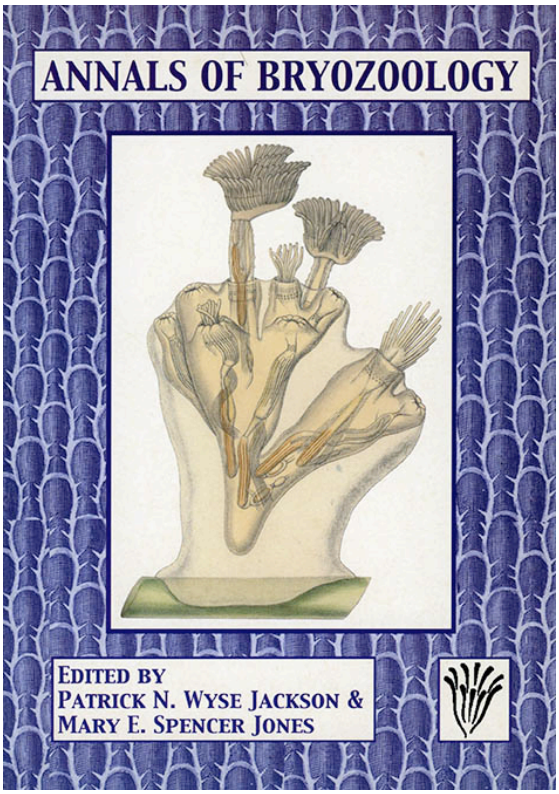


Paper in:

Patrick N. Wyse Jackson & Mary E. Spencer Jones (eds) (2002) *Annals of Bryozoology: aspects of the history of research on bryozoans*. International Bryozoology Association, Dublin, pp. viii+381.

Micropalaeontology in Vienna at the turn of the 19th century: foraminiferan and bryozoan studies of Leopold von Fichtel and Johann Paul Carl von Moll

Miklós Kázmér[*] and Norbert Vávra[†]

[*]*Department of Palaeontology, Eötvös University, H-1518 Budapest, P.O. Box 120, Hungary*

[†]*Institute of Palaeontology, University of Vienna, Althanstrasse 14, A-1010 Wien, Austria*

1. Introduction

The Habsburg emperors of Austria had a centuries-old tradition of interest in natural history. Ferdinand I (1503-1564) invited Pietro Mattioli (1500-1577), the greatest botanist of his age, to be his 'physician in ordinary' in 1555, and supported the publication of his comments on *Dioscorides* in 1565. His son, Maximilian II (1527-1576), supported Carolus Clusius (1526-1609), *princeps botanicorum*, for two decades during his stay in the Austrian empire. Both rulers spent great sums on establishing and maintaining rich gardens and menageries, and Maximilian also owned a collection of natural and art objects.[1] Rudolf II (ruled 1576-1612) founded the collection of physical and astronomical instruments, and spared no costs to stock the garden and the menagerie with the most exotic plants and animals.[2] He was probably the first to attempt to establish a systematic collection of the mineral wealth of his empire by commanding the mining towns to send mineral specimens to the natural history collection.[3] Anselmus Boetius de Boodt (1550-1632) published the most authoritative account on minerals and gems in the seventeenth century based on Rudolf's collection in Prague.[4]

Into this family married Franz Stephan von Lothringen (1708-1765). Having no real political power since his wife, the Empress Maria Theresa was the ruler of Austria, Bohemia, and Hungary from 1740 to 1780, he cultivated his private interests.[5] Besides improving agricultural methods on his property[6], he generously supported scientific research[7]. He had a deep knowledge of mineralogy, and assembled a significant collection of minerals, rocks, and fossils, and another one of coins and antiques in the imperial court next to the existing physical intruments museum in Vienna.[8] For this purpose in 1748 he bought one of the largest natural history collections of the time from Johann Baillou (1679-1758) of Florenz, which was one of the best in Europe, containing more than 30,000 mineralogical, palaeontological and marine zoological specimens.[9] Additionally, the Emperor invited Baillou to serve as director of the new museum in Vienna[10]. The collection contained mostly minerals and fossils, and crabs, conchs and zoophytes among the animals. The zoological objects were collected to serve as an explanation for the fossil ones.[11] The emperor liked the collection so much that almost no day passed without him spending time there. He transferred his interest to one of his daughters, the Princess Maria Anna (1738-1789), who developed her own mineral and fossil collection.[12]

Upon the early death of Emperor Franz Stephan von Lothringen in 1765, the Empress transferred the natural history collections from the family's private property to the care of the state. New rooms were built and new personnel hired to work scientifically on the collections. Baillou's post was taken by Born as director in 1777.

Ignaz von Born (1742-1791) (Figure 1), a native of Hungary, who had long been known as a scientist and organiser of exceptional capabilities,[13] brought new life into the Imperial Natural History Cabinet. He enriched it with specimens of his own and gifts from his acquaintances and friends in several countries. Born himself published the catalogue of the shell collection.[14] A new exhibition was installed in the years of 1778-1780 with the enthusiastic help of curators and volunteers, among them a certain Karl von Moll.[15] The mineralogical and fossil collection was ordered following the schemes of Wallerius and Cronstedt, the crabs, shells, and radiolarians according to Linnaeus, while the system of Pallas was used to arrange the zoophytes.[16]

In 1780 Born – together with his friend Benedict Franz Herrmann – founded a freemasons' lodge in Vienna[17]. Unusual in its activities, the lodge *Zur wahren Eintracht* was a kind of academy of sciences, with regular sessions, a mineral collection,[18] and most importantly, with a scientific journal titled *Physicalische Arbeiten der einträchtigen Freunde in Wien* edited by Born himself (1783-1788).[19] The lodge, with which even the would-be emperor Joseph was associated, helped Vienna become a centre of German enlightenment.[20]

Masonic activities were first put under state control by Emperor Joseph II in 1785, then

Figure 1. Ignaz von Born (1742-1791).

forbidden in the wake of the French revolution from 1794 by the new emperor Franz II. Born lived to see the demise of his journal and the dissolving of his academy, the lodge. However, his other great achievement, the Natural History Cabinet-turned-scientific-museum, survived him as an early symbol of imperial power and wealth[21] in the time when free thinking was severely limited in countries opposing the stormy events in France.

