

Spirorbinae (Polychaeta, Serpulidae) of the Hawaiian Chain Part 1, New Species¹

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TUBEWORMS of the subfamily Spirorbinae occur throughout the world and have been recorded from the east and northeast Pacific by Bush (1904), Pixell (1912), Rioja (1942, 1962), Berkeley and Berkeley (1952), Bailey and Harris (1968), Hartman (1969), and Straughan (1969). No previous taxonomic study has been made on those from the Hawaiian Islands, however.

Collections made by Dr. Dale Straughan around Oahu were placed at my disposal and, in early 1970, an opportunity was taken to make intertidal and subtidal collections on Oahu and Hawaii. Snorkel and SCUBA techniques were employed for collecting. Specimens were cut from their substrata and preserved in 5 percent seawater formalin. Details of setation were studied 4 months later on specimens mounted in polyvinyl-lactophenol and viewed with the phase microscope, using quartz-iodide illumination.

Previously described species found in these collections are discussed in a joint paper on p. 150–182 (Vine, Bailey-Brock, and Straughan, 1972), in which zoogeographic comparisons are made, but the new species are dealt with here.

Taxonomy of Spirorbinae has recently undergone several important advances. Bailey (1969) suggested a scheme for dividing the genus *Spirorbis* Daudin (1800) into several subgenera based on groups of associated characters, especially emphasizing methods of brood protection. The system adopted here is an extension of this and follows that suggested by Knight-Jones (1972), in which the subgenera recognized by Bailey are elevated to generic rank. Pillai (1970) proposed many more genera, but the divisions between these often rested on single

characters, resulting in a system which failed to recognize the close relationships which exist between many species. One of the characters on which he relied was the fusion of dorsal collar folds in certain forms, but the taxonomic importance of this has recently been placed in doubt (Straughan, 1966; Knight-Jones, 1972; Vine, in press). All the new species described here fit into one of the genera named in Bailey's scheme.

DIAGNOSES AND DESCRIPTIONS

Genus *Pileolaria* Claparède, 1868
(amended Knight-Jones, 1972)

Description of genus is as follows: sinistral coiling; incubation in the operculum; only two pairs of thoracic tori; fin and blade collar setae, with the blades usually bearing large teeth and distinct cross-striations, and greatly exceeding in length the blades of the abdominal setae; sickle setae may or may not be present; thoracic uncini very slender, with only one to three longitudinal rows of teeth; pegs of thoracic uncini about as broad as rest of uncinus and not pointed in surface view; largest abdominal tori lie toward the posterior half of the setigerous region; larvae have single, white, middorsal attachment glands.

Subgenus *Pileolaria* (Vine, in press)

Operculum lacks a secondary plate and same chamber is probably used for successive broods; collar setae are coarsely toothed and cross-striated; thoracic uncini have only one or two longitudinal rows of teeth.

Type

Pileolaria (Pileolaria) militaris Claparède, 1868.

