

## Carl Gottfried Semper (1832–1893) and the location of his type specimens of sea cucumbers

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**ABSTRACT:** Carl Gottfried Semper (1832–1893), German naturalist, produced one of the most influential monographs in the history of sea-cucumber systematics (Echinodermata: Holothuroidea). This work, based on one of the most extensive collections of his time, introduced nearly a hundred taxa new to science. Unfortunately, Semper's collection subsequently became increasingly fragmented, and many of his types soon became considered as lost. We trace the history of Semper's holothuroid collection and report the location of many of the purported missing types.

**KEY WORDS :** taxonomy – nomenclature – Holothuroidea – history of collection – Philippines – Bohol – Zamboanga.

**ABSTRAKTAS:** Carl Gottfried Semper (1832–1893), Duits natuuronderzoeker, is de auteur van één van de meest invloedrijke monografieën in de geschiedenis van de systematiek van zeekomkommers (Echinodermata: Holothuroidea). Dit werk, gebaseerd op één van de meest extensieve collecties die toen bestonden, introduceerde bijna honderd nieuwe taxa. Helaas, Semper's collectie fragmenteerde steeds meer in tijd en ruimte waardoor de types gedurende een lange tijd als verloren werden beschouwd. In deze wetenschappelijke mededeling hebben we de geschiedenis van Semper's zeekomkommer collectie gereconstrueerd, menig van de verloren gewaande types gelocaliseerd.

**KEY WORDS:** taxonomie – nomenclatuur – geschiedenis van een collectie – Filippijnen.

### INTRODUCTION

In 1867 and 1868, Carl Gottfried Semper (Figure 1) delivered the first of the four volumes he contributed to the ten-volume monographic series entitled *Reisen im Archipel der Philippinen. Wissenschaftliche Resultate*. This monograph is of particular importance to holothuroid taxonomy for four important reasons. It was one of the first times that the (later recognized) hyperdiverse marine fauna of the Indo-West Pacific triangle was comprehensively investigated. Ninety-two species or varieties recognized proved to be new to science. It was one of the first works where the ossicle assemblage was consistently and extensively used to recognize and characterize taxa. The classification proposed was the first in holothuroid systematics that was based on the theory of evolution.

Given the extensive scope of this work, it is no surprise that it is still often cited by holothuroid taxonomists. The validity of the species recognized by Semper has, however, remained partly unverifiable because many of his type specimens were believed to be lost,

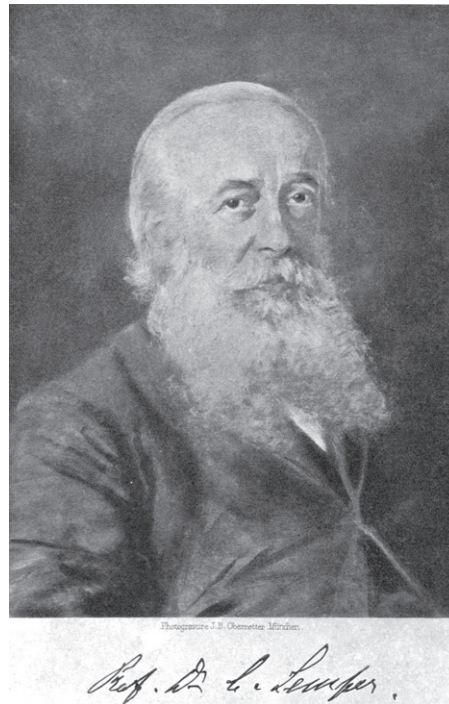


Figure 1. Carl Gottfried Semper, German animal taxonomist and ethnologist (from Schuberg 1895).

as the natural history institutions in which Semper worked (mainly the University of Würzburg) do not house his records.

#### CARL GOTTFRIED SEMPER AND HIS SEA CUCUMBER COLLECTION

Schuberg (1895) published a detailed biography and bibliography for Carl Gottfried Semper who was born on 6 July 1832 in Altona, near Hamburg, and died in 1893 at the age of 61 in Würzburg. Although destined for a career in the Prussian navy and trained as an engineer – Semper studied at the polytechnical school of Hanover between 1851 and 1854 – his interests lay predominantly in natural history. From 1854 to 1856 he studied at the University of Würzburg under the supervision of the renowned comparative anatomists Frans von Leydig (1821–1908), Rudolf Albert von Kölliker (1817–1905) and Karl Gegenbaur (1826–1903). During this period he developed a profound interest in comparative morphology and histology, disciplines in which he excelled. His skills in morphological research would later serve him well when he undertook his natural history expeditions.

After his studies at the University of Würzburg, he spent the autumn of 1856 in Trieste. On 20 December that year he was awarded his doctorate on the basis of his dissertation, completed under the direction of Kölliker, entitled “Beiträge zur Anatomie und Physiologie der Pulmonaten”. In 1857 Semper continued his studies partly at Würzburg and partly at the University of Kiel. Between November 1857 and June 1858, he travelled through Germany, France, Spain and the Netherlands, “teils Studien in Museen und Bibliotheken zu treiben, teils auch Gefährten zu zuchen, die bereit wären, sich mit ihm zu einer grösseren

naturwissenschaftlichen Reise zu verbinden" – 'in part to study in museums and libraries, in part to search for ships that would be able to take him on a long natural history voyage'.

Semper was especially keen to explore the Philippines. On 20 June 1858, Semper left Hamburg on board the trading vessel *Conradine Lackman*, arriving in Manila in December 1858. Having mastered the local language, he spent seven years exploring many different islands, studying the biodiversity of the Philippines, and at the same time developing a profound interest in anthropology and ethnology.

