

SPIRORBINAE (SERPULIDAE : POLYCHAETA) ON LIMPETS FROM THE SOUTH ORKNEY ISLANDS

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ABSTRACT. A collection of Antarctic limpets, *Patinigera polaris*, bore numerous *Paralaeospira levinseni* Caullery and Mesnil and a few of a new species which, though dextrally coiling, must be placed in *Protolaeospira* (= *Marsipospira* Bailey). This genus, like *Helicosiphon* and *Romanchella sensu stricto*, has a characteristic stalk for the attachment of embryos.

SPECIMENS of the limpet *Patinigera polaris* (Hombron and Jacquinot) which were encrusted with Spirorbinae were collected sub-littorally by one of us (Walker, 1972) over a period of several months in 1965, whilst working with the British Antarctic Survey at Signy Island, South Orkney Islands. The following descriptions of two species of Spirorbinae are based on alcohol-preserved material collected in August of that year, but others collected in February, March, May and June were also examined.

The animals were extracted by chipping away their tubes with dissecting needles. The general morphology was observed whilst in the preservative and viewed under a dissecting microscope in reflected light, but the fine details of the opercular talons could be seen clearly only after alcohol dehydration and immersion in clove oil. To distinguish details of setae the specimens were then mounted in polyvinyl-lactophenol (Knox, 1951; Gee, 1964) and viewed by phase contrast with quartz-iodide transmitted light. Drawings were made on squared paper with the help of squared gratitudes in the eyepiece, the largest setae and uncini of each type and species being selected for illustration. The material collected in May and June retained the body colours remarkably well 2 years after collection, and these were matched against the coding of the *Methuen handbook of colour* (Kornerup and Wanscher, 1967).

DIAGNOSES AND DESCRIPTIONS

The taxa below are used in the restricted senses outlined in an earlier paper (Knight-Jones, 1972b) and discussed on p. 39.

Genus *Paralaeospira* Caullery and Mesnil (1897) amended

Sinistral coiling; three rows of thoracic tori on the concave side; no embryonic attachment stalk; embryos incubated in the region of the faecal groove but attached neither to the body nor the tube; collar margins not fused dorsally; collar setae with fin and blade lacking cross-striations; sickle setae present in the third fascicle; thoracic uncini slender and with a blunt anterior peg; thoracic and abdominal uncini more numerous on the concave side (Fig. 3a); largest abdominal tori occur towards the anterior part of the setigerous region; abdominal setae about half the size of the collar setae (Fig. 3b) and with sharply tapered blades; no white attachment glands can be seen in the larvae.

Type: Paralaeospira aggregata Caullery and Mesnil (1897)

Paralaeospira levinseni Caullery and Mesnil (1897)

Tube up to 2.5 mm. across, smooth, round in cross-section. Coiling may be regular and flush with the substratum (Fig. 1a) or loose and somewhat ascending in crowded conditions (Fig. 1b). Dense aggregations are often formed as the young settle on or alongside adult tubes of their own or even other species (Figs. 1a, 2a and b).

Opercular plate of young forms thin, flat and lightly calcified. The calcification is often incomplete, in that a slightly eccentric "perforation" can be seen (Fig. 1c) particularly after clearing in clove oil. There is usually a minute talon towards the dorsal edge of the perforation (Fig. 1d). In older specimens the talon is a little more developed and variable in shape. The