Pileolaria (Pileolaria) semimilitaris n. sp.
Fig. 1, 2a, d

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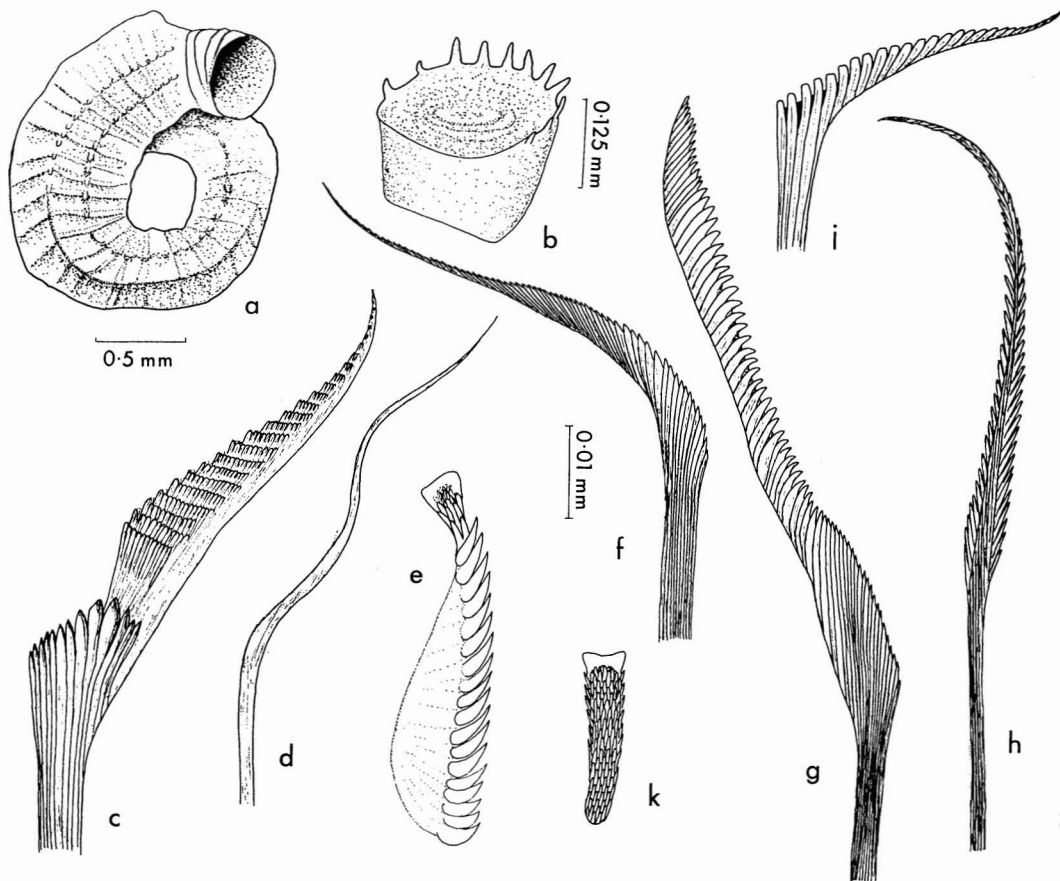


FIG. 1. *Pileolaria (Pileolaria) semimilitaris* n. sp. *a*, tube; *b*, empty operculum; *c*, fin and blade collar seta; *d*, smooth capillary seta associated with collar setae; *e*, thoracic uncinus; *f*, simple seta as in second and third fascicles; *g*, sickle seta from third fascicles; *h*, face view of simple seta from third fascicle; *i*, abdominal seta; *k*, abdominal uncinus.

SCALE: *c*, *d*, *e*, *g*, *h*, *j*, and *k* as *f*.

Holotype

Holotype is set in polyvinyl-lactophenol mount. British Museum (Natural History) no. ZB. 1972. 12a.

Paratype

One specimen is preserved as a polyvinyl-lactophenol mount.

Material

Two specimens.

Location

Coconut Island, Oahu, Hawaii.

Habitat

P. semimilitaris is found on settlement plates in shallow water.

Description of Species

TUBE: Tube is sinistral, nonporcelaneous. Three longitudinal ridges are formed by rows of calcified "knobs," between which there are transverse ridges (Fig. 1*a*). Mouth of tube is partly upturned. Only one whorl is visible from above. Coil diameter is 2.0 to 3.0 mm.

THORAX: Thorax has two pairs of tori. Dorsal collar folds are not fused. Collar setae have dis-