He arrived back in Hamburg in July 1865. On 11 November 1865, Semper asked the University of Würzburg for a teaching position which he soon obtained. He was appointed Professor of Zoology and Comparative Anatomy in February 1869, and after the death of Professor Valentin Leiblein (1805–1869), Semper took over the Chair of Zoology at Würzburg. During this period Semper prepared and published the first volume of *Reisen im Archipel der Philippinen. Wissenschaftliche Resultate*. According to Johnson (1969) pages 1–70 and plates 1–15 were published in 1867, and pages 71–228 and plates 16–40 were published in 1868. However, three new holothuroid species – *Cucumaria glaberrima*, *C. crucifer* (= *Trachythyone crucifera*) and *Thyone rosacea* – mentioned in the part published in 1868 are also referred to Semper's 1869 publication. Thus, there are three different dates for Semper's type material.

Semper's holothuroid type specimens have been dispersed. We have traced material in eight museums so far (Table 1) but specimens might still be hidden in other museums. The most unexpected find we made was at the Zoological Museum of the Moscow State University (ZMMSU). It is worth documenting how the specimens got there.

A paper in Russian (Anonymous 1874) mentioned that Semper sold an important part of his sea-cucumber collection to the Russian Imperial Society of Amateurs of Natural History, Anthropology and Ethnography (IOLEAE), in Moscow. In 1872 this society organized a Polytechnical Exhibition. Among the organizers was one of the founders of the society, the Director of the ZMMSU, Anatoliy Petrovich Bogdanov (1834–1896). The exhibition included an extensive natural history section with zoological and ethnographical exhibits. On Bogdanov's initiative, a number of zoological collections were bought from renowned zoologists. The collections were exhibited at the Polytechnical Exhibition and subsequently transferred to the ZMMSU. The minutes of the 67th session of IOLEAE of 3 January 1873 (Anonymous 1874) stated that "the acquisitions from the Polytechnical Exhibition represent a significant addition [to the museum collections], thanks to the Society of Amateurs of Natural History". A collection of Philippines holothurians was acquired from Carl Semper that included a major portion of the material on which his monograph on holothurians was based. In total, 73 specimens of holothurians were purchased, at the rate of three thaler per specimen. Every species was represented by a single specimen. All specimens acquired by the museum were registered in the so-called "cord book" ("shnurovaya kniga") in 1872. Sixty nine of these specimens may be considered as type material.

Many species names listed in the "cord book" are marked as unique ("*uniquum*"), that is as represented by a single specimen. Most of the descriptions in Semper's monograph explicitly state that they were based on a single specimen. Sometimes, when there is no such explicit statement, indirect evidence (for example, when body length is listed as a single value rather than a range) suggests there was indeed only a single specimen available.

Two specimens in the ZMMSU collection were labelled as varieties ("var."). One is extant: *Sporadipus martensii* Semper var. (Semper 1867: 87) described without mentioning

that it was a new variety. The other, *Holothuria tubulosa* Gmelin var., may still exist but additional research is needed to confirm this.

According to an inventory undertaken in 1910, 16 specimens (including nine types) of the Semper collection had been lost. Many specimens still present in 1910 were lost between 1910 and 1948, most likely during the Russian Revolution and Civil War. In 1948, the holothurian collection of the museum was catalogued again, and the remaining specimens were given new numbers, which are recorded here.

## INVENTORY OF SEMPER'S SEA CUCUMBER SPECIMENS

Starfish (Asteroidea) and sea urchins (Echinoidea) rank among the most typical organisms when it comes to characterizing the marine fauna. Much less well known are the other three living echinoderm (Phylum Echinodermata) classes: Crinoidea (sea lilies), Ophiuroidea (brittle stars) and Holothuroidea (sea cucumbers). However, for sea cucumbers this might not be absolutely true since these organisms have been fished for human consumption ever since the Middle Ages (Conand 2001), with the processed product known as beche-de-mer. While in the early days, exploitation was done mostly in the Far East with some extensions into the Indian Ocean (Panning 1944), today exploitation is a worldwide phenomenon (Purcell *et al.* 2012), with considerable concern towards declining stocks that in turn gives rise to a potential eroding of the resilience of fisheries (Purcell *et al.* 2011).

Several of the type specimens Semper described are beche-de-mer. Unambiguously defining the “objective standard of reference for the application of the(ir) name(s)” is the object of International Code of Zoological Nomenclature Article 61, and is a pre-requisite of sound conservation action (Samyn and De Clerck 2012). Employing ICZN Article 61 however demands that the whereabouts of the name-bearing types is known. In this paper we trace both the types of commercially important species as well as of others named by Semper (1867, 1868, 1869)

We have screened several museums for type material either personally or via published works (Jangoux *et al.* 1987; Jangoux and De Ridder 1990) and can document the presence of Semper's specimens in eight different museums (Table 1).

