

Haeckel's Messina Radiolarian Collection Housed in the Ernst-Haeckel-Haus

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Abstract Ernst Heinrich Philipp August Haeckel (1834–1919) published 59 new polycystine radiolarian species from Messina in 1860 and 1862. The scientific community has long been unaware that the original slides examined by him are deposited in the Ernst-Haeckel Haus in Jena, Germany. In addition to a few radiolarian microscopic slides from the H.M.S. *Challenger* Voyage, the collections of the Ernst-Haeckel Haus keeps two wooden boxes labeled as “Messina 1859.” Reexamination of these remaining 74 glass slides reveals that Haeckel generally picked and mounted single specimens on each slide with Canada balsam. He examined the internal structure of some species, including *Spongosphaera streptacantha* and *Rhizosphaera trigonacantha*, by artificial breakage of the single specimens. We found 16 species described by Haeckel and one species named by Müller from the slides in the two Messina boxes. All the specimens in these boxes are illustrated in our paper, together with the original slides and boxes. Further examination of his original slides and other materials in universities and museums is still needed for taxonomic stability.

Key words: Classification, Haeckel, Legacy Collection, Radiolaria, Taxonomy.

Introduction

Ernst Heinrich Philipp August Haeckel (1834–1919) was a great radiolarian specialist who constructed the first comprehensive framework for radiolarian taxonomy. Haeckel (1860a, 1860b, 1862, 1878, 1879, 1882, 1884, 1887a) reported approximately 750 genera and 4,300 species (Tanimura *et al.*, 2006), which are now classified into the orders Acantharia, Collodaria, Nassellaria, Spumellaria, and Phaodaria (Anderson, 1983; Suzuki and Aita, submitted). Haeckel summarized his taxonomic work in 1887 (Haeckel, 1887b). His work, however, started with studies on plankton samples from the Mediterranean Sea near Messina, and the results were mainly published in the early 1860s (Haeckel, 1860a, 1860b, 1862). Haeckel (1862) is one of the literature's first, and still most extensively documented, presenter of systematic radiolarian cytology linked to skeletal morphology, with voluminous explanations and beautiful color plates.

Haeckel's work has been followed in many subsequent studies, but the illustrated figures are commonly too schematic to apply to actual specimens (e.g., Suzuki and Aita, submitted). For proper use of Haeckel's species, reexamination of the actual original material is essential. This

reexamination is intended to lead to the next step in taxonomic revision: if the type specimens, or his examined specimens, are found, the morphological characters of his species can be clearly understood. If his examined specimens are not found, neotypes could be selected from the topotypic materials, or his species can be permanently deleted from available taxonomic names under the International Code of the Zoological Nomenclature 2000.

Since the existence of Haeckel's Messina radiolarian collection has only recently been discovered (Lazarus, 2000), this study is the first substantial reexamination by radiolarian taxonomists of this important original collection in the Ernst-Haeckel Haus in Jena, Germany.

Radiolarian Collection in the Ernst-Haeckel Haus

Since 1919, the Ernst-Haeckel Haus, formerly Haeckel's home, has maintained his personal archives, which include some of the radiolarian material he used for his studies. It is now the Institute for the History of Science and a museum at the university in Jena (<http://www.ehh.uni-jena.de>).

The Ernst-Haeckel Haus houses a large number of Haeckel's scientific objects. Scientific objects related to radiolarians include his microscopic slides for his own study, those for teaching, his notebooks used to review the radiolarians illustrated in Ehrenberg's papers, study notes, letters, diaries, and the original drawings by Haeckel marked with what appear to be serial numbers. In addition, a suite of artistic furniture with radiolarian fine art motifs remains in the Ernst-Haeckel Haus. The Japanese members of this project had only a few hours to examine these collections, so we concentrated on the Messina microscopic slides for study. The other microscopic slide set is less unique, being one of many "teaching sets," and the same sets were distributed in London, Berlin, and Basel. This teaching set was not as high a priority in this project in that this set is presumed not to have as high a status for type fixation as the original topotypic material.