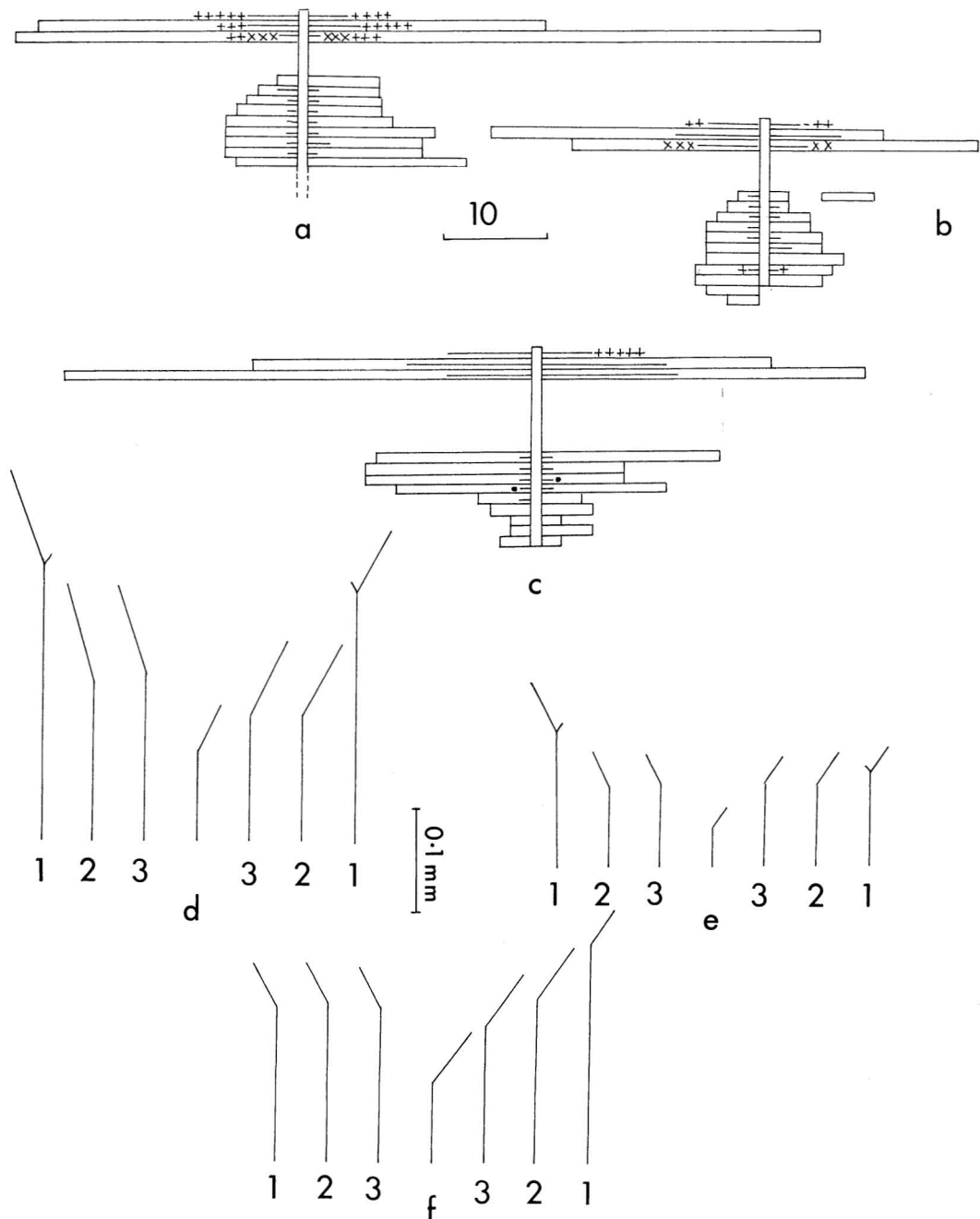


FIG. 2. Distribution of setae and uncini, *a-c*, and relative lengths of setal blades and shafts, *d-f*. *a* and *d*, *Pileolaria* (*Pileolaria*) *semimilitaris* (the abdomen did not appear to be complete); *b* and *e*, *Pileolaria* (*Duplicaria*) *dalestraughani*; *c* and *f*, *Janua* (*Dexiospira*) *turrita*.

The histograms represent the numbers of uncini in each torus and the setae associated with each torus are represented by a short line or by the following symbols: + = capillary seta (in thorax or abdomen); X = sickle seta (thorax only); • = secondary abdominal seta with rudimentary shaft.

The species are drawn as they appear *in situ*, so that in sinistral species the concave side of the animal is on the observer's right and, in the dextral one, on the observer's left.