European museums that do not contain any of Semper's type material include (see Jangoux 1985a, 1985b, 1986, 1991; Jangoux and Deridder 1987; Jangoux and Massin, 1986):

- Amsterdam: Zoölogisch Museum Amsterdam
- Basel: Naturhistorisches Museum
- Berne: Naturhistorisches Museum der Burgergemeinde Bern
- Brussels: Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussel
- Copenhagen<sup>1</sup> = Natural History Museum of Denmark, Copenhagen
- Frankfurt<sup>2</sup>: Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt
- Genève: Muséum d'histoire naturelle de Genève
- Kiel<sup>3</sup>: Zoologisches Museum, University Christian-Albrechts-Universität zu Kiel
- Leiden: Naturalis, Leiden
- Liège: l'Aquarium-Muséum de Liège
- Lyon: Muséum d'histoire naturelle de Lyon
- Neuchatel: Muséum d'histoire naturelle de Neuchâtel
- Paris: Muséum national d'Histoire naturelle, Paris
- Strasbourg: Musée zoologique de la ville de Strasbourg
- Würzburg<sup>4</sup>: Zoologische Sammlung am Biozentrum der Universität Würzburg

Table 1. Museums known to hold Semper's material.

code	museum	no. of types	no. of species
NHMUK	London: Natural History Museum	7 syntypes	4
NMW	Vienna: Naturhistorisches Museum (see Jangoux and Deridder 1990)	3 syntypes	3
MCZ	Cambridge (Massachusetts): Museum of Comparative Zoology, Harvard University	11 syntypes 1 paralectotype	10
ZMB	Berlin: Museum für Naturkunde, Humboldt-Universität	21 syntypes 3 holotypes	11
ZMH	Hamburg: Zoologisches Museum zu Universität (including Museum Godeffroyi)	10 holotypes 35 syntypes 2 lectotypes	33
ZMMSU	Moscow: Zoological Museum, Moscow State University	11 holotypes 26 syntypes 2 paralectotypes	36 (?37)
ZMUG	Göttingen: Zoologischen Museum der Universität	2 syntypes	2
ZSM	Munich: Zoologische Staatssammlung München (see Jangoux <i>et al.</i> 1987)	5 syntypes	5

In the appendix (pp 332–339) species are listed alphabetically according to the names published by Semper (1867, 1868, 1869). Semper included two unnamed species: *Phyllophorus* sp. nov. and *Mülleria* sp. nov. The first was later described by Ludwig (1875) and named *P. fraunfeldi*. The second was, as far as we know, never described. The reference specimens of these two species were deposited, according to Semper (1868), in MNW, but these were not listed by Jangoux and de Ridder (1990), and we consider both lost.

## CONCLUSION

In his day, Semper was at the forefront of zoological science. The greatest part of his work was malacological, anatomical, histological, embryological, systematical, physiological and biogeographical. His doctoral dissertation on the histology and anatomy of pulmonates soon became a classic and remained the standard for comparative research. The same can be said about Semper's monograph on the sea cucumbers which is still frequently cited. By documenting the whereabouts of extant specimens, most of which are types, Semper's sea cucumber taxa can be examined according to modern standards, leading to re-evaluation of the work of "Der Chef", as his students affectionately termed him (Beard 1893).

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## NOTES

<sup>1</sup> URL (accessed 19 March 2012): <http://www.zmuc.dk/InverWeb/invertebrater/Hjemmesider/Holothuroidea.HTM> (Online database of the Zoological Museum of the Natural History Museum of Copenhagen, University of Copenhagen).

<sup>2</sup> D. Fiege to Y. Samyn, pers. comm., 24 July 2006.

<sup>3</sup> G. Paulay to Y. Samyn, pers. comm., 30 August 2010.

<sup>4</sup> C. Lueter to Y. Samyn, pers. comm., 24 July 2006.

<sup>5</sup> M. Jangoux to Y. Samyn, pers. comm., about 1990.

<sup>6</sup> “Cotype”, a term not regulated by the ICZN, was formerly used for either syntype or paratype.

<sup>7</sup> F. Michonneau to Y. Samyn, pers. comm., 2 April 2012.

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## APPENDIX: C. G. SEMPER'S SEA CUCUMBER SPECIMENS

After the original species names, we give the current valid name. The type locality (preceded by T:) and number and location of those specimens traced by the present authors (for acronyms see Table 1) with the register number(s) following. (For some specimens from ZMH, a second number (prefixed MG) is also given: MG stands for Museum Godeffroy from which ZMH bought material when MG ceased to exist in 1881 (see Krantz 2005).)

