

Some Protozoan Parasites of the Chaetognatha from Suruga Bay, Central Japan

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Ms. Sachiko Nagasawa detected many species of parasites in chaetognaths collected in Suruga Bay and sent them to the author for identification. Helminths of them were recently described (Shimazu, 1978). The present paper deals briefly with protozoan parasites. Protozoa so far reported from the Chaetognatha have been reviewed by Hyman (1959), Alvarino (1965) and Weinstein (1972).

Materials and Methods

Chaetognaths infected with protozoan parasites were picked out of the formalin-preserved plankton samples collected in Suruga Bay, off the Pacific coast of central Japan, during 1972 to 1976. Some were examined alive and then fixed in Bouin's solution. Parasites taken out of the chaetognaths were stained with Heidenhain's iron hematoxylin or alum carmine and mounted in Canada balsam. Dilute Lugol's iodine was used to demonstrate paraglycogen granules in them. Serial paraffin sections of some infected hosts cut 10 μm thick were stained with Delafield's hematoxylin and eosin. The parasite specimens are deposited in part in the collection of the National Science Museum, Tokyo (NSMT-Pr-108~157).

Results

1. Acephaline gregarine

Hosts. *Krohnitta pacifica* (Aida) (NSMT-

Pr-108, 114~126), *Sagitta ferox* Doncaster (127 and 128), *S. nageae* Alvarino (129~131), *S. neglecta* Aida (109, 132~134, 150 and 151), and *S. regularis* Aida (110, 135~140, 152~157). *K. pacifica*, *S. neglecta* and *S. regularis* often showed heavy infections, whereas the two others harbored only a few parasites of this type.

Description. Trophozoites in the epithelial cells of the intestine, frequently crowding together in the anteriormost part of the intestine. Mature forms non-septate, elongate-oval, usually broader anteriorly than posteriorly, more or less spatulate, 63-95 μm long by 25-45 μm wide (Fig. 1). Anterior end of body simple, rounded or somewhat triangular; posterior end bluntly attenuated. Longitudinal pellicular striations prominent. A very small hyaline area occupying anterior tip of body; rest of body opaque, granular, containing numerous paraglycogen grains like hollow balls of a diameter less than 1 μm . Nucleus irregular in outline when fixed in formalin but globular when fixed in Bouin's solution, 9-12 μm long by 11-14 μm wide, located slightly anterior to middle of body, bearing a spherical karyosome in it.

Sporonts free in the lumen of the intestine, solitary, closely like the full-grown trophozoites mentioned above. Forms in syzygy and other developmental stages unknown.

Notes. Ms. Nagasawa's unpublished photomicrographs of living specimens indicate that this gregarine in life is oblongate

and much flexible, and possesses several transverse constrictions of the body at irregular intervals and the hindbody being narrower and more elongated than that of the formalin-preserved material described above.

Discussion. This non-septate gregarine probably belongs to the genus *Lankesteria* Mingazzini, 1891 (Eugregarinida: Acephalina: Diplocystidae). In the genus only *L. leuckarti* (Mingazzini, 1891) Labbé, 1899, has been named from the Chaetognatha. *L. leuckarti* is still little known except that Mingazzini (1891, 1893) very briefly described it as *Lecudina leuckarti*, without giving any measurements, from the intestine of a chaetognath of *Sagitta* species in the Gulf of Naples, the Mediterranean. The present parasite and *L. leuckarti* differ from each other in both the shape of the body and the position of the nucleus in the trophozoite or sporont stage. The former has the elongate-oval body being wider anteriorly than posteriorly and the pre-equatorial nucleus. So far as Mingazzini's description and figure are concerned, the latter has the lanceolate body broadening gradually from the anterior end towards the posterior and the post-equatorial nucleus. However, a possibility that Mingazzini may have interpreted by contraries the direction of the antero-posterior axis of his parasite should also be considered. If he did so, the above-mentioned differences seem to arise even though the two protozoa are conspecific. Therefore, the present gregarine is left unidentified until further detailed studies of *L. leuckarti* are done. In this connection, *L. leuckarti* may possibly be called *L. sagittae* by mistake in Hamon (1956) and Alvariano (1965) because the description of *L. sagittae* as a new species is nowhere to be seen.

