

REPORT

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The Mayer-Eymar collection of Cenozoic mollusks

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Abstract

Karl Mayer (later Karl Mayer-Eymar, 1826–1906) was a stratigrapher and palaeontologist who assembled during his long career a collection of Cenozoic (then “Tertiary”) mollusks that numbers more than 500'000 specimens. He mostly collected them himself at various localities in Europe and Egypt. In more than 175 publications he described more than 1100 new bivalve and gastropod species, the types of which are of paramount importance for mollusk taxonomists. Based on his collection, he furthermore, erected 13 new Cenozoic stages, five of them still in use today. Here the structure and content of this collection is described, along with an explanation of the labels which are at first not so easy to understand. The Mayer-Eymar collection is in the propriety of the “Eidgenössische Technische Hochschule” (ETH) in Zürich. From 1966 until 2020 it was on a permanent loan to the Natural History Museum Basel, where it was also curated. In October 2020 the collection was returned to the ETH.

Keywords: Karl Mayer-Eymar, Cenozoic mollusks, Cenozoic stages

Biographical sketch

Karl Mayer was born on July the 29th 1826 in Marseilles, France (for detailed biographies see Heim & Rollier, 1907; Sacco, 1907; Dollfuss, 1908; Heim, 1908; Cahuzac, 2008; Hall, 2018). His father, originally from St. Gallen, Switzerland, worked there as a merchant. A few years later, the family moved to Cohignac near Rennes, France, where the young Karl attended the first years in school. After the death of his father in 1839, Karl moved to St. Gallen, where he was raised by his uncle and attended grammar school. It was here that he started collecting fossils, mainly from Miocene marine sediments.

In 1846 he enrolled at the University of Zürich, first in Medicine, a year later in Palaeontology and Stratigraphy. His most important teacher was Arnold Escher von der Linth for whom he soon worked as an assistant in the fossil collection. After his graduation in 1851 he went to Paris and continued his studies, mainly at the “Muséum

d’Histoire Naturelle” and the “Ecole des Mines”. The contact with Alcide d’Orbigny, who had developed stratigraphic schemes for Jurassic and Cretaceous sediments and erected many new stages, was certainly crucial for Mayer’s further scientific steps. Soon he started to develop his own stratigraphic scheme for the Cenozoic, then known as Tertiary, which he would refine and modify many times during his life. Yet he did this not in isolation and communicated zealously with many colleagues. The preserved scientific correspondence (see Jaeggli, 1965) is digitized and available on e-manuscripta. Further documents can be found in the ETH Zurich University Archives (indexed under Hs 276–Hs 279, including the scientific correspondence Hs 277).

From 1858 on, Karl Mayer was assistant at the geological institute of the Polytechnic School in Zurich (today the Eidgenössische Technische Hochschule ETH) and became a few years later curator of the geological collection and lecturer for Palaeontology and Stratigraphy. In 1875 he also became adjunct professor of the University of Zürich. As a teacher, however, he seemed totally unqualified. His lectures were “incredible table dictations”

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(Heim in Heim & Rollier, 1907), and consequently were attended by two students at most.

Throughout his career he sampled an immense number of fossils, first from the Cenozoic of Switzerland, then also of Italy and France, to a lesser extent from Hungary, Germany and Tyrol, and in later years Egypt. Through his devotion and expertise on the Tertiary, Mayer was also known as “Tertiary-Mayer”. Many fossils were donated to him, and it is documented that he bought fossils from dealers, among others English material from dealers in Paris (Hall, 2018).