- cucumaria* Semper, 1867: 54 = *Cladolabes acicula* (Semper, 1867) (Heding and Panning 1954).  
 T: Viti Islands, Fiji: Semper deposited three specimens in ZMB; 5 in ZMH (E.2747) (= MG.5155); 1 in ZMMSU (H-52).
- aculeata*  
*Holothuria* Semper, 1868: 84 = *Holothuria (Metrialya) aculeata* Semper, 1868 (Rowe 1969).  
 T: Bohol, Philippines: no indication that Semper had more than one specimen; 1 in ZMMSU (H-115).
- adversaria*  
*Echinocucumis* Semper, 1867: 60 = *Thorsonia adversaria* (Semper, 1867) (Heding 1940).  
 T: Bohol, Philippines: no indication that Semper had more than one specimen; 1 in ZMMSU (H-130).
- africana*  
*Cucumaria* Semper, 1867: 53 = *Afrocucumis africana* (Semper, 1867) (Deichmann 1944).  
 T: Querimba, Mozambique; Semper noted three specimens in ZMB; 2 in ZMB (Ech.1198); 1 in ZMH (E.2914) (= MG.7745); 1 in ZMMSU (H-62); 1 in ZSM (52.1).
- albiventer*  
*Holothuria* Semper, 1868: 83 = *Holothuria (Metrialya) albiventer* Semper, 1868 (Rowe 1969).  
 T: Bohol, Philippines: Semper noted several specimens: 1 in ZMB (Ech.1676); 1 in ZMMSU (H-118); 1 NHMUK (84.3.8.28). The original catalogue of ZMH (E.2503) also noted seven co-types from the Red Sea.
- arenicola*  
*Holothuria* Semper, 1868: 81 = *Holothuria (Thymitosycta) arenicola* Semper, 1868 (Rowe 1969).  
 T: Bohol, Philippines: Semper noted several specimens: 1 in ZMH (E.2508) (= MG.5742); 2 in ZMB (Ech.1576); 2 in ZMMSU (H-13 and H-81); 3 in MCZ (708, 709, 632).
- australis*  
*Molpadia* Semper, 1868: 233 = *Paracaudina australis* (Semper, 1868) (Clark 1946)  
 T: Australia: no indication that Semper had more than one specimen; 1 in ZMH (E.2723) (= MG.6362).
- boholensis*  
*Psolus* Semper, 1867: 62 = *Psolus boholensis* Semper, 1867.  
 T: Bohol, Philippines: Semper noted several specimens; 1 in ZMH (E.2727); another was in ZMMSU but is now lost.<sup>5</sup>
- boholensis* var. *pandanensis*  
*Psolus* Semper, 1867: 62 = *Psolus boholensis pandanensis* Semper, 1867.
- T: Bohol, Philippines: Semper recorded only a single specimen; it was in ZMMSU but is now considered lost.<sup>5</sup>
- californica*  
*Cucumaria* Semper, 1868: 235 = *Pseudocnus californicus* (Semper, 1868) (Panning 1962).  
 T: Mazatlan, Mexico: unique type specimen was deposited in ZMH (Semper 1868: 235); not located and considered lost.

- canescens*  
*Cucumaria* Semper, 1867: 48 = *Stolus canescens* (Semper, 1867) (Panning 1949).  
 T: Bohol, Philippines: Semper's description suggests that he had several specimens; 1 in ZSSMU (H-53).
- cebuense*  
*Thyonidium* Semper, 1868: 67 = *Phyllophorus (Phyllothuria) cebuense* (Semper, 1867) (Heding and Panning 1954).  
 T: Cebu, Philippines: Semper noted three specimens; 1 in ZMMSU (H-46).
- chilensis*  
*Holothuria* Semper, 1868: 249 = *Holothuria (Halodeima) chilensis* Semper, 1868 (Rowe 1969)
- chilensis*  
 T: Chile: Semper noted a single specimen; 1 in ZMH (E.2547).
- citrea*  
*Thyone (Stolus)* Semper, 1868: 241 = *Athyodinium chilensis* (Semper, 1868) (Deichmann 1941).  
 T: Chile: Semper noted a single specimen; 1 in ZMH (E.2922).
- coeruleus*  
*Cucumaria* Semper, 1867: 50 = *Pentamera citrea* (Semper, 1867) (Panning 1949).  
 T: Bohol, Philippines: Semper noted several specimens; 1 in ZMMSU (H-72).
- coluber*  
*Colochirus* Semper, 1867: 59 = *Colochirus quadrangularis* Lesson, 1830 (Clark 1946).  
 T: Bohol, Philippines: Semper noted two specimens; not traced and considered lost.
- complanatus*  
*Holothuria* Semper, 1868: 90 = *Holothuria (Acanthotrabeza) coluber* Semper, 1868 (Rowe 1969).  
 T: Zamboanga, Philippines: Semper's description was based on several specimens; 1 in ZMB (Ech.1650); 1 in ZMMSU (H-1).
- conjugens*  
*Psolus* Semper, 1867: 61 = *Psolus complanatus* Semper, 1867.  
 T: Zamboanga, Philippines: no indication that Semper had more than one specimen; 1 in ZMMSU (H-120).
- crucifera*  
*Cucumaria* Semper, 1867: 51 = *Stolus conjugens* (Semper, 1867) (Clark and Rowe 1971).  
 T: Manila Bay, Philippines: Semper's description was based several specimens; one was in ZMMSU but it now considered lost.<sup>5</sup>  
*Cucumaria* Semper, 1869: 121 = *Trachythone crucifera* (Semper, 1869) (Panning 1949).  
 T: Aden, Yemen: Semper (1868: 238) introduced the name *Cucumaria crucifer* without describing it; he based his description (Semper 1869: 121) on three specimens; one sent to ZMMSU now lost.<sup>5</sup> 2 in ZMH (E.2760).
- cucumiformis*  
*Orcula* Semper, 1868: 244 = *Afroccumis africana* (Semper, 1868) (Deichmann 1944).  
 T: Australia: no indication that Semper had more than one specimen; 1 in ZMMSU (H-19).
- cucumis*  
*Colochirus* Semper, 1867: 58 = *Cercodemus anceps* (Selenka, 1867) (Rowe and Gates 1995).  
 T: Bohol, Philippines: Semper noted a single specimen which was in ZMMSU, but now considered lost.<sup>5</sup>
- cylindrica*  
*Cucumaria* Semper, 1867: 53 = *Ocnus cylindricus* (Semper, 1867) (Clark and Rowe 1971).  
 T: Ile de France (= Mauritius): no indication that Semper had more than one specimen; 1 in ZMB (Ech.1189).<sup>6</sup>

