ON THE SPIROCHAETE BACTERIA INFESTING THE CRYSTALLINE STYLE OF BIVALVIA (PHYLUM: MOLLUSCA)

P. SHAHUL HAMEED and A. L. PAULPANDIAN
Centre of Advanced Study in Marine Biology, Parangipettai 608502, India.

THE spirochaete bacteria, belonging to the genus *Cristispira* are large (150 μm × 3 μm), motile, without flagella and with spiral axis[1] and reported to infest the crystalline style of several bivalve species[2-7] since their discovery by Certes[2]. Although there are about 20,000 described bivalve species[8], only 62 species have been reported to harbour *Cristispira* in the crystalline style and none reported from India. The present communication records the occurrence of *Cristispira* in the style of estuarine bivalves belonging to the species, *Crassostrea madrasensis, Meretrix meretrix, M. casta* and *Katelysia opima.*

During the present investigation, specimens of 12 bivalve species were collected from the marine and estuarine habitats of Parangipettai (11°29′ N lat. and 79°46′ E long.). The crystalline styles were removed by dissection from the bivalves and washed in sterile distilled water. The style was examined for the presence of *Cristispira* under low power of microscope in the dark field illumination. For measuring morphological characters, the style was softened in the sterile filtered sea water for 10 min and a bit of style was squashed and observed under high power. The bacteria were also stained in Giemsa, following the method of Berkeley[6].

It is evident from table 1 that only the estuarine oyster, *C. madrasensis* and clams *M. meretrix, M. casta* and *K. opima* carry a dense population of *Cristispira* in their styles and none of the marine bivalves harboured the bacteria. The style of every *C. madrasensis* examined was colonised by *Cristispira* and in the clams the percentage of infection ranged between 87–90%.

The morphological characters of *Cristispira* recorded in the four species varied within a narrow range (table 1). The striking common features are the pointed ends, cell length (46–57 μm), cell width (1.6–2.1 μm) and the number of turns (4–5) in the helix (figure 1). In general, they resemble the characters of *Cristispira anodontae* as described in the Bergey's manual[5]. Since *in vitro* axenic cultivation of *Cristispira* still remains a challenge in this field the taxonomic relationship between the 20 morpho-species described so far could not be established[1].

The bacteria were most abundant in the style of *C. madrasensis.* The soft nature of its style perhaps may provide suitable environmental conditions thus accounting for greater abundance of the bacteria recorded among the bivalves. In all the four bivalve species, the style has a central semi-fluid core surrounded by firmer crystalline layers (figure 2). Along the style matrix the bacteria move back and forth by undulation, the direction of movement being non-specific. The spirochaetes were distributed in large numbers in the central core than in the crystalline layers in which they orient themselves in the space between layers (figure 2). A similar differential distribution of the bacteria within the style was reported by Noguchi[3].

However, at the extreme gastral end of the style projecting into the stomach lumen, they were absent in all the four bivalve species. Berkeley[6] made similar observation in the style of *Saxidomus* and opined that *Cristispira* is anaerobic and the toxic oxidising condition prevailing at the gastral end may cause the bacteria to retreat from the region. But *in vitro*

Table 1 *Range of morphological characters* (μm) of *Cristispira in C. madrasensis K. opima, M. meretrix and M. casta*

Host Species	Number examined	Cell length	Cell width	Spiral wave-length	Spiral width	Number of turns
C. madrasensis	90	34.1–55.8 (46.2)	Constant (1.6)	6.2–15.5 (8.9)	3.1–9.3 (5.8)	2.5–6.0 (4.3)
K. opima	120	27.9–55.8 (56.8)	1.0–3.1 (2.0)	6.2–10.9 (8.5)	4.2–6.2 (5.2)	3.0–5.5 (3 8)
M. meretrix	120	31.0–59.0 (46.8)	1.6–3.1 (2.1)	9.3–17.1 (12.2)	6.2–12.4 (7.3)	3.0–5 0 (4.0)
M. casta	120	31.0–68.2 (46.2)	1.6–3.1 (1.9)	9.3–15.5 (11.0)	1.6–4.7 (3.1)	3.0–6.5 (5.4)