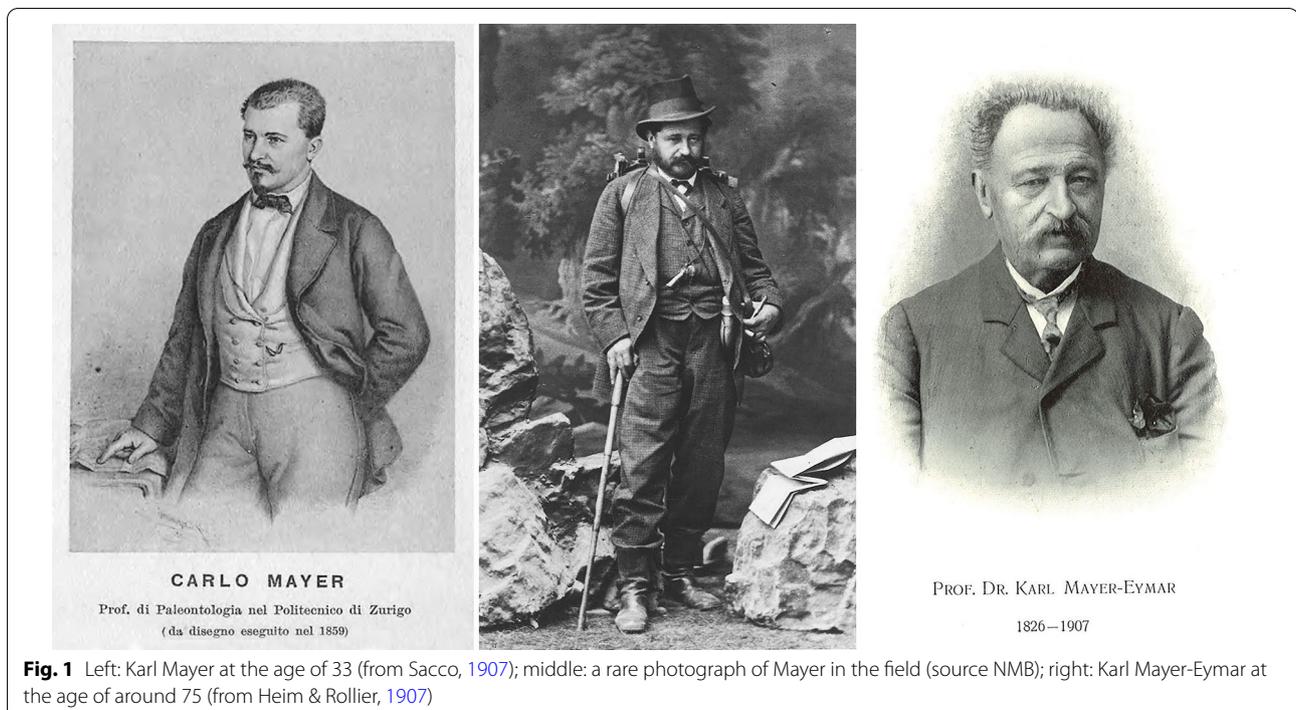
Mayer's first publication appeared in 1853, and by the end of his immensely productive life the number amounted to more than 175 (Rollier in Heim & Rollier, 1907). Among these were some voluminous ones like his (incomplete) catalogue of the mollusks in the collection of the “Musée Fédéral de Zurich” that appeared in four parts (Mayer, 1867–1870), and his description of the fossils of Madeira, Porto-Santo and Santa Maria (Mayer, 1863), and his listing of the fossils of the “Helvetien” (Mayer, 1872). However, many more were only a few pages long and described new species of bivalves and gastropods. To these belong the more than 60 publications that appeared over many years in the “Journal de Conchyliologie”. To avoid confusion, he published from 1881 on under the name of Karl (also at times Charles) Mayer-Eymar, Eymar just being an anagram of Mayer. Although the Cenozoic was his main focus,

he also described a few belemnites and other Jurassic fossils. In addition, in 1864, he introduced the Middle Jurassic Aalenian stage that is still in use today.

Apart from the taxonomic work on Cenozoic mollusks, Mayer resp. Mayer-Eymar (Fig. 1) had an immense influence on the subdivision of the Tertiary. He presented his first attempt at a subdivision of the Tertiary at the meeting of the Swiss natural scientists in 1857 (Mayer, 1857–1858). Many more such schemes followed (see Rollier in Heim & Rollier, 1907).

