XI. *Synagoga mira*, a Crustacean of the Order *Ascothoracica*.
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(Plates 33-35.)

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PROF. DE LACAZE-DUTHIERS published in 1882 a monograph of a small and remarkable Crustacean which he found off the Algerian coast, parasitic upon a new Antipatharian which he named *Gerardia*. This parasite he called *Laura gerardiae* *.

This Crustacean was covered by the polypes of *Gerardia*, except a very small opening on the dorsal margin. It was contained in a *Cypris*-like sheath formed by two very large valves, which were five or six times the length of the body itself. Lacaze-Duthiers bred the young and assigned the species to the Cirripedia, establishing for it a new group which he styled "*Ascothoracidae* ou *Rhizothoracidae*," the former of which names has since been generally adopted.

Since the publication of Lacaze-Duthiers' admirable and exhaustive monograph five more species of the group have been discovered:—

1. I briefly noticed a species, which is the subject of the present paper, in the Report of the British Association 1887 (1888), p. 86.
2. Dr. G. H. Herbert Fowler † described a curious Crustacean parasite which he found in a specimen of the coral *Bathyactis symmetrica* which had been dredged by the 'Challenger' in the Pacific Ocean in lat. 35° 41' N., long. 157° 42' E., in the great depth of 2300 fathoms.
3. Mr. N. Knipowitsch ‡ found a species in the White Sea inhabiting the two Echinodermata *Echinaster sarsii* and *Solaster papposus*; this species he named *Dendrogaster astericola*.
4. M. Otto le Roi § has described two additional species of *Dendrogaster*—the one *D. arborescens* from *Dipsacaster sladeni*, Alcock, the Cape; and *D. ludvigi* from *Echinaster fallax*, Müll. & Trosch., the Philippines.

Monsieur A. Gruvel, in his 'Monograph des Cirrhipèdes ou Thécostraces,' 1905, instituted a distinct order *Ascothoracica* to receive these forms and has made each of them a type of a new family—*Synagogidae*, *Lauridae*, *Petrarcidae*, *Dendrogasteridae*.

* "Histoire de la *Laura gerardiae*. Type nouveau de Crustacé Parasite, 1882." (Extract of vol. xlii. Mémoires de l'Acad. des Sci.)—Archives Zoologie Expérimentale et Générale, ser. 3, vol. i. Notes et Revue, p. xix.—A. Gruvel, Monog. des Cirrhipèdes ou Thécostraces, 1905, p. 338.

† G. Herbert Fowler, "A remarkable Crustacean Parasite, and its Bearing on the Phylogeny of the Entomostraca," Quart. Journ. Micr. Sci., July 1889.—A. Gruvel, Monog. des Cirrhipèdes ou Thécostraces, 1905, p. 342.

‡ Knipowitsch, N., Biolog. Centralblatt, vol. x., 1890-1891, p. 707; Arch. de Zool. Expérimentale et Générale, ser. 3, vol. i. 1893, Notes et Revue, p. xvii.—A. Gruvel, Monog. des Cirrhipèdes ou Thécostraces, 1905, p. 345.

§ Otto le Roi, "Zwei neue parasitische Cirripeden aus der Gruppe der Ascothoracida," Zoologischen Anzeiger, Bd. xxix. Nr. 12, Sept. 19, 1905.

CIRRIPIEDIA.

Order ASCOTHORACICA.

Family SYNAGOGIDÆ, Gruvel.

SYNAGOGA MIRA, Norman.