Figures in parantheses indicate mean values

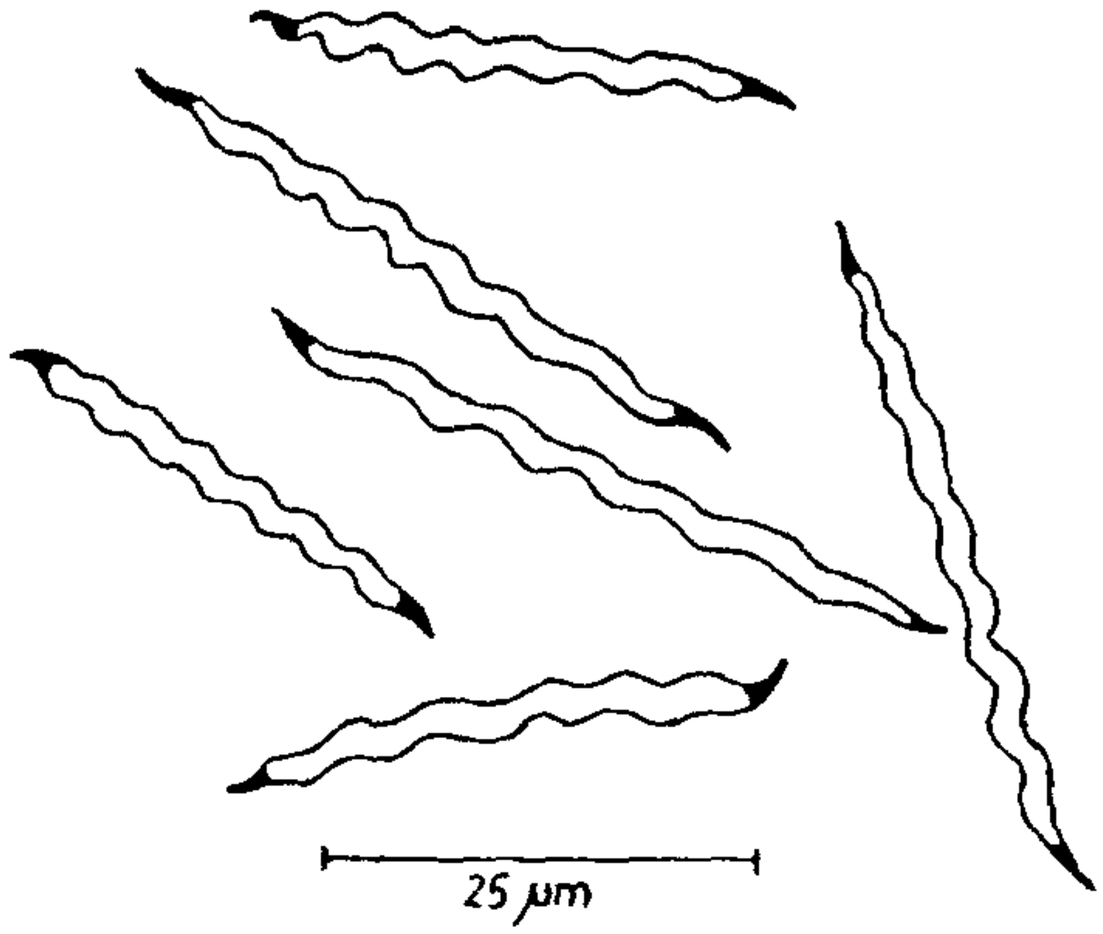

Figure 1. Structure of *Cristispira*.