During his career, he erected many new stages and sub-stages of the Cenozoic. He presented a synthesis 1888 at the Fourth Session of the International Geological Congress in London, and the same year he published them in his “Cours de Stratigraphie” (Mayer-Eymar, 1888; see Matteucci et al., 2016). In Italy alone, 13 stages, substages and formations were erected by Mayer-Eymar (Matteucci et al., 2016), and in all of Europe, he established 13 new Cenozoic stages, of which five are still in use today (see Hall, 2018, who omitted the “Latdorfian”). Mayer-Eymar had a wide network of correspondents with whom he frequently discussed different topics (Jaeggli, 1965). He was also esteemed for his good humor (Heim in Heim & Rollier, 1907).

He was also concerned during his long life with the question of the age of the earth. He distinguished 64 sedimentary stages during earth's history and estimated, based on astronomical calculations, an average duration



of at least 21'000 to 26'000 years for them. He, therefore, obtained a minimum age of the earth of 1.5 million years after sedimentation began (Rollier in Heim & Rollier, 1907).

Mayer-Eymar's work was recognized early as important and he was awarded the Barlow-prize by the Geological Society of London in 1892 and the Prix Savigny in 1894 by the Institut de France. There are also two gastropod genera named in honour of Mayer-Eymar: *Mayeria*, a melongenid (Bellardi, 1873); and *Eymarella*, a phymatopleurid (Cossmann, 1897). At least three gastropod species were dedicated to Mayer (see Cahuzac, 2008): *Stolidoma mayeri* Tournouer, 1870 (figured in Tournouer, 1872), an ellobiid; *Ringicula mayeri* Morlet, 1880, a shelled heterobranch; and *Neritina mayeri* Semper, 1867, from the family Neritidae.

Karl Mayer-Eymar remained a bachelor, and it is assumed that droll manner together with a lack of order and cleanliness in his household played a role (Heim in Heim & Rollier, 1907). At times he also seemed to suffer from paranoia.

Mayer-Eymar restlessly continued to sample Cenozoic fossils, and even at the age of 80 he undertook an expedition to Egypt. Yet when returning from this fieldtrip he fell seriously ill. After finally entering the polyclinic in Zürich, he died only 3 days later on February 25th 1906. He was entombed on the Sihlfeld cemetery in Zurich (Hall, 2018).

The collection and its structure

The whole collection of Cenozoic mollusks must contain around 500'000 individual specimens (earlier estimates were approximately 350'000), sometimes in lots with more than 100 objects. These are stored in densely

packed drawers (see Fig. 2). The collections of Paleozoic corals (probably only curated by Mayer-Eymar and not collected by himself), Jurassic and Cretaceous fossils and rock samples will not be considered here.

The "systematic collection" = "paleontological collection" contains the best specimens and most of the types. The systematic collection is stored in about 300 drawers (Figs. 3, 4). It is organized roughly according to genera, but this arrangement is not very reliable, and in drawers labeled, e.g., with "*Pecten*" we might also find bivalves that do not belong to the pectinids, and on the other hand there might be pectinid bivalves in drawers that are labeled as, e.g., "*Ostrea*". It is likely that this disarray does not go back to Mayer-Eymar who was very well-organized in this respect but is the result of the many relocations of the collection. For better access to genera, species and especially the types, the collection should be rearranged. Unfortunately, the resources for such a reorganization were neither available in Basel nor in Zürich.



Fig. 3 Oysters in the systematic collection



Fig. 2 Two examples of densely packed drawers; left various gastropods from the systematic collection; right oysters from the collection of fossils from Egypt

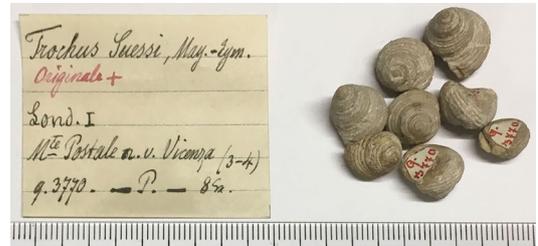


Fig. 4 Bivalves of the genus *Arca* in the systematic collection. Today, many of these are placed in different genera

Former director of the Natural History Museum Basel Peter Jung compiled a literature-based list of more than 1'300 species that were erected by Mayer-Eymar, including also belemnites and a few other groups, and perhaps this list is not even complete. However, the Cenozoic mollusks alone named by Mayer-Eymar must have numbered around 1'100. These types are marked on the labels (see below) and are scattered throughout the systematic collection. For some types additional placeholder boxes were made. These empty boxes fill three drawers.