- cylindricus*  
*Colochirus* Semper, 1867: 56 = *Colochirus cylindricus* Semper, 1868.  
 T: Bohol, Philippines: Semper noted a single specimen which was in ZMMSU, but now considered lost.<sup>5</sup>
- difficilis*  
*Holothuria* Semper, 1868: 92 = *Holothuria*. (*Platyperona*) *difficilis* Semper, 1868 (Rowe 1969).  
 T: Samoa Islands: no indication that Semper had more than one specimen; nevertheless, 13 specimens have been traced; 1 in ZMMSU (H-50); 1 in ZMH (E.2546) (= MG.5740) regarded by Rowe (Rowe and Gates 1995) as holotype; 12 in MCZ (2 marked as holotype, the rest as syntypes).
- discrepans*  
*Holothuria* Semper, 1868: 251 = *Holothuria*. (*Stauropora*) *discrepans* Semper (Rowe 1969).  
 T: Samoa Islands: Semper recorded two specimens deposited in MG; we have traced four specimens labelled as types; 2 in ZMH (E.2542) (= MG.6371); 1 in ZSM (75/1); 1 in ZMMSU (H-47).
- dubia*  
*Chiridota* Semper, 1867: 21 = *Chiridota dubia* Semper, 1867.  
 T: Camungun (Luzon), Philippines: no types found; one was in ZMMSU but is now considered lost.<sup>5</sup>
- dubia*  
*Synapta* Semper, 1867: 10 = *Oestergrenia dubia* (Semper, 1867) (Heding 1931).  
 T: Bohol and Cebu, Philippines: Semper based his description on two fragments, each most possibly representing one specimen (one from Bohol and one from Cebu); we failed to find them and consider them lost.
- dubiosa*  
*Cucumaria* Semper, 1868: 238 = *Pseudocnus dubiosus* (Semper, 1868) (Panning 1949).  
 T: Peru: Semper noted one specimen deposited in MG; we failed to find it and consider it lost.
- erinaceus*  
*Holothuria* Semper, 1868: 91 = *Holothuria*. (*Selenkothuria*) *erinaceus* Semper, 1868 (Rowe 1969).  
 T: Bohol, Philippines, and Fiji Islands: Semper clearly had several specimens; 1 in MCZ (579); 1 in ZMMSU (H-38); 1 in ZMH (E.2551). ZMH has another specimen collected in Queensland (ZMH E.2550) labelled as type. However, we consider it does not belong to the type series.
- erinaceus* var. *pygmaeus*  
*Holothuria* Semper, 1868: 91 = *Holothuria*. (*Selenkothuria*) *erinaceus* Semper, 1868 (Rowe 1969).  
 T: Albay (Luzon), Philippines: Semper recorded that numerous specimens had been deposited in ZMB by Jäger; 8 in ZMB (Ech.1793).
- flavo-maculata*  
*Holothuria* Semper, 1868: 87 = *Holothuria*. (*Semperothuria*) *flavomaculata* Semper, 1868 (Rowe 1969).  
 T: Samoa Islands: although there is no indication that Semper had more than one specimen but we have traced three specimens indicated as types: 1 in ZMH (E.2540) (= MG.5747), termed holotype by Rowe (Rowe and Gates 1995); 1 in ZMMSU (H-64); 1 in ZSM (78/1).
- frondosa* var. *mediterranea*  
*Cucumaria* Semper, 1868: 235 = *Cucumaria frondosa mediterranea* Semper, 1868.  
 T: Naples, Italy: there is no indication that Semper had more than one specimen; not traced.
- glaberrima*  
*Cucumaria* Semper, 1869: 238 = *Trachytyone glaberrima* (Semper, 1869) (Panning 1964).  
 T: Aden, Yemen: Semper had several specimens; 1 in ZMH (E.2833); 1 in ZMMSU (H-82).
- glabra*  
*Synapta* Semper, 1867: 12 = *Ophcodesoma glabra* (Semper, 1867) (Fisher 1907).  
 T: Bohol, Philippines: no indication that Semper had more than one specimen; 1 in ZMMSU (H-135).