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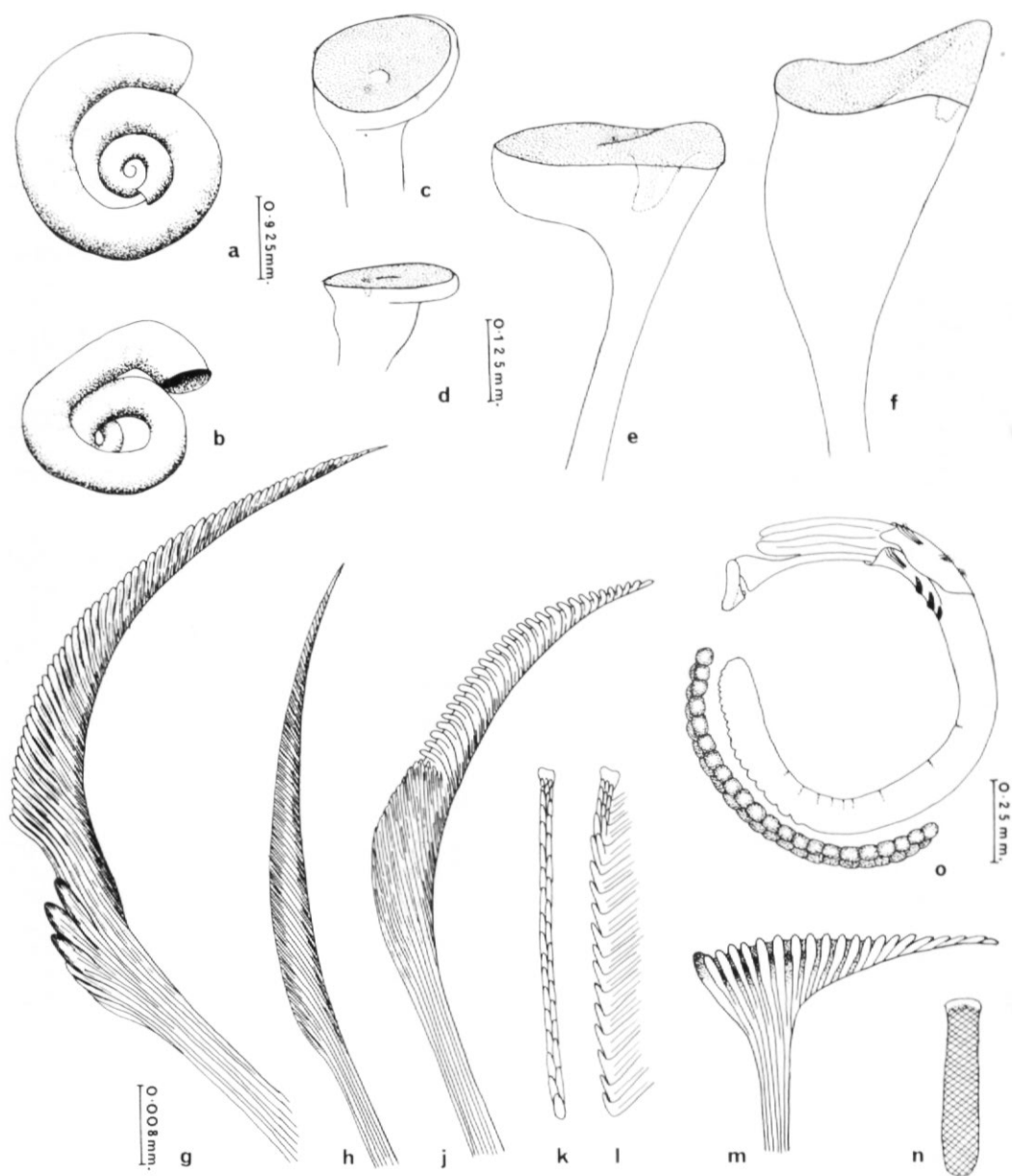


Fig. 1. *Paralaeospira levinseni*. a. Tube on which a young specimen of *P. levinseni* has settled; b. An irregularly coiled tube; c and d. Views of a young operculum; e and f. Side views of mature opercula; g. Collar seta; h. Simple seta as in the second and third fascicles; j. Sickle seta of the third fascicle; k. Thoracic uncinus viewed from above; l. Thoracic uncinus, side view; m. Abdominal setae; n. Abdominal uncinus (cross-hatching denotes longitudinal rows of surface teeth, which are too small to be accurately represented); o. Whole animal. Scales: b as a; e-f as c; h-n as g.

plate above the talon may be convex or even in the form of a sharp peak (Fig. 1e and f). The transparent talon is easily overlooked unless the operculum is cleared in clove oil.

Thorax. Collar seta each with a heavily toothed fin and finely serrate blade (Fig. 1g). Second fascicle of uniformly simple setae (Fig. 1h), but the third contains both simple and sickle types (Fig. 1j). The largest uncini bear two longitudinal rows of teeth for most of their length.

Abdomen. Relatively short asetigerous region followed by up to 30 setigers (Fig. 3a). Setae with sharply tapered blades (Fig. 1m). Uncini show little variation and seem to bear about ten longitudinal rows of teeth.

Incubation. The egg string (about 40 eggs) lies loosely along the faecal groove (Fig. 1o). No variation in the percentage breeding was observed between February and August.