2. Cephaline gregarine A

Hosts. *K. pacifica* (NSMT-Pr-120~126), *S. ferox* (127), and *S. neglecta* (133). These hosts were always infected with a small number of parasites of this type.

Description. Trophozoites in the epithelial

cells of the intestine. Mature forms distinctly septate (Fig. 2). Protomerite like a frustum of a cone, 7-11 μm long by 8-12 μm wide; epimerite small, hemispherical (Fig. 2) or truncate with a scalloped periphery (Fig. 3). Deutomerite obovoid, 20-27 μm long by 13-20 μm wide. Longitudinal pellicular folds conspicuous. Ectoplasm considerably thick. Endoplasm very finely granular, evenly and weakly stainable with iodine, including minute paraglycogen granules and globular vacuole-like spaces varying in size. Nucleus usually reniform, sometimes spherical, 3-5 μm long by 5-7 μm wide, situated close or contiguous to anterior border of deutomerite, containing ovoid karyosomes. Ratio of length of protomerite to total length 1:3.3-5.3; ratio of width of protomerite to that of deutomerite 1:1.2-2.2. Other developmental stages unknown.

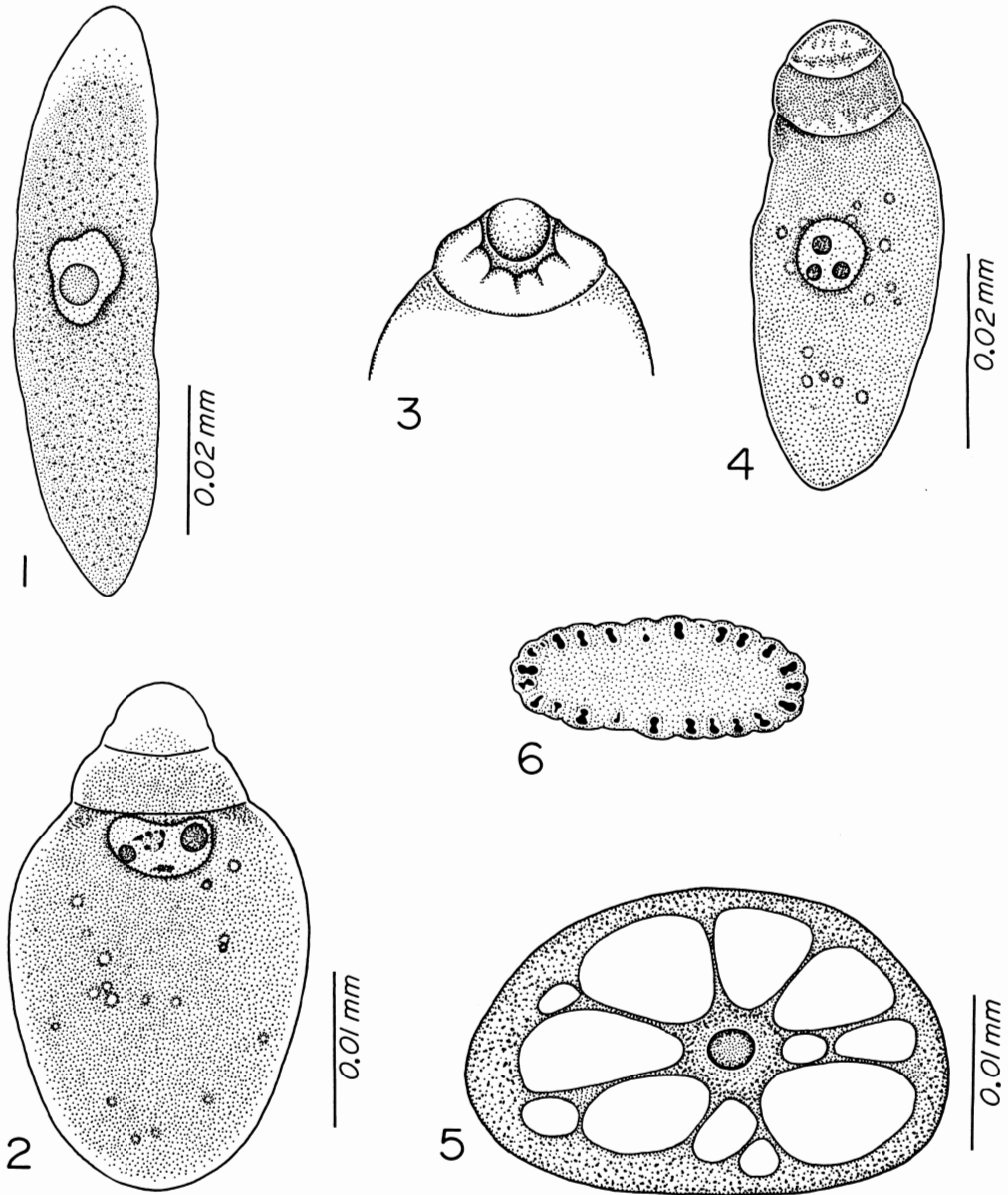
Discussion. This septate gregarine very likely represents an undescribed species of cephaline (Eugregarinida: Cephalina) because no gregarines similar to it have been known from the Chaetognatha. It is uncertain which family or genus this parasite should be assigned to for lack of the knowledge of developmental stages other than the above-mentioned trophozoite in the life cycle.