Results

Two wooden slide boxes, labeled "Radiolaria I. Messina. 1859" (Pl. 10, Fig. 4) and "Radiolaria II. Messina. 1859" (Pl. 23, Fig. 5) are archived in the Jena museum. These two boxes contain 74 radiolarian slides for which Haeckel prepared labels with the species, locality, and slide codes in his own handwriting. Our paper presents all the slides with radiolarians in Plates 1 to 23. Seventeen polycystine, 2 acantharian, and 2 phaeodarian species are preserved in these two boxes.

The radiolarian slides in these two boxes are made of standard glass microscope slides, but the coverslips are very thick and irregularly chipped (e.g., Pl. 1, Fig. 7). Each slide generally contains a single radiolarian specimen embedded with Canada balsam. The location of the specimen in the slide is indicated by the sharp tip of the black arrow (probably tar) painted on the slide (e.g., Pl. 4, Figs. 7, 8) or is within an open circle marked by the same black tar (Pl. 9, Fig. 2). Several slides with the term "*diruta*," meaning "*broken*" in Latin, include crushed specimens (Pl. 3, Figs. 6, 8; Pl. 14, Figs. 1, 2; Pl. 20, Figs. 7, 8; Pl. 22, Figs. 3, 4), which we presume were crushed by Haeckel for examination of the internal structures. The labels of several slides include a code with "R" (e.g., Pl. 2, Fig. 5), probably "Radiolarian." These labels also indicate several abbreviations: exclamation points "!" (Pl. 1, Fig. 9), "!!" (Pl. 1, Fig. 9), numbers like "49" (Pl. 1, Fig. 9), locality names, individual letters like "b" (Pl. 2, Fig. 5), and comments (Pl. 5, Fig. 3; Pl. 6, Fig. 4). Only a few indications can be understood based on the limited number of slides.

Exclamation points were often used by early workers, including Ehrenberg, to denote particularly interesting specimens, and are thus a useful guide to identifying possible type specimens. Some of the numbers seem to refer to species: for example, the number “33” seems to have been used for *Spongosphaera streptacantha* (Pl. 3, Fig. 9; Pl. 7, Fig. 2; Pl. 13, Fig. 6), “54” for *Euchitonia muelleri* (Pl. 4, Fig. 7; Pl. 21, Figs. 2, 6), and “69” for *Collosphaera huxleyi* (Pl. 3, Fig. 1; Pl. 6, Fig. 4; Pl. 8, Fig. 3; Pl. 10, Fig. 3; Pl. 13, Fig. 4). The indication “j” in Pl. 18, Fig. 6 seems to correspond to “juvenile.”

Several specimens preserve the protoplasm (Pl. 1, Figs. 5, 8; Pl. 3, Fig. 10; Pl. 6, Fig. 1; Pl. 8, Figs. 1, 2; Pl. 11, Fig. 8; Pl. 12, Figs. 4, 5; Pl. 13, Fig. 8; Pl. 14, Figs. 1, 8; Pl. 17, Fig. 1; Pl. 19, Figs. 1, 3; Pl. 20, Fig. 4; Pl. 22, Fig. 1). “Central capsules” are present in *Collosphaera huxleyi* (Pl. 13, Figs. 3, 4), *Rhizosphaera trigonacantha* (Pl. 17, Figs. 1, 2), and *Rhopalastrum truncatum* (Pl. 9, Figs. 3, 4) according to the indication on the slide label: “cum capsula centrale.”

Concluding remarks

Haeckel (1860a, 1862) described 30 and 29 polycystine radiolarians from Messina, respectively. We found only 16 of Haeckel's species, and one species described by Müller (1858b), so that 43 species are missing. The missing species also include the type species of some genera (e.g., *Haliomma trinacrium* Haeckel for the genus *Actinomma* [Haeckel, 1860a]). Although it is still possible that further original material may be found of this Messina material, it is unlikely (see Lazarus and Suzuki, 2009) and for practical purposes these specimens should be assumed to be lost.