Colour (preserved). Thorax and base of tentacles orange (5A7-6A7), stomach dull olive (3D3) and the remainder of the animal tinged yellowish orange (4A2-5A2).

Remarks. The type material of *P. levinseni* (from Orange Bay, near Cape Horn) was kindly loaned by the Muséum National d'Histoire Naturelle, Paris. The opercular plates agreed well with the younger form described above (Fig. 1d and e) and there was no difference in setation.

P. levinseni has been found recently in South Africa (personal observations by P. K.-J.) on algae and stones in littoral and sub-littoral zones, but forming particularly dense aggregations on limpets and mussels. It also occurs in New Zealand (personal communication from P. J. Vine), at Cape Denison, Antarctica (Monro, 1939; Harris, 1969), in the Straits of Magellan (Ehlers, 1901) and at Talcahuano, Chile (personal observations by P. K.-J.).

Genus *Protolaeospira* Pixell (1912) re-defined (Knight-Jones, 1972b)
(= *Marsiposira* Bailey, 1969b; includes *Pixellia* Pillai, 1970)

Type: Protolaeospira ambilateralis Pixell (1912)

Coiling usually sinistral; three rows of tori on the concave side of the thorax; other traces of a fourth thoracic segment may or may not be present; embryos attached to a stalk which arises dorsally from the floor of the faecal groove in the thoracic region and towards the left side; collar margins not fused dorsally; collar setae with separate fin and blade, the latter usually bearing cross-striations; sickle setae present in the third fascicle; thoracic and abdominal uncini more numerous on the concave side (Fig. 3c); thoracic uncini usually very long and slender, with a blunt bilobed anterior peg; abdominal setae less than a quarter the length of the collar setae (Fig. 3d) and with vestigial brush-like blades; opercular talon massive and usually bearing lateral lobes; unpaired white larval attachment glands may be present in the abdominal region.

Subgenus *Dextralia* Knight-Jones (1972b)

Type: Protolaeospira (Dextralia) falklandica Pixell (1913)

Coiling dextral; blade of collar setae lacking cross-striations; otherwise as above.

Protolaeospira (Dextralia) stalagmia n.sp.

Holotype: Operculum, British Museum (Nat. Hist.) No. ZB 1971, 245; slide, British Museum (Nat. Hist.) No. ZB 1971, 245a.

Paratype: British Museum (Nat. Hist.) No. ZB 1971, 246.

Tube dextral, large (up to 6 mm.), thick-walled, the last whorl with three well-defined ridges terminating as teeth over the aperture (Fig. 2a and b). The tubes of young specimens may bear only one median ridge.

Opercular plate asymmetrically convex. When cleared in clove oil, it is seen to form a domed roof over a glassy core of longitudinal rods, which are closely packed and fused together (Fig. 2c). The apex of the dome in larger specimens is usually missing, revealing an oblique concavity, at the bottom of which the rounded ends of the rods are seen. The talon is massive, bearing on