3. Cephaline gregarine B

Host. *K. pacifica*. A single parasite specimen obtained was lost after being studied and sketched.

Description. A trophozoite or sporont found in the intestine septate (Fig. 4); its exact habitat not determined. Protomerite 10 μm long by 11 μm wide, with hemispherical anterior part (? epimerite) measuring 4 μm long by 9 μm wide. Deutomerite oblong, 34 μm long by 18 μm wide. Cytoplasm resembling that of the foregoing cephaline gregarine A. Nucleus globular, 7 μm in diameter, situated slightly anterior to middle of deutomerite, bearing spherical karyosomes in it. Pellicular striations and paraglycogen granules not worked out.

Discussion. Although it is not clear wheth-



Explanation of Figures

Figs. 1-6 Protozoan parasites found in chaetognaths collected in Suruga Bay, off the Pacific coast of central Japan.

Fig. 1 Acephaline gregarine, a mature trophozoite.

Figs. 2 and 3 Cephaline gregarine A. 2: a mature trophozoite; 3: anterior part of another specimen, scale as in Fig. 2.

Fig. 4 Cephaline gregarine B, a trophozoite or sporont.

Fig. 5 Unidentified protozoon A, possibly a trophozoite.

Fig. 6 Unidentified protozoon B, a section, scale as in Fig. 5.

er this cephaline gregarine is a true parasite or not, it appears to be similar in morphology to *Tricystis planctonis* Hamon, 1951 (Eugregarinida: Cephalina: ?Aikinetocystidae), which parasitizes *S. lyra* Krohn in the Bay of Algiers, the Mediterranean (Hamon, 1951).

4. Ciliate, *Metaphrya sagittae*

Hosts. *S. enflata* Grassi (NSMT-Pr-111, 141~143), *S. nagaе* (112, 144~146), and *S. pacifica* Tokioka (113, 147~149). Commonly these chaetognaths were heavily infected.