In 1887, when working at Naples, Signor Lo Bianco brought me some parasites in spirits which he had found on the Actinozoan *Antipathes latrix*, Esper. The parasites were external and had all been removed from the host to which they had been attached. These most interesting parasites I briefly described in the British Association Report for 1887 (1888), p. 86, under the name *Synagoga mira*. I purposed to write a full account of this species shortly afterwards, but I delayed doing this in the hope of being able to procure the earlier stages of development, which I had requested Signor Lo Bianco to kindly look out for me; these, however, he was unable to procure. About two years ago, finding that my material was not sufficient to clear up certain points connected with the sexual characters, I wrote to Dr. Giesbrecht to ask him if he could procure for me some further, and fresh, specimens of the species. He has now written me to say that, although he has examined such specimens of *Antipathes* and *Isis* as had come into the Station, he has not been able to meet with *Synagoga*. He tells me that the two genera just mentioned are much scarcer in the Bay than they used to be; he adds that "*Synagoga* has not been found in the Bay of Naples since the time that you described it." It would seem, therefore, that the species must be extremely rare. As long ago as 1890 I had a series of illustrative drawings made for me by Mr. A. Scott; a few additional drawings have been made by Mr. E. Popple.

The *Synagoga* is enclosed in a mantle or sheath in form as the bivalve of *Cypris* or *Estheria*. This enclosing sheath is nearly ovate (Pl. 33. fig. 1), somewhat narrower in front, where it is slightly emarginate above; its measurements when full-grown are 4 mm. in length and 3 mm. in breadth; the external surface is covered with minute triangular spinules which are somewhat larger towards the margins; the eggs are contained in ovaries within the sheath. The animal itself is attached by two very strong bundles of muscles to the upper portion of the sheath, and with this exception enjoys perfect freedom of motion; it is rarely withdrawn wholly within the sheath.

The body consists of a cephalon, furnished with very large and strongly developed antennules (Pl. 33. fig. 2), very prominent buccal mass, and the peculiar organ hereafter to be described. The mesosome or body is composed of six segments bearing six pairs of legs. The metasome or tail is five-jointed, of which the first is the genital segment; this is followed by three segments without appendages, and the fifth which carries distally a pair of serrated spines and two large unjointed rami, which remind one of the same organs in *Nebalia bipes*.

The antennules (Pl. 33. figs. 2 & 3) take the form of grasping-organs of remarkable size and strength, strong muscles also uniting the several joints. The first joint is about

equal to the second, or rather longer, and smooth; the second joint is bent at an angle with the first, and has at the base behind a bunch of small cilia, the front is smooth. The third joint is triangular, wider in front than behind, with a bunch of delicate cilia on the proximal half of the front margin. The fourth joint is narrowly triangular, the greatest width is behind; in front it is projected into a small lobe which is furnished with two strong produced spines, the front margins of which are serrated; beyond these large spines are two or three small denticulate processes: this peculiar formation of the fourth joint seems to suit it for uniting with the terminal claw to form a strong grasping-organ. The fifth joint is longer than the combined length of the front margins of the two preceding joints; it tapers gently from the base to the extremity and is fringed throughout the front margin with very large and finely plumose setæ. The sixth joint is subequal in length to the preceding: from near the base of the hind margin there is projected a lobe which is more than equal in length to the breadth of the joint; at its base this lobe gives out a little process which carries a long and peculiar seta and terminates in three long setæ. Moreover, near the distal extremity of the same margin of the joint another articulated lobe is seen, which terminates in three setæ. Beyond this on the side of the joint spring three small setæ. The limb ends in a strongly curved claw denticulated on its inner edge and furnished with a small seta on its side.

The mouth-organs are enclosed in a very large pear-shaped sheath much constricted at the base (Pl. 33. fig. 2 and Pl. 34. figs. 1 & 2), and thence swelling out and then narrowing to the extremity; this sheath bears a bundle of down-like cilia at half its length, and the extremity is drawn out to a spine-like point bordered with a few minute cilia (Pl. 34. fig. 2). Within this sheath are a remarkable series of organs, the structure and arrangement of which will be better understood from study of the illustrations given than from any verbal description; one of the outer pair of mouth-organs is represented in fig. 3. The next pair are shorter and may be seen in fig. 4. The beautiful and complicated structure of the third pair is seen in fig. 5, while the split teeth of its margin are shown in the more enlarged drawing fig. 6. The central organ with its powerful and acute termination and saw-like edge behind is represented in fig. 7. It would appear that there is only one of this central organ, while the other organs are in pairs.