- Godeffroyi*  
*Cucumaria* Semper, 1867: 53 = *Heterocucumis godeffroyi* (Semper, 1867) (O'Loughlin 2002).  
 T: Iquique, Chile: no indication that Semper had more than one specimen; 1 in ZMH (E.2830) (= MG.1980).
- Godeffroyi*  
*Synapta* Semper, 1868: 231 = *Euapta godeffroyi* (Semper, 1868) (Östergren 1898).  
 T: Bohol, Philippines: Semper had several specimens; 1 in ZMMSU (H-123); 2 in ZMH (E.2950) (= MG.6368); 1 in MCZ (832).
- Godeffroyi*  
*Stichopus* Semper, 1868: 75 = *Stichopus horrens* Selenka, 1867 (Clark 1922).  
 T: Samoa Islands: Semper recorded a type series of eight specimens; 2 in ZMH (E.2695); 1 in ZMUG (4-71a); 2 in MCZ (759 and 760); MCZ 760 cannot be treated as a type as it was collected in Fiji; ZMH (E.2690) is labelled "Type" ("Paratype" in original catalogue) but its collection locality (Bowen, Queensland, Australia) does not match the type locality
- gracilis*  
*Anapta* Semper, 1867: 17 = *Anapta gracilis* Semper, 1868.  
 T: Manila, Philippines: Semper had several specimens; 1 lectotype (designated in Mucharim *et al.*, 2011) in ZMH (E.2978); 1 paralectotype in ZMMSU (H-134); 1 paralectotype in NMW (1159D); 1 paralectotype in MCZ (352).
- gracilis*  
*Holothuria* Semper, 1868: 84 = *Holothuria*. (*Thymtosycia*) *gracilis* Semper, 1868 (Rowe 1969).  
 T: Bohol, Philippines: Semper had several specimens; 1 in ZMH (E.2559); 1 in ZMMSU (H-63); 1 in ZMUG (6-73a). Another specimen in ZMH (E.2558) from Palau is labelled "Cotype"<sup>7</sup> in the original catalogue so is not part of the type series.
- gräffei*  
*Holothuria* Semper, 1868: 78 = *Pearsonothuria graeffei* (Semper, 1868) (Levin *et al.* 1984).  
 T: Luzon, Philippines: Semper had several specimens; 1 in ZMH (E.2696); 1 in ZMMSU (H-106); 3 in ZMB (Ech.1674, 1683, 1468); 1 in MCZ (612).
- grisae*  
*Synapta* Semper, 1867: 11 = *Ophredosoma grisae* (Semper, 1867) (Fisher 1907).  
 T: Bohol, Philippines: no indication that Semper had more than one specimen; it was in ZMMSU but is now considered lost.<sup>5</sup> Rowe (in Rowe and Gates, 1995) questioned if ZMH (E.5075) might be the type specimen, but the original catalogue of the ZMH does not indicate type status.
- hayitensis*  
*Stichopus* Semper, 1868: 75 = *Isostichopus badiontus* Selenka, 1867 (Clark 1922).  
 T: Haiti: no indication that Semper had more than 1 specimen; 1 in ZMMSU (H-41).
- hispidum*  
*Echinossoma* Semper, 1867: 44 = *Eupyrgus scaber* Lütken, 1857 (Clark 1908)  
 T: Norway: Semper noted 6 specimens; none traced.
- imbricatus*  
*Ocnus* Semper, 1867: 54 = *Leptopentacta imbricata* (Semper, 1867) (Clark 1938).  
 T: Bohol, Philippines: Semper had several specimens; 2 in ZMH (E.2793: the largest of these (36 mm) is labelled lectotype, while the smallest (33 mm) paratype; 1 in MCZ (279); a specimen was in ZMMSU, but it is now lost.<sup>5</sup> The vial that holds ZMH (E.2793) specimens also has a voucher from Hong Kong (ZMH E.2804) but this specimen is not part of the type series.
- immobilis*  
*Holothuria* Semper, 1868: 90 = *Holothuria* (*Lessonothuria*) *vernucosa* Selenka, 1867 (Clark 1946)  
 T: Bohol, Philippines: no indication that Semper had more than one specimen which was in ZMMSU, but is now considered lost.<sup>5</sup>
- incongrua*  
*Chiridota* Semper, 1867: 22 = *Chiridota incongrua* Semper, 1867.  
 T: Camiguon (Luzon), Philippines: no indication that Semper had more than one specimen which was in ZMMSU, but is now considered lost.<sup>5</sup>

- indivisa*  
*Synapta* Semper, 1867: 13 = *Synaptula indivisa* (Semper, 1867) (Clark 1908).  
 T: Zamboanga, Philippines: it is unclear if Semper based his description on just one specimen (from the Mindanao Peninsula, Zamboanga) or on two (one from Mindanao and one from Zamboanga); a specimen deposited in ZMMSU is now considered lost.<sup>5</sup>
- inornata*  
*Holothuria* Semper, 1868: 252 = *Holothuria (Halodeima) kerfersteini* (Selenka, 1867) (Deichmann 1958).  
 T: Mazatlán, Mexico: Semper noted five specimens in ZMH; 3 in ZMH (E.2575); 1 in NHMUK (1884.3.8.18); the fifth specimen has not been traced.
- Jagorii*  
*Colochirus* Semper, 1867: 60 = *Colochirus jagorii* Semper, 1868.  
 T: Singapore: Semper had more than one specimen; 2 in ZMB (Ech.1591); another was in ZMMSU but is now considered lost.<sup>5</sup>
- japonica*  
*Cucumaria* Semper, 1868: 236 = *Cucumaria frondosa japonica* Semper, 1868 (Panning 1955).  
 T: Japan: Semper had two specimens; one was in ZMMSU but is now lost<sup>5</sup>; the other specimen has not been traced.
- Koellikeri*  
*Holothuria* Semper, 1868: 86 = *Bohaduschia koellikeri* (Semper, 1868) (Rowe 1969).  
 T: Samoa Islands: Semper had a single specimen which he deposited in MG; 1 in ZMH (E.2637) (= MG.6360); 1 in ZMMSU (H-65); none is accompanied by an original label. Rowe (in Rowe and Gates, 1995) treated ZMH (E.2367) as the holotype.
- Koellikeri*  
*Cucumaria* Semper, 1867: 237 = *Pseudocnus dubiosus koellikeri* (Semper, 1867) (Panning 1962).  
 T: Sicily, Italy: Semper had several specimens; 1 in ZMMSU (H-51); 1 in MNW (11387).
- leonina*  
*Cucumaria* Semper, 1867: 53 = *Pseudocnus dubiosus leonina* (Semper, 1867) (Panning 1951).  
 T: Singapore: Semper mentioned only one specimen; 1 in ZMMSU (H-61).
- longipeda*  
*Cucumaria* Semper, 1867: 51 = *Phyllophorus (Phyllophorella) longipeda* (Semper, 1867) (Heding and Panning 1954).  
 T: Bohol, Philippines: no indication that Semper had more than one specimen which was in ZMMSU, but is now considered lost.<sup>5</sup>
- maculata*  
*Cucumaria* Semper, 1867: 47 = *Cladotabes perspicillum* (Selenka, 1867) (Heding and Panning 1954).  
 T: Bohol, Philippines: no indication that Semper had more than one specimen; 1 in ZMMSU (H-102).
- Martensii*  
*Holothuria* Semper, 1868: 86 = *Holothuria (Metriatyta) martensii* Semper, 1868 (Rowe 1969).  
 T: Ambonia, Indonesia: it is unclear if Semper based his description on one or three individuals (two juveniles from Luzon were also mentioned); 1 in ZMB (Ech.1681); 1 in MCZ (1062) collected in Murray Islands is not part of the type series.
- möbii*  
*Stichopus* Semper, 1868: 246 = *Isostichopus badionotus* (Selenka, 1867) (Clark 1922).  
 T: West Indies: no indication that Semper had more than one specimen; 1 in ZMH (E.2702).
- molesta*  
*Synapta* Semper, 1867: 9 = *Protankyra bidentata* Woodward and Barrett, 1858 (Clark 1908).  
 T: Bohol, Philippines: no indication that Semper had more than one specimen; 1 in ZMMSU (H-113).
- molpadioides*  
*Haplodactyla* Semper, 1867: 41 = *Acaudina molpadioides* (Semper, 1867) (Clark 1946)  
 T: Bohol, Philippines: from Semper's description the number of specimens cannot be deduced; 1 in ZMMSU (H-38). Rowe (in Rowe and Gates 1995) noted 1 specimen in ZMH (E.5237).