Description and Discussion. This ciliate, *Metaphrya sagittae* Ikeda, 1917 (Astomatida: Anoplophryidae), was first studied by Ikeda (1917), who found it in a specimen of *Sagitta* species most presumably taken in Sagami Bay located next Suruga Bay. Its morphology has been adequately described by Ikeda (1917) and Weinstein (1972). Some of the details observed here are that (1) most parasites were in the trunk coelom, frequently in great numbers, and some were in the tail coelom; (2) they were in various stages of development, varying in size from less than 42 μm long by 17 μm wide to more than 484 μm long by 255 μm wide; (3) some larger forms were transversely constricted to various degrees at about the mid-body level and some were invaginated at one or two of the body ends; and (4) cilia were found to grow on 12 to 14 longitudinal ridges, rather than in furrows, in cross sections.

5. Two other protozoa, A and B

In addition to the four protozoa described above, two other kinds of protozoa, the taxonomic positions of which are unknown, were found mainly in the epithelial cells and rarely in the lumen of the intestine of *S. regularis* (NSMT-Pr-135~140, 156 and 157).

Description of A. Possibly the specimens of this type are in the trophozoite stage. They were ellipsoidal and measured about 25 μm long by 20 μm wide (Fig. 5). The endoplasm contained many large vacuoles and the compact nucleus, which was spherical, about 3 μm in diameter, and located

in the center of the cell. In infected chaetognaths these protozoa occurred in nearly all the epithelial cells of the intestine.

Description of B. The protozoa of this type were ellipsoidal and about 18 μm long by 13 μm wide. A large number of small nuclei with a diameter of about 1.5 μm were present, occasionally arranged in the peripheral layer of the cytoplasm (Fig. 6). These parasites were found in small numbers together with the protozoon A.

Discussion. These two types of protozoa, A and B, appear to be a trophozoite and a schizont respectively. They stand in need of future studies.

Summary

From the chaetognaths collected in Suruga Bay, off the Pacific coast of central Japan, during 1972 to 1976, the following protozoan parasites are described briefly: (1) an acephaline gregarine, probably related to *Lankesteria leuckarti* (Mingazzini, 1891) Labbé, 1899, from *Krohmitta pacifica* (Aida), *Sagitta ferox* Doncaster, *S. nagaе* Alvarino, *S. neglecta* Aida, and *S. regularis* Aida; (2) a septate gregarine, very likely representing an undescribed species of cephaline, from *K. pacifica*, *S. ferox*, and *S. neglecta*; (3) a septate gregarine, possibly resembling *Tricystis planctonis* Hamon, 1951, from *K. pacifica*; (4) a ciliate, *Metaphrya sagittae* Ikeda, 1917, from *S. enflata* Grassi, *S. nagaе*, and *S. pacifica* Tokioka; and (5) two protozoa of undetermined position from *S. regularis*.

Acknowledgments

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駿河湾産ヤムシに寄生する原虫類

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東京大学海洋研究所永沢祥子氏は、1972年から1976年にかけて駿河湾で採集したヤムシから寄生虫を見出して、同定のために著者に送られた。本報では、永沢氏の寄生虫のうち次の原虫類を簡単に記載した。(1) *Kroh-nitta pacifica* (Aida), *Sagitta ferox* Doncaster, *S. nagae* Alvarino, *S. neglecta* Aida, *S. regularis* Aida からアセファリナ類に属するグレガリナをえた。これは *Lankesteria leuckarti* (Mingazzini, 1891) Labbé, 1899 に近縁と考えられた。(2) *K. pacifica*, *S. ferox*,

S. neglecta からセファリナ類に属するグレガリナを見出した。これは恐らく未記載種である。(3) *K. pacifica* からは他のセファリナもえた。これは *Tricystis planctonis* Hamon, 1951 に似ているようにみえた。(4) *S. enflata* Grassi, *S. nagae*, *S. pacifica* Tokioka から繊毛虫 *Metaphrya sagittae* Ikeda, 1917 を見出した。(5) 以上の他に、*S. regularis* から、2つの相異なる形態を呈する、所属不詳な原虫をえた。