The six pairs of feet are all composed of a two-jointed peduncle and two branches. The outer branch in all cases is composed of two joints; the inner branch of the first and of the sixth pairs is two-jointed, while that branch in the second, third, fourth, and fifth pairs is three-jointed. The first pair (Pl. 35. fig. 1) has the basal joint of the peduncle without setæ, the second joint carries three setæ on the distal portion of the inner face. The inner branch consists of two joints of subequal length, of which the first carries about five setæ on the inner side and the second joint has three terminal setæ; the outer branch has the first joint as long as the whole of the inner branch and is devoid of setæ, the second joint is equal in length to two-thirds of the first and terminates in a dense bunch of setæ. The second feet (Pl. 35. fig. 2) have the peduncle

of very much stouter proportions than those of the first feet; the first joint carries one distal external seta and the inner margins of both joints are densely setose, the inner branch has three joints nearly subequal to each other in length and are densely setose on the inner margins and the apex, the outer two-jointed branch has the first joint equal in length to the first two joints of the inner branch; the second joint is fully twice as long as the terminal joint of the inner and is setose both on the inner and outer margins; the third, fourth, and fifth feet are of very similar structure to the second just described. The sixth pair (Pl. 35. fig. 3) has the first joint of the peduncle long and comparatively narrow; there are no conspicuous setæ either on that or the following joint. Both rami are two-jointed and furnished with long setæ, especially on their inner margins.

The last joint of the metasome (Pl. 35. fig. 7) carries two spines, which are considerably longer than the breadth of the segment from which they spring; these spines have the margins serrated. Besides these spines the body terminates in two one-jointed uropods (Pl. 33. fig. 6); these uropods are more than twice as long as the preceding segment, on the outer margins they carry two plumose setæ and two terminal, while their inner margins are densely clothed with similar setæ; the outer margins of these rami are dentate from the base to the origin of the first external seta. With respect to the organs of generation, I am not able to describe them satisfactorily, and it was chiefly with a view of examining them more fully that I desired to procure fresh specimens of *Synagoga*. Posteriorly to the sixth pair of feet on the first segment of the metasome a peculiar organ is found which appears to be that of the male. At half its distance from the base a portion bends downwards and terminates in a conical point which appears to be the penis; beyond this point the limb arches and is gradually attenuated. Pl. 35. fig. 4 represents this appendage as seen from side. Fig. 5 (which is, however, partly diagrammatic) gives the appearance as seen from below. We find other specimens in which the first segment of the metasome is more produced downwards than the last segment of the mesosome (Pl. 35. fig. 6), and this produced segment is crenulated at the extremity and on the front margin; this would appear to represent the vulva of the female, and thus it would seem that the two sexes are separate.

Behind the antennæ there is an organ which occupies the place of what Lacaze-Duthiers calls in *Laura* the first feet: the organ here can scarcely be regarded as a foot, inasmuch as behind it we have six pairs of distinct feet, nor does it present the appearance of a foot; nevertheless it would seem to discharge part of the functions of the first foot in *Laura*, inasmuch as I take the papilla to be the orifice of the oviduct which brings the ova from the ovary, situated beneath the mantle. Of this organ there are given three illustrations (Pl. 34. figs. 8, 9, 10), but for the differences between them I am unable to account.

Pl. 33. fig. 5 represents a tubule containing ova from beneath the mantle. Fig. 4 represents a portion of the margin of the mantle and shows the more fully developed ova within.