For taxonomists, the Mayer-Eymar collection of Cenozoic mollusks and especially the type specimens are of paramount importance. Every year there are several requests for photographs or even loans of types of bivalves and gastropods. Yet locating these types had proven to be a tedious endeavor, and quite often it was not possible to find the types. In addition, when the box and label of a type could be found it was frequently empty and the specimen itself missing. In addition, when a box with a label marked as original was found there might be several potential syntype specimens in it. All too often Mayer-Eymar's descriptions were published without figures, and if figures were included these were utterly idealized, making it impossible to identify a shell with the figure alone. In his descriptions, Mayer-Eymar did not indicate the number of specimens he had at hand but this is marked on the labels (see below). Yet Mayer-Eymar always described only one specific specimen and gave its accurate dimensions (see Fig. 5).

Much material from the Mayer-Eymar collection and especially many of the types were the subject of publications that revised the taxonomy of these species. A selection of important revisions and new descriptions include:



68. *Trochus Suessi*, Mayer (pl. XI, fig. 4).

Trochus Suessi, Mayer, Descr. Coq. foss., p. 5, 23 avril 1870.

T. testa conica, apice obtusiuscula; anfractibus 5, convexiusculis, sutura subcanaliculata separatis, spiraliter sexcingulatis; cingulis elevatiusculis, sulcis angustioribus, inaequalibus, plus minusve granosis; ultimo anfractu majusculi, spiram plus minusve superante, rotundato, basi sulcato, umbilicato; apertura subrotunda; labro acutato, columella obliqua, unidentata. — Long. 15, lat. 13 mill.

Coquille conique, à sommet un peu obtus, formée de cinq tours médiocrement convexes, séparés par une suture légèrement canaliculée, ornés de six petites carènes assez



1. *Avellana cancellata*, Dumortier. | 4. *Trochus Suessi*, Mayer.

Fig. 5 Syntype specimens, label, description and figures of *Trochus suessi* Mayer, 1870. The publication appeared in the "Journal de Conchyliologie". Please note the accurate indication of the dimensions for the species in the description

- Mollusks from the Tertiary of the northern Italian provinces Piedmont and Liguria (Bellardi & Sacco, 1873–1904; see also Marshall 1991)
- Revision of the Neogene mollusks of the Aquitaine (Cossmann & Peyrot, 1909–1932)
- Reevaluation of Mayer's Aquitanian faunas (Eames & Clarke, 1967)
- Description of the Miocene mollusks of Dingden and Twistringden, Germany (Janssen, 1969, 1972)
- Revision of the muricid gastropods of the Western Atlantic region (Vermeij & Vokes, 1997; Vokes, 1975)
- Revision of the types of the genera *Lithophaga* and *Gastrochaena* (Kleemann, 1981)
- Revision of various gastropod types of Mayer-Eymar (Gatto, 1990, 1991, 1992, 1993, 1997)
- Revision and new descriptions of the bivalve fauna of the Miocene "Belpbergschichten", canton Bern, Switzerland (Pfister & Wegmüller, 1994, 1998, 1999)
- Revision of Paleogene mollusks from the Paris Basin (Le Renard, 1994; Le Renard & Pacaud, 1995)

- Redescription of planktonic gastropods in the Mayer-Eymar collection (Zorn, 1995)
- Description of new muricid genera (Vermeij, 1998)
- Revision of the lower Oligocene fauna of Häring, Tyrol, Austria (Löffler, 1999)
- Re-evaluation of the fauna of Santa Maria, Azores (Avila, 2009, 2022)
- Revision of vesicomyid bivalves from the Mediterranean Neogene (Janssen & Krylova, 2012)
- Evolution of the pelagic gastropod genera *Janthina* and *Recluzia* (Beu, 2017)
- Revision of the Aquitanian bivalve fauna of Saucats (Lesport et al., 2019)
- Revision of Miocene Conidae of Crete (Greece; Psarras et al., 2021, 2022)