The setal diagrams are each drawn with an abdominal seta in the center. The numbers 1, 2, and 3 refer to setae of the collar, second and third fascicles, respectively.

tinct cross-striations and a proximal fin with many teeth (Fig. 1*c*). Smooth capillary setae are associated with all the thoracic fascicles. Second and third segments have simple, finely serrate setae and the latter segment also has sickle setae. The distal portions of the sickle setae are rather broad and almost three times as long as the proximal portion (Fig. 1*g*). Uncini have one or two longitudinal rows of teeth and a gougelike fan anteriorly (Fig. 1*e*).

OPERCULUM: Operculum is slightly domed and has a narrow rim of spines (Fig. 1*b*). It is very lightly calcified and extremely fragile. Its general structure is similar to that of *P. pseudomilitaris* (Thiriot-Quiévreux, 1965) or *P. quasimilitaris* (Bailey, 1970).

ASETIGEROUS REGION: This region is rather long but, because the nearer abdominal tori are also widely spaced, it is equivalent to only twice the distance between the first two abdominal tori.

ABDOMEN: Abdomen has approximately nine segments. Setae are geniculate with blunt, almost square-ended teeth (Fig. 1*j*). Uncini have approximately five longitudinal rows of distinct teeth and a wedge-shaped convoluted anterior end (Fig. 1*k*).

INCUBATION: No eggs or embryos were found but the structure of the operculum strongly suggests that this is used as a brood chamber.

Remarks

Presence of sickle setae in the genus *Pileolaria* is a useful characteristic for separating species. Indeed, Pillai (1970) used the presence or absence of sickle setae as a criterion for distinguishing genera. On this basis alone *P. semimilitaris* is different from *P. pseudomilitaris* (which it superficially resembles), *P. moerchi* Levinsen (1883) (*sensu* Berkeley and Berkeley, 1952), and *P. berkeleyana* Rioja, 1942.

It bears closest similarities to *P. quasimilitaris* from the West Indies. Both species have a domed operculum with spines (a double row in *P. quasimilitaris* and single row in the new species described here). Although Bailey illustrated thoracic uncini of *P. quasimilitaris* with up to four longitudinal rows of teeth, investiga-

tion of specimens identified by her reveals a single row of teeth along most of the length of each uncinus. This is similar to those of *P. semimilitaris*. The two species differ in tube form, however, that of *P. quasimilitaris* lacking transverse ridges and "knobs" on the longitudinal ones. The opercula also show differences, there being a double row of spines on the more domed operculum of *P. quasimilitaris*. The full extent and importance of these differences, however, will be revealed only when more specimens are available.

Subgenus *Duplicaria* Vine, in press

Type

Pileolaria (Duplicaria) koebleri Caullery & Mesnil, 1897.

Description of type is as follows: adult operculum developing from juvenile form without sharp dimorphism; two or more opercular plates stacked one above the other; embryos brooded below them in a chamber with lightly calcified, rather delicate walls; collar setae with cross-striations lacking or less distinct than in *Pileolaria (Pileolaria)*; thoracic uncini with more than a single longitudinal row of teeth; anterior abdominal torus on concave side is usually split into two unequal portions.

Pileolaria (Duplicaria) dalestraughani n. sp.

Fig. 2*b, e, 3*

Holotype

Holotype is mounted in polyvinyl-lactophenol. British Museum (Natural History) no. ZB. 1972. 13*a*.

Paratypes

One specimen is mounted in polyvinyl-lactophenol and five specimens preserved in tubes.

Material

Seven specimens.

Location

Maili Point, Oahu, Hawaii (8 m deep); McVey's artificial reef, Oahu (15 m deep).