The several genera of the order Ascothoracica differ in development of the various organs, and these changes have, doubtless, been brought about by the more or less

distinctly parasitic mode of life of each species. The *Petrarca bathyactidis* of Fowler inhabits the Actinozoan *Bathyactis symmetrica*, and lives in the mesenterial chambers of its host. Active powers of locomotion would be useless, and the limbs and tail are merely represented by lobes of the body. The antennæ are an exception, ending in two nails and a spine. Yet we find strong resemblances in the enclosing mantle, form of the buccal cone, and general structure to the other genera.

In the *Dendrogaster astericola* of Knipowitsch we again have an internal parasite within the body of the Echinoderms *Echinaster sarsii* and *Solaster papposus*. What the author draws as figure of the "*Larve au stade Cypris*" so closely accords in general structure with *Laura* and *Synagoga* that it seems impossible to regard it as an immature form.

Laura gerardiae of Lacaze-Duthiers, the most fully described species, has its body covered over by the *Gerardia*, so that it is protected in a great measure from outside interference, and it is contained in such a gigantic test that were it free it seems impossible that it could lift so large a mass; moreover, its limbs are free from swimming-setæ.

Synagoga mira is less protected than the preceding genera; it lives externally upon the *Antipathes*, and instead of being covered by the host it simply clings to it by its massive antennæ and would seem to have the power of relaxing its hold and swimming off to attach itself to another part of the host. Its bifid feet are largely furnished with setæ, which would enable it to swim easily.

As compared with *Laura*, *Synagoga* shows the following points of difference:—In *Laura* the mantle which enwraps the body is of a prodigious size, in *Synagoga* it is only large enough just to cover the body. In *Laura* the antennæ are small and insignificant; in *Synagoga* they are very large and strong, and the mouth-organs are much more highly and elaborately developed. In *Laura* Duthiers finds a very small organ which he styles "*antennules ou tubercules sous-céphaliques*"; of these I have not been able to find any trace in *Synagoga*. *Laura* has only six pairs of unbranched feet, of which the first pair contains the female organ in its upper portion and also discharges the matured ova; the four following feet have at their bases the organs of the male, and thus the animal is an hermaphrodite. The feet, being without setose adornment, are unfitted for swimming. *Synagoga* bears the peculiar organ (Pl. 34. figs. 8–10) which would seem to discharge at least some of the functions of the first feet of *Laura*; behind this are six pairs of bifid feet, which are densely setose, and behind these there are appendages of the first segment of the metasome, which, differing in character in different specimens, are regarded as the distinctive organs of two separate sexes. Lastly, *Synagoga* has the terminal rami much more fully developed, and, moreover, carries two large spines on the last segment of the metasome above the well-developed rami.

EXPLANATION OF THE PLATES.

PLATE 33.

- Fig. 1. Entire animal of *Synagoga mira* with its shell, female.
2. „ „ „ „ with shell removed, showing the bases of the large muscles which attach the animal to the shell.
 3. The antennule.
 4. Portion of margin of shell showing structure and ova within.
 5. Portion of ovaries in tubule removed from the shell.
 6. Uropods from below showing telsonic spines at the base, but their upper portion and attachment hidden by the uropods.

PLATE 34.

- Fig. 1. Mouth-organs in the form of a cone as seen naturally in the enclosing sheath.
2. The same under pressure to exhibit the various portions of the mouth-organs.
 3. The uppermost pair of these organs.
 4. Second pair.
 5. The third pair.
 6. Portion of the teeth of the third pair to show they are divided.
 7. The central organ. Whereas the other members of the mouth are in pairs, there is only one central organ.
 - 8, 9, 10. Three different illustrations of the peculiar organ situated behind the antennæ, showing the papilla which is supposed to represent the orifice of the oviduct.

PLATE 35.

- Fig. 1. Foot of first pair
2. Foot of second pair.
 3. Foot of sixth pair.
 4. Penis seen from the side as attached to a first segment of the metasome.
 5. The same as seen from below, partly diagrammatic.
 6. The last segment of the mesosome and the first of the metasome; this last supposed to represent the generative segment of the female.
 7. Spines attached to telson.

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