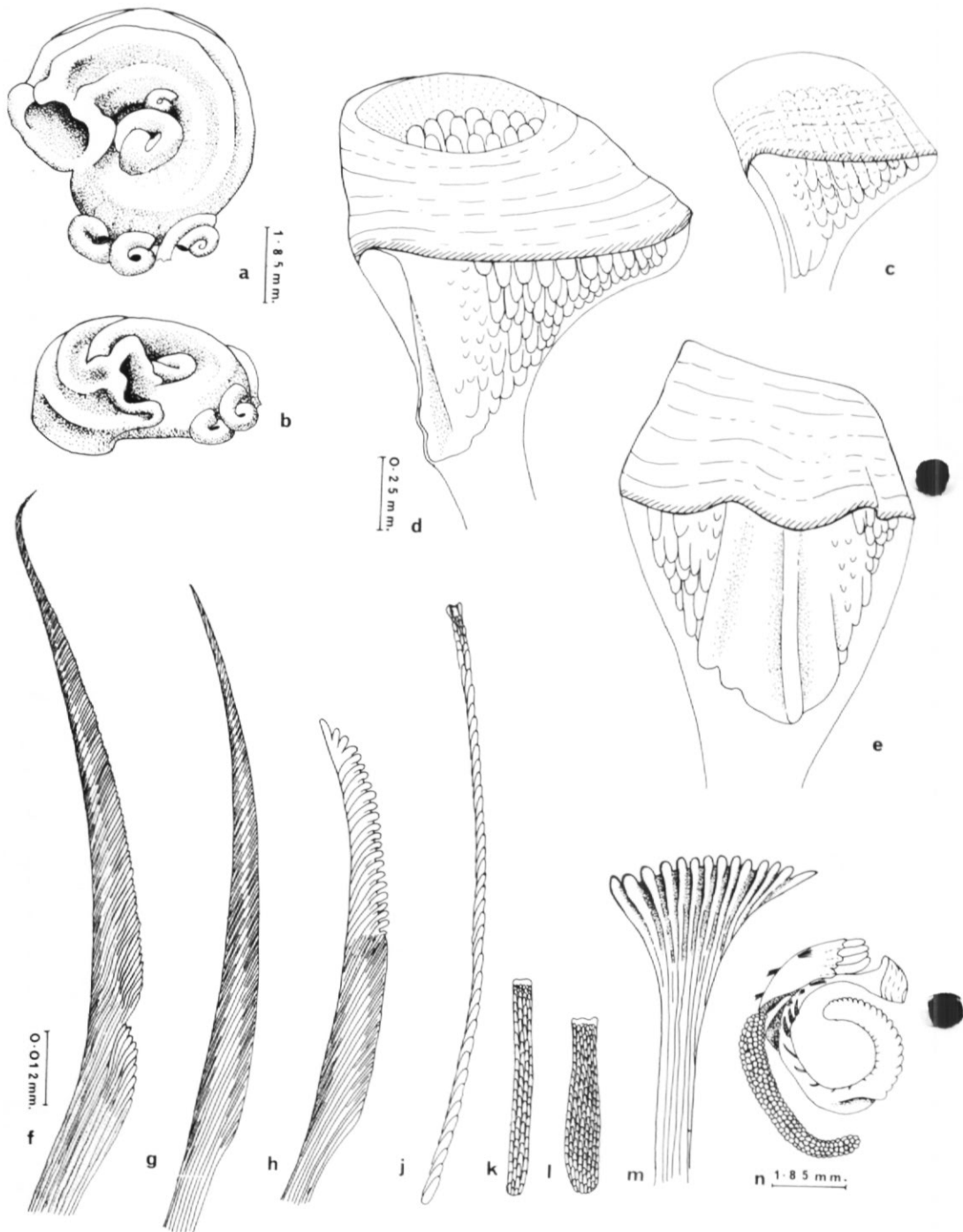


Fig. 2. *Protolaeospira (Dextralia) stalagmia*. a. Tube viewed from above, bearing both young and mature tubes of *Paralaeospira levinseni*; b. Side view of same tubes; c. Operculum of a small specimen as it appears in clove oil; d. Side view of operculum of a large specimen, after apical moult; e. Dorsal view of (d); f. Collar seta; g. Simple seta as in the second and third fascicles; h. Sickie seta of third fascicle; j. Thoracic uncinus; k. Uncinus typical of the first and second abdominal tori; l. Uncinus typical of the majority of abdominal tori; m. Abdominal seta; n. Whole animal showing embryo attachment stalk. Scales: b as a; c and e as d; g-m as f.

the dorsal side three well-spaced longitudinal ridges and, on the ventro-lateral sides, numerous pendant lobes which are apparently formed by the proximal ends of the rods (Fig. 2d). The specific name refers to these pendants.

Thorax. Collar setae unusual in having both fin and blade bearing finely serrate margins, with a minimal gap between the two regions (Fig. 2f). Setae of the second fascicle simple (Fig. 2g), whilst those of the third include both simple and sickle types (Fig. 2h). Uncini numerous and slender, the largest bearing a single row of teeth for most of its length, and with a deeply gouged anterior peg that may appear bilobed if viewed from certain angles.

Abdomen. Relatively short asetigerous region, followed by about 19 setigers with a bilaterally asymmetrical distribution of tori (Fig. 3c). Most of the tori are closely spaced and have uncini with about nine longitudinal rows of teeth (Fig. 2l), but the first and second tori (concave side) are widely spaced and have relatively slender uncini with only about four longitudinal rows of teeth (Fig. 2k). Setae with small brush-like blades bearing thick distal teeth (Fig. 2m). In many fascicles, only the end view of these teeth can be seen, for the shafts of the setae (Fig. 3d) are so short compared with the girth of the animal that they are not spread out by the pressure of the cover slip.