Many of the species described by Mayer-Eymar are not considered valid species any more, and many of them were allocated to other genera. A number of them represent different deformation stages. This is most evident in the bivalve fauna of the Miocene marine Molasse of St. Gallen, Switzerland. Mayer listed no less than 426 different bivalve species in these layers, among them 126 new species described by Mayer himself (Mayer, 1867–1870, 1872, plus unpublished material). Yet it could be shown that this incredible diversity is an artefact. When taking different deformation stages into consideration, the number of bivalve species was reduced to 62 and the number of valid new Mayer species amounts to only six (Fanck, 1929).

The “stratigraphic collection” = “geological collection” groups faunas according to their age/stages and location. Here we find large samples of famous assemblages, many of which were the basis for the erection of new stages that Mayer-Eymar proposed. Notable examples are:

- various localities from the Paris Basin as the basis for the “Parisien” stage (middle Eocene)
- localities near Genova in northwestern Italy as the basis for the “Ligurian” stage (Eocene)
- Latdorf in Brandenburg, Germany, as the basis of the upper Eocene–lower Oligocene “Latdorfium”
- the locality Häring near Kufstein, Austria (lower Oligocene, Rupelium)
- Tongeren in eastern Belgium, type locality of the lower Oligocene “Tongrien”
- various localities of the Bordeaux region, among them famous Saucats, as the basis of the lower Miocene Aquitanian stage
- Tortona and adjoining localities in northwestern Italian Piedmont as the basis of the upper Miocene Tortonian stage

- Piacenza and neighbouring localities in the northern Italian province Piacenza, type locality of the Pliocene Piacenzian stage
- Asti in northwestern Italian Piedmont province as the basis of the Pliocene Astian stage
- Castell’Arquato in the northern Italian province Piacenza (Pliocene, Astian)

A large proportion of the fossils in the stratigraphic collection are glued on cardboard (Fig. 6). This might have served presentation purposes, perhaps in Mayer’s lectures. The stratigraphic collection comprises around 310 drawers and is thus the largest part of Mayer-Eymar’s collection, also in terms of specimen numbers slightly larger than the systematic collection.

In the “geographic collection” we find fossils ordered according to their provenance. It is safe to assume that this was the first ordering by Mayer-Eymar, when he arranged the material he brought back from his field campaigns. From this working collection, he selected the better pieces to integrate them in the stratigraphical and systematic collections.

The geographic collection which amounts to around 150 drawers contains less important material from Switzerland, mainly from the Ralligstöcke (Eocene, canton Bern), the Eocene of the surroundings of Einsiedeln (canton Schwyz), and the Miocene marine Molasse near St. Gallen (canton St. Gallen). The more important collection from Egypt comes mainly from the Eocene of Mokattam near Kairo, the Eocene of Dimeh near Fayum, and a few Quaternary localities in northern Egypt. This material was collected by Mayer-Eymar in the last 20 years of his life, and it was the last large project he was working on (e.g., Mayer-Eymar, 1901, 1902, 1903).

There is, furthermore, a collection of “doublettes”. This part contains material of lesser quality that is



Fig. 6 Different fossils glued onto cardboard in the stratigraphic collection

ordered according to age and provenance, in part also according to systematics. The doublettes collection was stored until around 2000 in small wooden boxes (see Fig. 7) and was not accessible. It is now stored in 130 drawers.

Unfortunately, there is yet another part of the Mayer-Eymar collection. These are specimens that were loaned, while the collection was still in Zurich but only returned after it was moved to Basel (see below), encompasses mainly the large loan of muricid gastropods by Emily Vokes (Tulane University, USA) in 1964. When the more than 900 specimens (among them dozens of Mayer-Eymar types) were returned in 1997, the material could not be put back in its proper place, because there were no placeholders in the drawers. The collection of loaned and returned material amounts to 30 drawers.