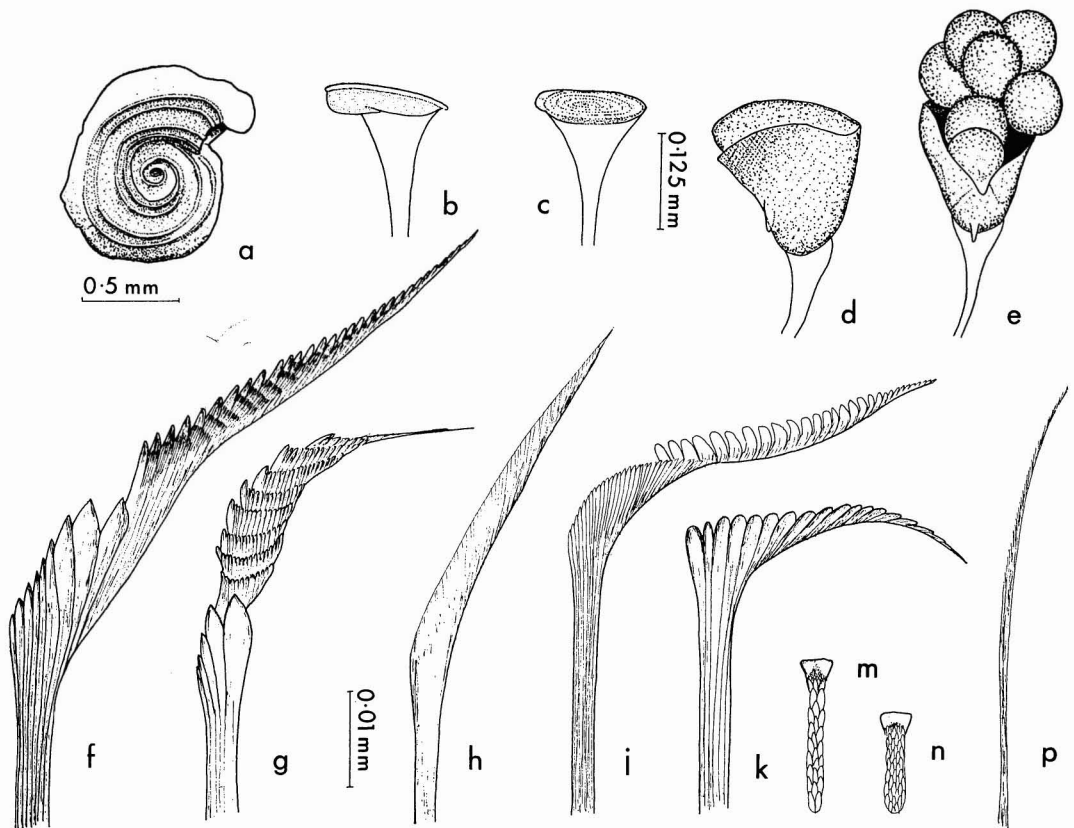


FIG. 3. *Pileolaria (Duplicaria) dalestraughani* n. sp. *a*, tube; *b* and *c*, juvenile opercula; *d*, adult operculum without eggs; *e*, adult operculum containing eggs; *f*, fin and blade collar seta; *g*, edge-view of collar seta showing rows of teeth; *h*, simple seta as found in second and third fascicles; *i*, sickle seta from third fascicle; *j*, abdominal seta; *k*, thoracic uncinus; *l*, abdominal uncinus; *m*, capillary seta from posterior abdominal fascicle.

SCALE: *b* and *e* as *c* and *d*; *f*, *j*, *k*, *m*, *n*, and *p* as *g* and *h*.

Habitat

P. dalestraughani is found on bryozoa encrusting dead corals.

Description of Species

TUBE: Tube is sinistral, nonporcelaneous, and has two or three whorls. Coil diameter is 1.5 to 2.0 mm. Four narrow and rather delicate longitudinal ridges may be seen on top of tube, two of which are grouped on each side of the top, with a wider gap in the midsection (Fig. 3*a*). Sides of tube are almost vertical. Terminal section is often ascending.

OPERCULUM: The operculum has a simple,

lightly calcified plate in juveniles (Fig. 3*b, c*) and a delicate cup forming the brood chamber in adults (Fig. 3*d, e*). A minute talon is present on the dorsal side of this, close to the base. The operculum was only just large enough for two eggs to be held in the cup but about six embryos were brooded; most of them were overspilling the cup but were apparently held in place on top of it by a mucuslike covering. The delicately calcified walls of the cup are somewhat reminiscent of those of *P. (D.) koebleri* and *P. (D.) endoumensis* Zibrowius (1968), species which have multiple, loosely hinged plates in their opercula. Accordingly, several additional tubes were opened to see if any loose opercular plates could be found on top of the cup, but none were ob-

served. There is a deep V-shaped indentation on the dorsal side of the cup, however, which tends to support the suggestion that a plate may hinge over the top of the operculum during initial development of the eggs.