Incubation. The egg mass is sausage-shaped (comprising over 200 eggs) and lies along the body in the position of the faecal groove, attached anteriorly by a stalk which arises from the floor of the faecal groove close to the first and second tori on the concave side (Fig. 2n). It is interesting to note that the ten specimens collected in August were large (greatest diameter 4–6 mm.) and of those dissected most were breeding, whilst the rest had well-developed embryo attachment stalks. A few smaller specimens were found in the May and June collections, three of which (2.7, 3.2, 3.7 mm.) had small to well-developed attachment stalks of various lengths, whilst the remaining three (2.7, 2.7 and 4.0 mm.) were without such stalks. It therefore seems probable that the stalk is developed only a relatively short time prior to the first spawning and is retained to anchor subsequent broods. This species was not found in the February and March samples, but this may not be significant owing to its relatively sparse settlement (19 specimens from 21 limpets).

Colour (preserved). Ampulla, opercular stalk, tentacles and upper thorax bright reddish orange (7A8); stomach, dull olive (3D3); and the remainder of the animal tinged yellowish orange (4A2–5A2).

Remarks. The type and only other species of this subgenus, *P. (D.) falklandica* (kindly loaned by the Royal Scottish Museum), differs in having a funnel-shaped operculum bearing shallow proximal lobes on the dorsal side; a strongly toothed fin on each collar seta, separated from the blade by a distinct gap; and evenly spaced abdominal tori with uncini of rather uniform form and size.

P. (D.) stalagmia is superficially similar to the sinistral form *Protolaeospira (P.) lebruni* (Caullery and Mesnil, 1897). Both species have two types of abdominal uncini, a particularly massive opercular talon and usually a markedly convex opercular plate. This plate is often in the form of a truncated cone which is seen particularly frequently in large individuals, suggesting loss of the distal part during moulting. In view of the occasional records of *situs inversus* strains of Spirorbinae (e.g. of *Circeis spirillum* L., Bock, 1953; *Paradexiospira vitrea* Fabricius, Potswald, 1965; and *Janua (Dexiospira) steueri* Sterzinger, 1909; Vine, 1972), the two species were closely compared.

The type material of *P. (P.) lebruni* (kindly loaned by the Muséum National d'Histoire Naturelle) differs in that those opercular plates that are shaped like truncated cones are of simple form, without any concavities or associated protuberances; the ventro-lateral lobes of the talon are fewer, larger and more irregular, with no sign of an interior rod-like construction; the collar setae have coarsely toothed fins and faintly cross-striated blades; and the first abdominal uncini on the concave side are unusually numerous (over 100). Certainly, the two species are distinct, but they may well have a comparatively close *situs inversus* relationship. Nevertheless the resemblance between *P. (D.) stalagmia* and *P. (D.) falklandica* seems even closer, suggesting that the subgenus *Dextralia* is a useful taxon. A rough application of

numerical taxonomy using all appropriate characters mentioned above (20) indicates the following percentage similarities between *P. (D.) stalagmia* and related forms:

<i>Protolaeospira (D.) falklandica</i>	74
<i>Protolaeospira (P.) lebruni</i>	71
<i>Protolaeospira (P.) ambilateralis</i>	58
<i>Paralaeospira levinseni</i>	58

DISCUSSION

Recognition of the taxonomic importance of the embryo attachment stalk in Spirorbinae originated with Bailey (1969b), who introduced the name *Marsipospira* to avoid confusion which might follow re-definition of *Protolaeospira*. The latter name was proposed by Pixell for *P. ambilateralis*, a little known species which she found to possess all four of the parapodial rudiments appropriate to a fourth thoracic "segment". Pillai (1970) re-defined *Protolaeospira* and introduced the new name *Pixellia*, for forms with an attachment stalk but fewer than four such rudiments in the last thoracic "segment". As Zibrowius (1968) has pointed out, it is best to avoid taxonomic distinctions based on the exact number of such rudiments, some of which may appear quite late in the ontogeny (Caulley and Mesnil, 1897; Crisp and others, 1967; Bailey, 1969a). It seems desirable to have one name for this fairly well-defined group of species and the name *Protolaeospira* has precedence over that proposed by Bailey. The genus must include *Protolaeospira racemosus* Pixell, originally placed in *Paralaeospira*. The discovery that the genus includes dextral forms as well as sinistral ones agrees with other evidence that *situs inversus* changes have occurred fairly readily in the Spirorbinae (Knight-Jones, 1972a).