The labels

It is important to understand the structure and meaning of the labels when working with the Mayer-Eymar collection. The labels come in three variants:

- “Field” labels
- “Old” labels
- “New” Labels

“Field” labels (see Fig. 8) are sketchy slips written with pencil that mostly contain species names and locality information, sometimes also only the latter. These were certainly the first labels that Mayer-Eymar put to the fossils.

The “old” labels (see Fig. 9) contain in the upper left a prefix (Po, V.s., V.e., d., du., f., h., i., l., lv. etc.) that relates to one of the catalogues of the ETH Zürich (see below). The inventory number is listed directly under this prefix and refers again to a catalogue. The locality is written



Fig. 7 In such wooden boxes were the “doublettes” stored until 2000

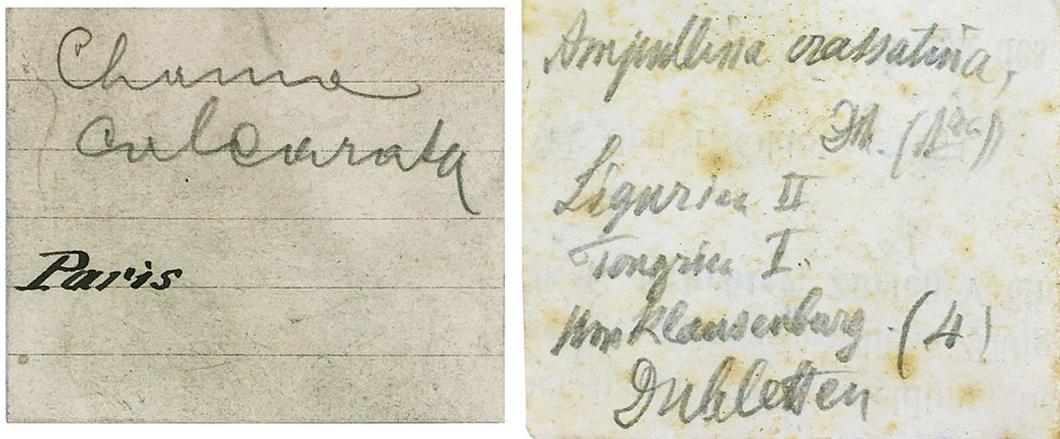


Fig. 8 Two examples of “field” labels; left of *Chama calcarata* Lamarck, 1806; right of *Amputillina crassatina* (Lamarck, 1804)

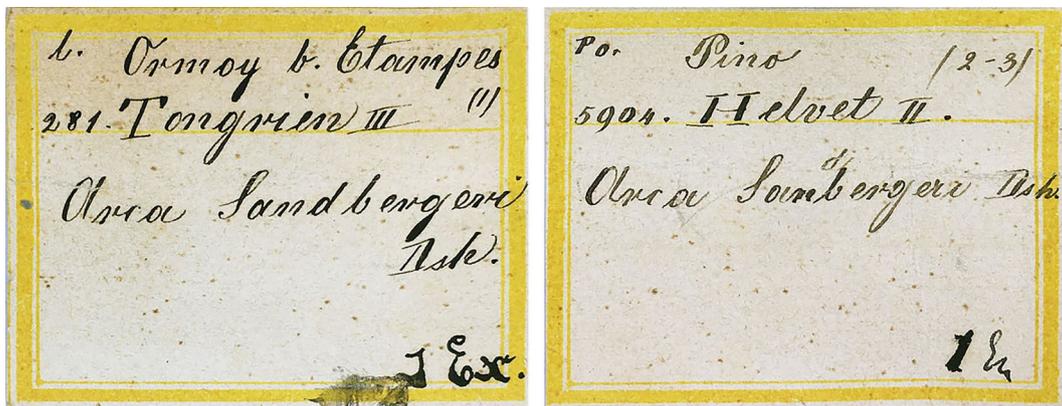


Fig. 9 Two examples of "old" labels, in this case of *Arca sandbergeri* Deshayes, 1858. For further explanations, see text

in the upper middle, to the right we find the frequency of occurrence in Mayer-Eymar's code (see below under new labels). Under the locality Mayer-Eymar listed the age/(sub)stage, and below we find the species name. In the lower right the number of specimens in the box is indicated.