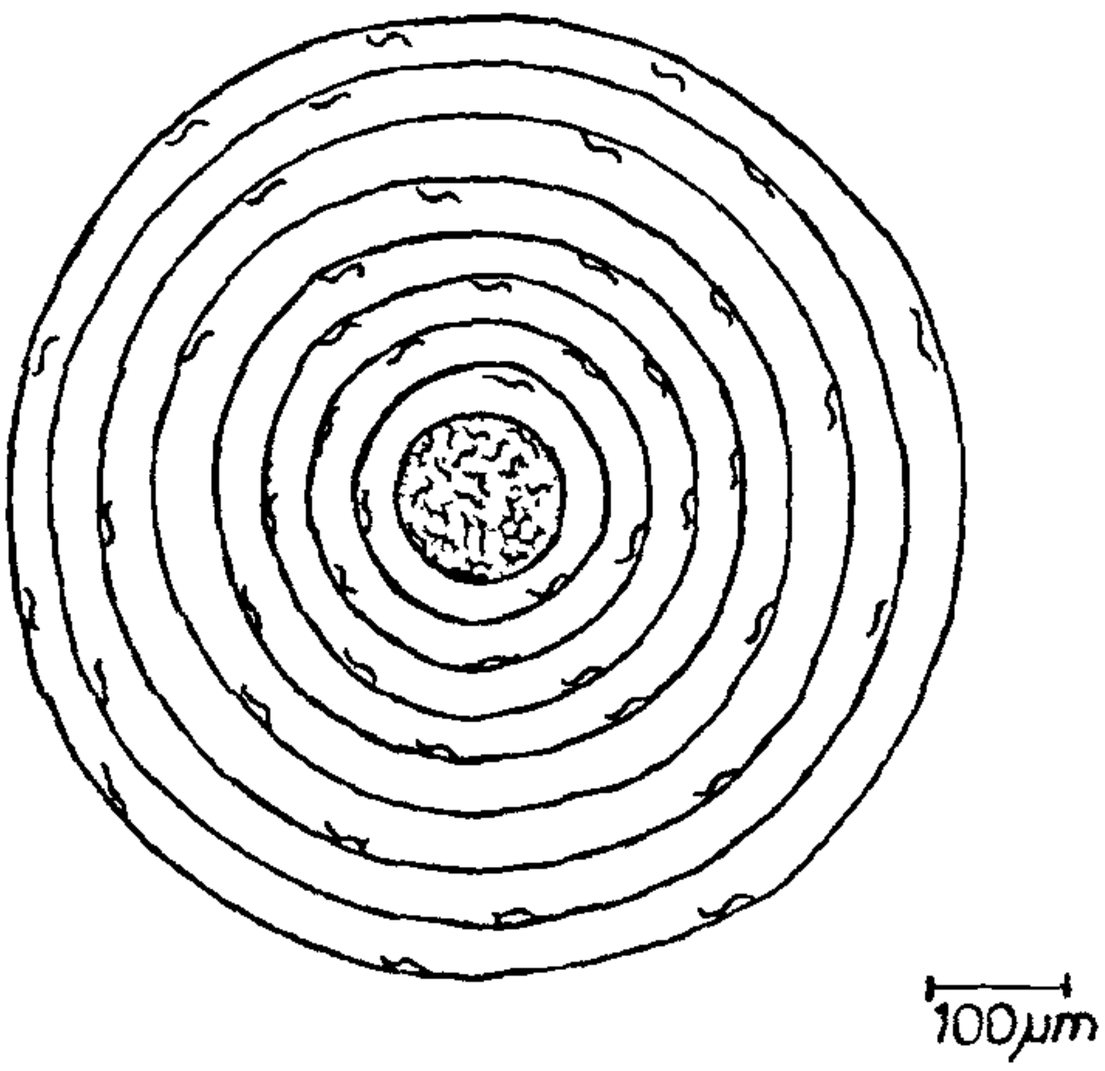

Figure 2. Transverse section of crystalline style of the oyster *Crassostrea madrasensis* showing the distribution of *Cristispira*.

observation of the style under low power of microscope, showed that the central core of the style flows out continously through the gastral end and therefore, the absence of *Cristispira* may be attributed to the negative response (negative taxis) of the bacteria to this anteriorly directed flow.

Crystalline style is a secreted mucoprotein rod containing several carbohydrases and thus aids the extracellular digestion in stomach[9]. Morton[10] suggested that cellulase activity of crystalline style may be directly linked with *Cristispira* population. The quantitative study of style cellulase activity revealed that a true cellulolytic activity was absent in all the four bivalve species that carry the bacteria (Personal observation). Further, Horiuchi and Lane[11] and Payne *et al.*[12], also proved that the cellulolytic property of style is molluscan but not bacterial. The bivalves inhabit the shallow estuarine water wherein organic matter undergoing degradation is abundant promoting the transmission of bacteria.

Dimitroff[4] considered them as parasites, Berkeley[6] as facultative anaerobes. Since the infection of *Cristispira* does not seem to affect the well-being of the host, it could be regarded as a commensal.

The authors are thankful to the Director for facilities. The fellowship awarded to PSH by UGC, New Delhi is gratefully acknowledged.

30 January 1984

1. Kuhn, D. A., *The prokaryotes*, Springer-Verlag, Berlin, 1981, 555.
2. Certes, A., *Bull. Soc. Zool.*, France, 1882, **7**, 374.
3. Noguchi, H., *J. Exp. Med.*, 1921 **34**, 295.
4. Dimitroff, V. T., *J. Bacteriol.*, 1926, **12**, 135.
5. Bergey, D. H., *Manual of determinative bacteriology*, Williams and Williams Co., Baltimore, 1957, 1094.
6. Berkeley, C., *Can. J. Zool.*, 1959, **37**, 53.
7. Bernard, F. R., *The Veliger*, 1970, **13**, 33.
8. Barnes, R. D., *Invertebrate zoology*, Saunders College, Philadelphia, 1980, 1089.
9. Purchon, R. D., *The biology of mollusca*, Pergamon Press, Oxford, 1968, 560.
10. Morton, J. E., *Biol. Rev.*, 1960, **35**, 92.
11. Horiuchi, S. and Lane, C. E., *Comp. Biochem. Physiol.*, 1966, **17**, 1189.
12. Payne, D. W., Thorpe, N. A. and Donaldson, E. M., *Proc. Malac. Soc. London*, 1972, **40**, 147.