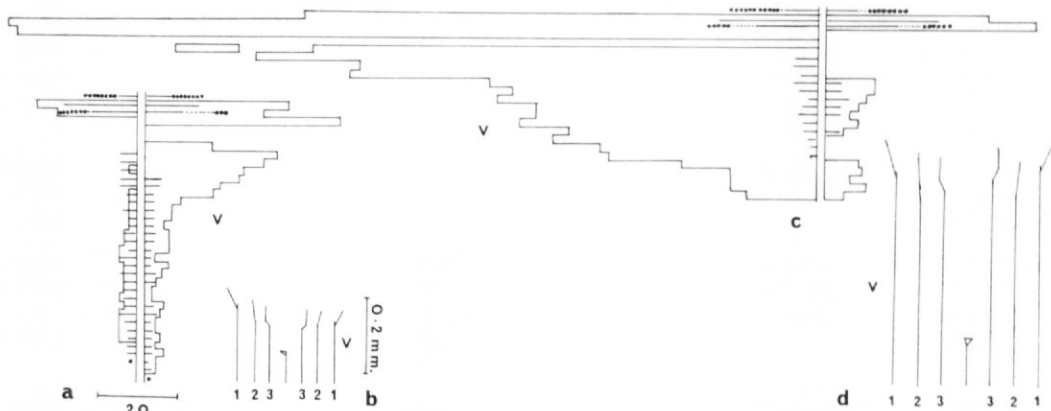


Fig. 3. a and b, *Paralaeospira levinseni*, c and d, *Protolaeospira (Dextralia) stalagmia*. Diagrams showing (a and c) the distribution of uncini and setae and also (b) and (d) the relative sizes of setae and their blades. (a) and (c) represent a worm straightened out and viewed ventrally (i.e. the concave side, which is marked "V", appears to the observer's right if the species is sinistral). Numbers of uncini per segment can be judged by applying the horizontal scale to the histograms. The numbers of setae of various types are indicated on the same scale by the following symbols:

- Fin and blade setae in 1st thoracic fascicle.
- Simple setae in 2nd and 3rd thoracic fascicles.
- Standard abdominal setae.
- Capillary setae in the 1st thoracic fascicle.
- Sickle setae in the 3rd thoracic fascicle.
- Hooked abdominal setae.
- - - Indeterminate setae.

The gap between thorax and abdomen represents the length of the aetigerous region relative to the length of the nearest abdominal segment. In (c) the anterior abdominal segment is unusually long, so that the aetigerous region appears relatively short. Each figure relates to a single typical individual.

b and d, 1, 2 and 3 denote the thoracic fascicles and the middle seta represents the largest abdominal seta. Each infected portion indicates the length of the blade and the angle at which it comes off from the shaft. Scales: c as a; d as b.

Recent studies (Knight-Jones, 1972*b*; personal communication from P. J. Vine) have shown that this genus is well represented in the Southern Hemisphere. The Antarctic form *Helicosiphon biscoensis* also has a stalk for the attachment of embryos (Hartman, 1953) and is indeed very closely related to *Protolaeospira* (Knight-Jones and others, in press). Southern species of *Romanchella* have a somewhat similar attachment of embryos (Knight-Jones, 1972*b*; Knight-Jones and others, 1972). All of these forms resemble *Paralaeospira* and other tube-incubating forms of the Southern Hemisphere in that they have a very asymmetrical distribution of setae and uncini (Fig. 3a and c).

Paralaeospira is closely related to *Protolaeospira*. It differs principally in lacking an embryo-attachment stalk, as was established by careful examination of the type species *Paralaeospira aggregata*. But even a young *Protolaeospira*, which has not developed its attachment stalk, can be distinguished from a *Paralaeospira* because of the remarkably short brush-like blades of the abdominal setae and the relatively massive talon with lateral protuberances or lobes. The sinistral species of *Protolaeospira* so far described also differ in that the blades of the collar setae appear cross-striated.

In contrast, the genus *Spirorbis sensu stricto* (which seems to be poorly represented in the Southern Hemisphere) has a fairly symmetrical setation and the habit of attaching its egg strings to the wall of its tube. *Paradexiospira vitrea* Fabricius, the type of its genus, attaches its embryos individually to the tube wall (Knight-Jones and others, 1972). Southern Hemisphere tube-incubators, in contrast, either attach their egg-masses to special stalks or hold them freely in the faecal grooves.

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