Since Haeckel (1887a) separated specimens of different ontogenetic stages of what is now considered to be a single species into different genera, he was thought to have generally ignored ontogenetic growth. However, he identified specimens with different numbers of hoops as belonging to the same species in *Rhopalastrum truncatum* (Pl. 1, Figs. 2, 4, 10) and *Stylodictya arachnia* (Pl. 2, Fig. 4; Pl. 5, Fig. 1; Pl. 9, Fig. 8), and individuals with different patagium developmental states as belonging to the same species for *Euchitonia muelleri* (Pl. 18, Fig. 4; Pl. 20, Fig. 1; Pl. 21, Figs. 1, 5, 6), suggesting his recognition of ontogenetic growth for at least these three species.

Taxonomic note

This taxonomic note simply summarizes, presents material, and provides information for Haeckel's descriptions. Taxonomic reexamination of these Messina species will be published in the future. Plates and figures in our paper are arranged in the order of the microscopic slides in the Messina boxes, rather than taxonomic order. Phaeodaria has now been moved from “Radiolaria” to Cercozoa based on molecular phylogenetic analyses (Adl *et al.*, 2005; Suzuki and Aita, submitted), but this issue is beyond the scope of this paper. Thus, this taxonomic note includes all of the traditional “Radiolaria.”

Order Spumellaria Ehrenberg, 1876
Actinomma drymodes (Haeckel 1860a)

Pl. 5, Fig. 4

1860a *Haliomma* (*Actinomma*) *drymodes* n. sp. –HAECKEL, p. 816

1862 *Actinomma drymodes* (Haeckel) –HAECKEL, p. 442–443, pl. 24, fig. 9

1887a *Hexacantium (Hexacantura) drymodes* (Haeckel)–HAECKEL, p. 198–199

***Coccodiscus darwinii* Haeckel 1862**

Pl. 1, Fig. 5, Pl. 7, Fig. 4

1862 *Coccodiscus darwinii* n. sp. –HAECKEL, p. 486–488, pl. 28, figs. 11, 12

1887a *Coccodiscus darwinii* Haeckel–HAECKEL, p. 461

***Collosphaera huxleyi* Müller 1858b**

Pl. 3, Figs. 1–3, Pl. 6, Figs. 1–3, Pl. 8, Figs. 1, 2, Pl. 10, Figs. 1, 2, Pl. 13, Fig. 3

1858b *Collosphaera huxleyi* n. sp. –MÜLLER, p. 55–59, pl. 8, figs. 6–9

1862 *Collosphaera huxleyi* Müller –HAECKEL, p. 534–536, pl. 34, figs. 1, 2, 4, 6–8, 10, 11