THORAX: The thorax has two pairs of tori, each with relatively few uncini. Collar setae show pronounced asymmetry, those on the convex side being much larger than the others. They have a proximal fin with three large and approximately four smaller teeth (Fig. 3*f*). This fin is separated by a gap from a distal blade with somewhat rounded teeth and rather faint cross-striations. These are more prominent when the blade is viewed edge-on (Fig. 3*g*). Flexible capillary setae are associated with the collar setae. Second and third segments have simple, finely serrate setae and the third segment also has sickle setae (Fig. 3*j*). Uncini have about three longitudinal rows of teeth and a blunt anterior end lacking teeth (Fig. 3*m*).

ASETIGEROUS REGION: This region is long, approximately twice the length of the anterior abdominal segment, even though the tori there are widely spaced.

ABDOMEN: The abdomen has nine segments. The first abdominal torus on the concave side is divided into two parts, like that recently described in *P. koehleri* (see Vine, in press). Setae are geniculate and have blunt, rounded teeth (Fig. 3*k*). Posterior segments also have capillary setae. Uncini have approximately four longitudinal rows of teeth and a broad anterior peg (Fig. 3*n*).

INCUBATION: Incubation is in operculum.

Remarks

In several ways this species conforms with the diagnosis of the subgenus *Duplicaria* and resembles the related species *P. (D.) koehleri*, *P. (D.) endoumensis* and perhaps *P. (D.) gelasinifera* Pillai (1970). The operculum has delicately calcified walls to what would appear to be a secondary plate, inasmuch as it lies below the embryos (though it is uncertain whether it ever has the multiple hinged plates which seem to characterize most members of this subgenus). The anterior abdominal torus on the concave

side is split and the largest thoracic uncini have more than a single row of teeth. It must be admitted that the collar setae are faintly cross-striated, but are less so than in *Pileolaria sensu stricto*.

P. (D.) dalestraughani appears to be most closely related to *P. (D.) endoumensis*, differing from this species mainly in having four longitudinal ridges on the tube, a slightly different operculum, and collar setae which are cross-striated only faintly.

Genus *Janua* Saint-Joseph, 1894

(redefined Knight-Jones, 1972)

Genus *Janua* has the following characteristics: mostly with dextral coiling; incubation in an opercular brood chamber, below which a secondary plate (rudiment of next opercular plate) is formed soon after spawning; only two pairs of thoracic tori; collar setae without a toothed fin; abdominal setae with blades as big as or bigger than those of the collar setae (Fig. 2) and often accompanied by secondary setae with rudimentary shafts; thoracic uncini with anterior pegs narrow and more or less pointed in surface view; largest abdominal tori lie in the anterior half of the setigerous region; larvae have paired white attachment glands in thoracic region.

Subgenus *Dexiospira* Caullery & Mesnil, 1897

(amended Knight-Jones, 1972,
= *Neodexiospira* Pillai, 1970)

The subgenus may be described as follows: coiling usually dextral; talon when present flattened and often bifid; sickle setae absent; margins of the collar usually fused over the middorsal thoracic groove, to form a tunnel.

Type

Janua (Dexiospira) pseudocorrugata Bush (1904) (= *Spirorbis corrugatus* Caullery & Mesnil, 1897).

Janua (Dexiospira) turrita n. sp.

Fig. 2*c, f, 4*

Holotype

Holotype set in polyvinyl-lactophenol mount. British Museum (Natural History) no. ZB. 1972. 14*a*.

Paratypes

Eleven specimens preserved in tubes comprise the paratypes. British Museum (Natural History) no. ZB. 1972. 15a.

Material

Fourteen specimens.

Location

Janua (Dexiospira) turrita was taken offshore from Hilo, Hawaii.

Habitat

The species is found in the intertidal zone on red algae.