The "new" labels (see Fig. 10) are mostly restricted to the systematic collection. They have always the same very clear structure. On top the genus, species and author are listed. Below or just to the right is indicated with red ink if it is a type of a new Mayer-Eymar species. The notion "Original-" indicates that Mayer-Eymar considers it a new species but it is not yet described but only mentioned in a faunal list (nomen nudum; see also Kleemann, 1981). "Original+" indicates that the description was published. All the types seem to have new labels. Yet there are a few types that are not in the Mayer-Eymar collection at all. Examples are *Lithodomus oosteri* Mayer-Eymar, 1887, and

Lithodomus ornatissimus Mayer-Eymar, 1887, which are both in the possession of the Natural History Museum Bern (Kleemann, 1981). Mayer-Eymar published these species but the specimens probably already belonged to the Bern Museum before.

Further below we find the age/the stage. The locality is given below the stage and to the right, in parentheses, the coded frequency of occurrence (Mayer-Eymar, 1902; Evelyn Boesch personal communication, 2014); (1) means very rare, (2) rare, (3) not rare, (4) common, (5) very common. Quite often we find combinations like (3-4) or (4-3).

The inventory number with prefix is written on the bottom line, followed by a letter or a combination of letters with the following meaning: P palaeontological or systematic collection; G geological or stratigraphic collection; S.p.S. see palaeontological collection; we find the latter on the labels of the empty placeholder boxes for



Fig. 10 Two examples of "new" labels: of *Trochus suessi* Mayer, 1870, and of *Ostrea radiolata* Mayer-Eymar. Please note that the latter species just appeared in a species list but was never formally described. It is, therefore, a nomen nudum

type material (Kleemann, 1981). Finally, the number of specimens in the box is indicated to the right.

Catalogues

Several inventory books or ledgers record the new entries in the collection of the geological department of the Polytechnic (ETH Zurich) during Mayer-Eymar’s employment. The entries were made by Arnold Escher von der Linth, Oswald Heer, Karl Mayer (-Eymar) and others, later also by Albert Heim and Louis Rollier. The following ledgers are transmitted (Evelyn Boesch (ETH Zurich University Archives), communication, 2019):

001 Ledgers P.o. for mineralogical, geological and palaeontological specimens which are registered as property of the Polytechnic, since its foundation and after 1861 for specimens that were donated to the Polytechnic or acquired through particular credits.

002 Ledgers V.s. (Vereinigte Sammlungen = united collections) for mineralogical, geological and palaeontological specimens which were acquired after 1861 from the acquisition fund of the city of Zurich, the canton Zurich and the federal state (Polytechnic), and for specimens that were donated to the collection of the geological department without clear designation of the property.

003 Ledgers V.e. for specimens that were donated to the federal state university from the collections of Oswald Heer, Karl Mayer-Eymar, and the Friedrich Rolle collection, or that were collected during the 1868 Pentecost field trip, or were purchased and listed in the book from 1867 on.

004 Ledgers city of Zürich 1, for fossils and rock samples, numbered with prefixes a through k, sampled by Arnold Escher from 1834 on from Switzerland and the

adjoining countries, with additions by Charles Mayer-Eymar (especially for the Aquitanien), and supplements for entries before 1833.

005 Ledgers city of Zurich 2, for fossils and rock samples, numbered with prefixes l through z + y (volcanic rocks), from Switzerland and the adjoining countries.

006 Ledgers city of Zurich 3, with prefixes aa through zz, mainly rock samples.

007 Ledgers city of Zurich 4, prefix Zü, mainly vertebrates, a few mollusks and echinoderms.

The prefixes and inventory numbers on the “old” labels correspond to the entries in these inventory books 001–007 (see Figs. 9, 11).

Starting in 1879, Mayer listed the fossils of the collection of the geological department in a systematic manner in his new “stratigraphic-systematic” booklets (Evelyn Boesch Evelyn Boesch (ETH Zurich University Archives), communication, 2019). There are three booklets for the Silurian, three for the Devonian, two for the Carboniferous and two for the Permian. There are, however, only sparse entries for the Palaeozoic. The Triassic has seven booklets, which are, apart from the one with the bivalves, again only sparsely filled.