1878 *Collosphaera huxleyi* Müller –HAECKEL, p. 42, fig. 27

1887a *Collosphaera (Dyscollosphaera) huxleyi* Müller–HAECKEL, p. 96

***Collosphaera spinosa* Haeckel 1860a**

Pl. 8, Figs. 4, 5, Pl. 15, Figs. 1–4

1860a *Collosphaera spinosa* n. sp. –HAECKEL, p. 845

1862 *Collosphaera spinosa* Haeckel –HAECKEL, p. 536, pl. 34, figs. 12, 13

1878 *Collosphaera spinosa* Haeckel–HAECKEL, p. 41, fig. 28

1887a *Acrosphaera spinosa* (Haeckel)–HAECKEL, p. 100

***Collosphaera* sp.**

Pl. 6, Fig. 8

***Euchitonia gegenbauri* Haeckel 1862**

Pl. 12, Fig. 1

1862 *Euchitonia gegenbauri* n. sp. –HAECKEL, p. 506–507, pl. 31, figs. 2, 3

1887a *Trigonastrum (Trigonastrella) gegenbauri* (Haeckel)–HAECKEL, p. 539

***Euchitonia muelleri* Haeckel 1862**

Pl. 4, Fig. 8, Pl. 18, Fig. 4, Pl. 20, Fig. 1, Pl. 21, Figs. 1, 5, 7

1862 *Euchitonia muelleri* n. sp. –HAECKEL, p. 508, pl. 30, figs. 5–10

1887a *Euchitonia (Stylactis) furcata* Ehrenberg–HAECKEL, p. 532–533

***Euchitonia virchowii* Haeckel 1862**

Pl. 18, Fig. 5

1862 *Euchitonia virchowii* n. sp. –HAECKEL, p. 503–505, pl. 30, figs. 1–4

1887a *Euchitonia (Stylactis) virchowii* Haeckel–HAECKEL, p. 535

***Euchitonia* sp.**

Pl. 11, Fig. 3

***Haliomma capillaceum* Haeckel 1860a**

Pl. 2, Figs. 2, 6, Pl. 23, Fig. 4

1860a *Haliomma (Haliomma) capillaceum* n. sp. –HAECKEL, p. 8141862 *Haliomma capillaceum* Haeckel–HAECKEL, p. 426, pl. 23, fig. 21887a *Haliomma (Haliommilla) capillaceum* Haeckel–HAECKEL, p. 236***Haliomma castanea* Haeckel 1860a**

Pl. 21, Fig. 3

1860a *Haliomma (Haliomma) castanea* n. sp. –HAECKEL, p. 8151862 *Haliomma castanea* Haeckel–HAECKEL, p. 428–429, pl. 24, fig. 41887a *Haliomma (Haliommantha) castanea* Haeckel–HAECKEL, p. 232***Haliomma erinaceus* Haeckel 1860a**

Pl. 4, Fig. 4, Pl. 9, Fig. 5, Pl. 16, Figs. 1–3

1860a *Haliomma (Haliomma) erinaceum* n. sp. –HAECKEL, p. 8141862 *Haliomma erinaceus* Haeckel–HAECKEL, p. 427, pl. 23, figs. 3, 41887a *Haliomma (Haliommilla) erinaceum* Haeckel–HAECKEL, p. 236***Heliodiscus* sp.**

Pl. 13, Fig. 2

***Hymeniastrum* sp.**

Pl. 6, Fig. 9

***Ommatospyris* sp.**

Pl. 20, Figs. 4, 5

***Rhizosphaera leptomita* Haeckel 1860a**

Pl. 18, Fig. 1

1860a *Rhizosphaera leptomita* n. sp. –HAECKEL, p. 8401862 *Rhizosphaera leptomita* Haeckel–HAECKEL, p. 453–454, pl. 25, figs. 8–101887a *Rhizosphaera leptomita* Haeckel–HAECKEL, p. 284***Rhizosphaera trigonacantha* Haeckel 1860a**

Pl. 6, Fig. 6, Pl. 13, Fig. 8, Pl. 14, Figs. 1, 4, Pl. 14, Fig. 8, Pl. 15, Fig. 7, Pl. 17, Figs. 1, 4, 6, Pl. 20, Fig. 7

1860a *Rhizosphaera trigonacantha* n. sp. –HAECKEL, p. 840

1862 *Rhizosphaera trigonacantha* Haeckel–HAECKEL, p. 452–453, pl. 25, figs. 1–7

1887a *Rhizosphaera trigonacantha* Haeckel–HAECKEL, p. 283–284

***Rhopalastrum truncatum* Haeckel 1860a**

Pl. 1, Figs. 2, 4, 10, Pl. 4, Fig. 1, Pl. 9, Fig. 3

1860a *Rhopalastrum truncatum* n. sp. –HAECKEL, p. 842

1862 *Rhopalastrum truncatum* Haeckel–HAECKEL, p. 500–501, pl. 29, fig. 6

1887a *Rhopalastrum (Rhopalastrella) truncatum* Haeckel–HAECKEL, p. 526–527

***Sponchelius* sp. [nomen nudum for genus]**

Pl. 22, Fig. 6

***Spongosphaera streptacantha* Haeckel 1860a**

pl. 1, fig. 8, pl. 3, fig. 10, pl. 7, fig. 1, pl. 8, fig. 8, pl. 11, fig. 4, pl. 13, fig. 5, pl. 22, fig. 1