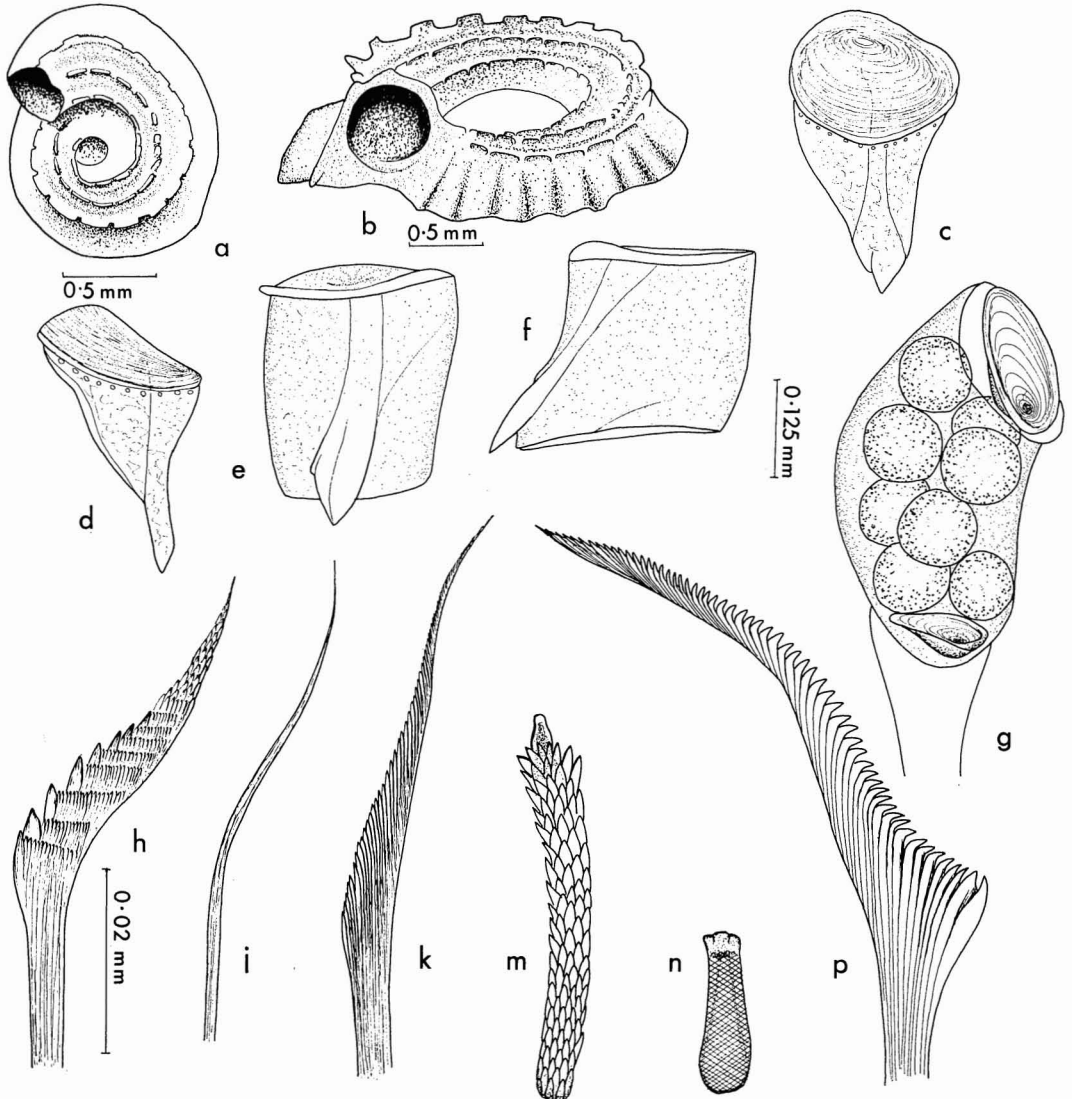


FIG. 4. *Janua (Dexiospira) turrita* n. sp. *a* and *b*, tube; *c* and *d*, juvenile operculum; *e* and *f*, primary brood chamber with talon but no eggs; *g*, later operculum without talon but containing eggs; *b*, collar seta from convex side; *j*, capillary seta associated with collar setae; *k*, simple seta from second or third fascicle; *m*, thoracic uncinus; *n*, abdominal uncinus (cross-hatching represents rows of fine teeth, too small to draw accurately); *p*, abdominal seta.