The 21 booklets (two of them discarded) have many more entries for the Jurassic system, especially the ones on cephalopods, bivalves, gastropods and brachiopods. The same applies to the 18 booklets for the Cretaceous.

There are 28 booklets for the Tertiary. These contain in 23 booklets the entries for Mayer-Eymar’s collection of Cenozoic mollusks, with the prefixes i through v with the exception of u which was used for the Triassic. The “new” labels indicate these prefixes and the inventory number in the “stratigraphic-systematic” booklets (Figs. 10, 12).

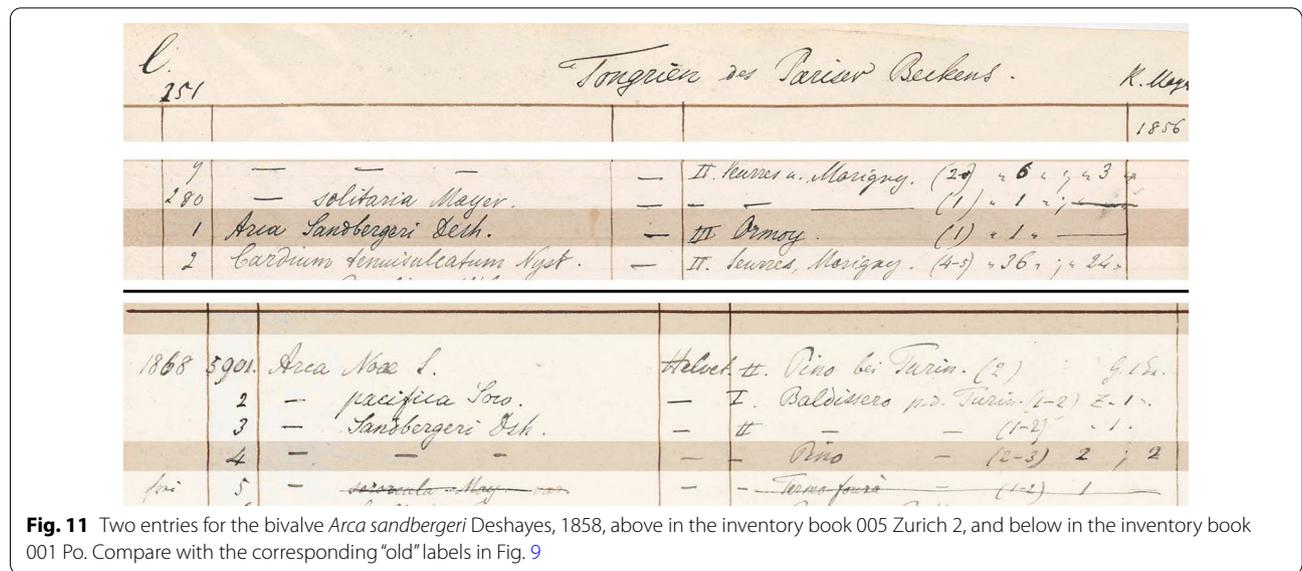


Fig. 11 Two entries for the bivalve *Arca sandbergeri* Deshayes, 1858, above in the inventory book 005 Zurich 2, and below in the inventory book 001 Po. Compare with the corresponding “old” labels in Fig. 9

acquire the property of the collection. However, the ETH Zürich, in contrast to the situation just a few years before, now emphasized the importance of its collections, and requested the return of the Mayer-Eymar collection. In September and October 2020, the content of the drawers as it was stored in Basel was transferred 1:1 to the ETH drawers which had approximately the same dimensions.

By the end of October, all the material had arrived in Zürich, where the collection was initially stored in the cellars of the Höggerberg building. From May until September 2022 the Mayer-Eymar collection was transferred to an external storage facility in Buchs, canton Zürich, where it is now accessible for visiting scientists.

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Author contributions

WE wrote the manuscript and read and approved the final manuscript.

Declarations

Competing interests

I have no competing interests.

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