1860a *Spongosphaera streptacantha* n. sp. –HAECKEL, p. 840–841

1862 *Spongosphaera streptacantha* Haeckel–HAECKEL, p. 455–456, pl. 26, figs. 1–3

1878 *Spongosphaera streptacantha* Haeckel–HAECKEL, p. 46, fig. 34

1887a *Spongosphaera streptacantha* Haeckel–HAECKEL, p. 282

***Spongosphaera* sp.**

Pl. 3, Fig. 6, Pl. 22, Fig. 4

***Stylodictya arachnia* Müller 1858b**

Pl. 2, Fig. 4, Pl. 5, Fig. 1, Pl. 9, Fig. 8, Pl. 11, Fig. 5, Pl. 23, Fig. 1

1858b *Stylodictya arachnia* n. sp. –MÜLLER, p. 41, pl. 1, figs. 8, 9

1862 *Stylodictya arachnia* Müller–HAECKEL, p. 497–499

1887a *Stylodictya (Stylodictyon) arachnia* Müller–HAECKEL, p. 510–511

***Stylodictya arachnoides* [nomen nudum]**

Pl. 9, Fig. 1

***Stylodictya* (?) (*multispina*) *spongiosa* ? [nomen nudum]**

Pl. 11, Fig. 1

***Trematodiscus* sp.**

Pl. 4, Fig. 5

***Tetrapyle octacantha* Müller 1858b**

Pl. 3, Fig. 7

- 1858a *Tetrapyle octacantha* n. sp. [nomen nudum]—MÜLLER, p. 154
 1858b *Tetrapyle octacantha* n. sp. —MÜLLER, p. 33–35, pl. 2, figs. 11, 12, pl. 3, figs. 1–6
 1862 *Tetrapyle octacantha* Müller—HAECKEL, p. 435–436
 1887a *Tetrapyle (Tetrapylura) octacantha* Müller—HAECKEL, p. 648

Order Nassellaria Ehrenberg 1876

***Lithomelissa thoracites* Haeckel 1860a**

pl. 14, fig. 5

- 1860a *Lithomelissa thoracites* n. sp. —HAECKEL, p. 836–837
 1862 *Lithomelissa thoracites* Haeckel—HAECKEL, p. 301–302, pl. 6, figs. 2–8
 1887a *Lithomelissa (Micromelissa) thoracites* Haeckel—HAECKEL, p. 1206

Order Acantharia Haeckel 1862

***Xiphacantha serrata* (Haeckel 1860a)**

Pl. 19, Figs. 1, 3

- 1860a *Acanthometra serrata* n. sp. —HAECKEL, p. 807
 1862 *Xiphacantha serrata* (Haeckel)—HAECKEL, p. 386–387, pl. 17, fig. 3, pl. 18, figs. 14a, 14b
 1887a *Astromelissa serrata* (Haeckel)—HAECKEL, p. 757–758

Order Phaeodaria Haeckel 1879

***Aulosphaera trigonopa* Haeckel 1860a**

Pl. 12, Fig. 4

- 1862 *Aulosphaera trigonopa* n. sp. —HAECKEL, p. 359, pl. 10, fig. 4
 1887a *Aulosphaera trigonopa* Haeckel—HAECKEL, p. 1622

***Dictyoplegma trigonizon* (Haeckel 1860a)**

Pl. 12, Fig. 5

- 1860a *Dictyosoma trigonizon* n. sp. —HAECKEL, p. 841
 1862 *Spongodictyon trigonizon* (Haeckel)—HAECKEL, p. 459–460, pl. 26, figs. 5, 6
 1887 *Sagmarium trigonizon* (Haeckel)—HAECKEL, p. 1612–1613

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