- molpadioides* var. *Jagorii*  
*Haplodactyla* Semper, 1868: 32 = *Acaudina molpadioides* (Semper, 1867) (Cherbonnier and Féral 1981).  
 T: Singapore: unique specimen deposited in ZMB (Semper 1868: 232); not traced.
- molpadioides* var. *pellucida*  
*Haplodactyla* Semper, 1867: 42 = *Acaudina molpadioides* (Semper, 1867) (Sluiter 1912).  
 T: Bohol, Philippines: Semper mentioned two specimens; 1 was in ZMMSU but is now considered lost<sup>5</sup>; we failed to find the second.
- molpadioides* var. *sinensis*  
*Haplodactyla* Semper, 1867: 43 = *Acaudina molpadioides* (Semper, 1867) (Clark 1946).  
 T: China: Semper noted two specimens; not traced.
- molpadioides*  
*Ocnus* Semper, 1867: 55 = *Placothuria molpadioides* (Semper, 1867) (Liao (1997)).  
 T: China: Semper noted a single specimen donated by Salmini; 1 in ZMMSU (H-121).
- naso*  
*Stichopus* Semper, 1868: 72 = *Stichopus naso* Semper, 1868.  
 T: Bohol, Philippines: no indication that Semper had more than one specimen; it was in ZMMSU, but is now considered lost.<sup>5</sup>
- nigra*  
*Synapta* Semper, 1867: 12 = *Pendekaplectana nigra* (Semper, 1867) (Heding 1928)  
 T: Bohol, Philippines: no indication that Semper had more than one specimen; it was in ZMMSU, but is now considered lost.<sup>5</sup>
- panaensis*  
*Chiridota* Semper, 1867: 19 = *Polychaera rufescens* (Brandt, 1835) (Clark 1908)  
 T: Punaon, Philippines: Semper noted three specimens; 1 in ZMMSU (H-69).
- pedata*  
*Thyone* Semper, 1867: 67 = *Thyone pedata* Semper, 1867.  
 T: Chinese Sea: no indication that Semper had more than one specimen; it was in ZMMSU, but is now considered lost.<sup>5</sup>
- peruanus*  
*Colochirus* Semper, 1868: 233 = *Trachythione peruanus* (Semper, 1868) (Panning 1949)  
 T: Peru: Semper noted three specimens: 1 in ZMH E.2801 (= MG.6372); 1 in MCZ (280); the third was in ZMMSU, but it is now considered lost.<sup>5</sup>
- Petersi*  
*Synapta* Semper, 1868: 230 = *Protankira petersi* (Semper, 1868) (Östergren 1898)  
 T: Amboina, Indonesia: Semper noted a single specimen; 1 (*vide* Jangoux<sup>6</sup>) in ZMB (Ech. 1587).
- pseudo-digitata*  
*Synapta* Semper, 1867: 9 = *Protankyra pseudodigitata* (Semper, 1867) (Östergren 1898)  
 T: Bohol, Philippines: Semper noted that he has lost the single specimen and that he can only characterize the species via its ossicles and his notes. We could not trace Semper's microscope slides.
- pygmaeus*  
*Ocnus* Semper, 1867: 55 = *Leptopentacta pygmaea* (Semper, 1867) (Clark 1938).  
 T: Bohol, Philippines: Semper noted a single specimen; it was in ZMMSU, but is now considered lost.<sup>5</sup>
- recta*  
*Synapta* Semper, 1867: 14 = *Synaptula recta* (Semper, 1867) (Clark 1908).