SCALE: *c*, *d*, and *e* as *f* and *g*; *k*, *m*, *n*, and *p* as *b* and *j*.

Description of Species

TUBE: Tube is dextrally coiled with two or three whorls. It is nonporcelaneous. Three longitudinal ridges are formed by blunt castellations, those on the outer ridge projecting outward and visible from above, whereas the other two ridges project more or less vertically and can best be seen in side view (Fig. 4*a* and *b*). Central concavity is within whorls of tube. Mouth overlies half the thickness of the previous whorl. Coiling is sometimes helical. Coil diameter is 2.0 to 2.5 mm.

OPERCULUM: The operculum exhibits three characteristic forms. First, the juvenile operculum has an asymmetrical convex plate and a long, eccentric, asymmetrical talon (Fig. 4*c* and *d*). The walls of the primary opercular chamber develop under the plate, and calcification appears to be uneven, thus giving the appearance of wavy lines when viewed under reflected light. A band of minute calcified knobs is present under the edge of the plate. The talon persists in the primary brood chamber, but the convex plate is shed, leaving a flat or slightly concave, very lightly calcified plate (Fig. 4*e* and *f*). The talon joins the plate at an oblique angle and causes the chamber walls to be pulled out at the base. The third type of operculum is that of later brood chambers which lack talons and have small, calcified, concave plates on top of the broader distal end of the chamber (Fig. 4*g*). Each of these originates as the basal plate of an earlier operculum. The walls of all these opercula are lightly calcified and are more or less transparent.

THORAX: The thorax has two pairs of tori. Dorsal folds of the collar are fused. Collar setae on the convex side have coarse teeth and cross-striations, but lack proximal fins (Fig. 4*b*). Capillary setae with finely striated narrow blades are associated with these. Collar setae on the concave side are similar to the finely serrated setae of the second and third fascicles (Fig. 4*k*). Uncini have two or three longitudinal rows of teeth, and several teeth project anteriorly; these splay out on each side of a prominent peg (Fig. 4*m*).

ASETIGEROUS REGION: This is rather long,

about six times the length of the anterior abdominal segment.

ABDOMEN: The abdomen has about nine segments. Setae are geniculate with long, rather narrow blades joining the shaft in a much wider region, from which the shaft tapers markedly (Fig. 4*p*). Secondary setae are present in some segments (Vine, in press). Uncini have fine teeth arranged in approximately eight longitudinal rows. The anterior end lacks teeth and has a broad fan with a darker region centrally, which may be a blunt peg or caused by convolutions of the fan (Fig. 4*n*).

INCUBATION: Incubation is in operculum.

Remarks

This species is clearly different from any previously described member of the genus *Janua*. It is easily recognized by the sculpturing of its tube (after which it is named) and the form of its operculum. These characters alone are sufficient to distinguish it from *J. (D.) steueri* Sterzinger (1909), *J. (D.) pseudocorrugata* Bush (1904), *J. (J.) pagenstecheri* Quatrefages (1865), and *J. (Leodora) knightjonesi* de Silva (1965), all of which occur around the Hawaiian Islands (Vine et al., 1972). It is more similar to *J. (D.) preacuta* Vine (in press) from the Red Sea and to a new species from southern Australia described by Phyllis Knight-Jones (in press). It differs from both these forms, however, in the detailed structure of its tube and polymorphic opercula.

GENERAL DISCUSSION

The discovery of only three new species of Spirorbinae amongst a total of 13 species, which were found in a series of intensive collections, is in line with current discoveries elsewhere and suggests that the stage is approaching when most of the shallow-water species from warm seas will have been described.

The distribution of Spirorbinae around the Hawaiian Islands and the contributions towards zoogeography which this study has made is discussed on p. 150–182 in a separate joint paper (Vine et al., 1972).

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