for the production of the investigated ichnofossils *Helicotaphrichnus commensalis* belonged then to the important members of the successive organic communities.

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