- T: Bohol, Philippines: Semper seems to have had several specimens; one was in ZMMSU, but is now considered lost<sup>5</sup>; 2 in ZMB (Ech.1862),<sup>6</sup> *Synapta* Semper, 1867: 13 = *Synaptula reticulata* (Semper, 1867) (Clark 1908).
- T: Bohol, Philippines: Semper noted four specimens; one was in ZMMSU, but is now considered lost<sup>5</sup>; 1 in ZSM (119/1) (Jangoux *et al.* 1987).
- Chiridota rigida* Semper, 1867: 18 = *Chiridota rigida* Semper, 1868
- T: Bohol, Philippines: Semper must have had several specimens before him; 1 in ZMMSU (H-78).
- Thyone* Semper, 1867: 66 = *Stolus buccalis* (Stimpson, 1855) (Marenzeller 1882).
- T: Bohol, Philippines: Semper noted two specimens; 1 in ZMMSU (H-93).
- Thyone* Semper, 1869: 242 = *Staurothyone inconspicua* (Bell, 1887) (Clark 1938).
- T: Aden, Yemen: Semper had at least two specimens; 1 in ZMH (E.2901).
- Labiodemas* Semper, 1868: 77 = *Labiodemas semperianum*Selenka, 1867 (Sluiter 1901).
- T: Viti Islands, Fiji: Semper noted a single specimen; 1 in ZMH (E.2674) (= MG.1170).
- Holothuria similis* Semper, 1868: 85 = *Bohaschia similis* (Semper, 1868) (Cherbonnier 1954).
- T: Bohol, Philippines: Semper noted a single specimen; however we traced two specimens; 1 in ZMMSU (H-18) with Semper's original label annotated "unicum"; 1 in ZMH (E.2640) without an original Semper label (in the original catalogue it is marked as "co-type?").
- Synapta* Semper, 1867: 10 = *Protankyra similis* (Semper, 1867) (Østergren 1898).
- T: Bohol, Philippines: Semper had several specimens before him; 1 in ZMMSU (H-39); 1 in MCZ (351); 1 in MNW (11587).
- Holothuria squamifera* Semper, 1868: 83 = *Holothuria*. (*Theclothuria squamifera* Semper, 1868 (Rowe 1969).
- T: Bohol, Lapinig Channel, Philippines: Semper had several specimens; 1 in NHMUK (1884-3-8-29); a second was deposited in ZMMSU but is now considered lost<sup>5</sup>; 1 in ZMH (E.2641) from Java marked "co-type is not part of the type series.
- Thyone* Semper, 1867: 65 = *Ocnus surinamensis* (Semper, 1867) (Panning 1949).
- T: Surinam: Semper noted two specimens; 1 specimen in ZMMSU (H-100); 3 specimens in ZMH (E.2906).
- Holothuria tenuissima* Semper, 1868: 85 = *Bohaschia tenuissima* (Semper, 1868) (Cherbonnier 1955).
- T: Bohol, Philippines: no indication that Semper had more than one specimen; 1 in ZMMSU (H-42) is labelled "unicum". A specimen in ZMH (E.2578) (= MG.1875) was treated as holotype by Rowe (in Rowe and Gates 1995: 289) but this is not correct as added subsequently (Semper 1868: 248) to the description and from another locality (Samoa).
- Chiridota* Semper, 1867: 20 = *Polyschaera rifescens* (Brandt, 1835) (Clark 1908).
- T: Mariveles (Manila Bay), Philippines: Semper noted five specimens; 1 in ZMMSU (H-14).
- Chirodota* Semper, 1868: 231 = *Chiridota variabilis* Semper, 1868.
- T: Cape York, Australia: Semper noted that Salmin sent a single specimen to Hamburg; not traced.

- variegatus*  
*Stichopus* Semper, 1868: 73 = *Stichopus horrens* Selenka, 1867 (Rowe in Rowe and Gates 1995).  
 T: Bohol, Philippines and Samoa Island: Semper had several specimens; 1 in ZMH (E.2716) was designated lectotype by Rowe (Rowe and Gates, 1995); 1 in ZMMSU (H-119).
- variegatus* var *Herrmanni*  
*Stichopus* Semper, 1868: 73 = *Stichopus herrmanni* Semper, 1868 (Rowe in Rowe and Gates 1995).  
 T: Bohol, Philippines; Samoa Islands, Papua New Guinea: Semper had several specimens; 3 in NHMUK (1884.3.8.1/2; 1884.3.8.38); another was in ZMMSU but is now considered lost.<sup>5</sup> ZMH (E.2697) (= MG.1166) from Fiji cannot be part of the type series.
- versicolor*  
*Cucumaria* Semper, 1867: 49 = *Havelockia versicolor* (Semper, 1867) (Clark and Rowe 1971).  
 T: Bohol, Philippines: Semper had several specimens; 1 in ZMH (E.2873); 1 in ZMMSU (H-13); 1 in ZSM (65/1) (Jangoux *et al.* 1987).
- villosa*  
*Thyone* Semper, 1867: 65 = *Havelockia villosa* (Semper, 1867) (Panning 1949).  
 T: Cebu, Philippines: Semper had several specimens; 1 in ZMH (E.2909); another was in ZMMSU but is now lost<sup>5</sup>.
- viridis*  
*Colochirus* Semper, 1867: 59 = *Colochirus viridis* Semper, 1868.  
 T: Zamboanga, Philippines: Semper noted that he had lost the single type and that he could only characterize the species by his notes and an accompanying drawing.
- vitiensis*  
*Holothuria* Semper, 1868: 80 = *Bohadrschia vitiensis* (Semper, 1868) (Pearson 1914).  
 T: Viti Islands, Fiji: Semper noted only one specimen; 1 in ZMH (E.2669) (= MG.6374) designated holotype by Rowe (in Rowe and Gates 1995); 1 in ZMMSU (H-33) but original label illegible.