From 1788 Abbot Andreas Stütz (1747-1806), author of works on mineralogy, served as vice-director of the Natural History Cabinet, and following Born's early death in 1791 took full responsibility for the growth, arrangement and study of the collection. Stütz was followed by Carl Schreibers, a zoologist in 1806, who rearranged the exhibitions and encouraged scientific publishing.[22]

This was the historical and spiritual background behind the activities of two associates of the Imperial Natural History Museum in Vienna, Leopold von Fichtel and Johann Paul Carl von Moll. The two friends established the science of micropalaeontology in the Austro-Hungarian Monarchy, and are still considered as major figures in the history of

micropalaeontology.[23] Their works are highly valued even today, but the life of the authors and the circumstances in which they worked are largely unknown. This paper is a small addition to their respective biographies.

2. Leopold von Fichtel (1770-1810)

We are unaware about most of the details in the life of Leopold von Fichtel.[24] Often he is confused with his father, Johann Ehrenreich von Fichtel (1732-1795), a significant personality of Austro-Hungarian geology, palaeontology, and mining science.[25] A jurist by education, serving the governments of Transylvania and Austria in several capacities, the elder Fichtel was a celebrated scientist of his age, member of several scientific societies, and prolific author of geological and palaeontological monographs on the minerals and fossils of the Carpathians. He was an ardent vulcanist, and wrote a vitriolic pamphlet on contemporary mineralogical practices.[26] His biography is routinely included in lexicons and biographical compilations even today.[27] The son, probably a less colourful character and certainly a less prolific author, did not make his way into the favours of lexicographers. However, his lasting contribution to science certainly exceeds that of the elder Fichtel.

Leopold von Fichtel, the only son of his father, was born in Hermannstadt,[28] Transylvania in 1770.[29] We are unaware of the details of his education. His father was financial councillor in Hermannstadt up to the son's age of 15, then spent two years in Vienna as customs officer before returning to take the position of councillor to the Gubernium in Hermannstadt again.[30] Leopold probably never married and never took a paid position, at least not for any considerable time. His death record (he died in 1810 in Vienna) recorded him as *'Practicant beim k.k. Directorium'*, i.e. an unpaid assistant in the bureaucracy.[31]

Leopold possibly inherited the love for travel from his father. The elder Fichtel started travelling widely within Hungary while working for a law firm, and continued it during his occupations as mining supervisor and customs inspector. Leopold followed his father on many of his offical journeys.[32]

The scattered records tell that the younger Fichtel joined the work on the new exhibition in the Imperial Natural History Cabinet as volunteer.[33]

Probably the first scientific publication of the younger Fichtel was an annotated translation of a treatise on the lithology of Vesuvius.[34] His interest was probably started by his father, who was an ardent advocate of volcanist ideas.[35] Giuseppe Gioeni[36] (1743-1822) was professor of natural sciences at the University of Catania. He visited Vesuvius upon an invitation from Sir William Hamilton, the ambassador to the Bourbon court in Naples, author of the *Observations on Mount Vesuvius*.[37] Gioeni's work comprises an

Figure 2. The Imperial Collection

extensive geological description of Vesuvius and a catalogue of all volcanic products together with their mineralogical and chemical analyses. It is one of several contemporary treatises on the active volcanoes and their products in Italy.[38]

In 1798 Leopold von Fichtel published – together with J.P.C. von Moll – the *Testacea microscopica*, a lavishly illustrated treatise on Foraminifera at his own cost. The figures were drawn with the utmost care. A recent revision[39] accompanied by scanning electron photography of the original specimens proved the exceptional accuracy of the original illustrations arranged on twenty-four copper plates.

In 1804 10,000 gulden was paid for a rich collection of insects, which were collected by Fichtel during his stay in the East Indies.[40]

In 1806 Abbot Stütz died; he had been acting director of the Imperial Natural History Cabinet. Three scientists applied for the now vacant position: Leopold Fichtel, Moll, and Carl Schreibers. The last – an assistant professor, zoologist at the University of Vienna, besides being a promising scientist, had friends and relatives in higher positions than the other two. He was appointed to the position.[41] Under Schreibers's years as director, the Cabinet grew to a full-fledged, majestic natural history museum, with systematically arranged collections, where the scientists – employed and volunteers – published major monographs in their chosen fields.[42]

Schreibers, supported by Count Wrbna, convinced the Emperor to buy animals to fill the gaps in the systematic collections. Fichtel, who was an insider in the Cabinet for a long time and enjoyed the trust of the Emperor, undertook the task and travelled to England to supervise the buying. His aim was to buy all necessary and available specimens for the collection. He spent, through the Emperor's donation, 18,000 guldens in total for this project.[43] He obtained not only rare species but also a number of unique specimens for the Vienna Cabinet. It was during his visit to England that Fichtel laid the foundations for an ethnographic museum by obtaining some of the ethnographic collections of Captain James Cook.[44]

Leopold Fichtel enjoyed a considerable, although irregular income by gathering natural objects and selling whole collections to museums. He sold a large amount of the most rare and valuable conchs to the Natural History Cabinet in 1797 for a considerable sum.[45] The mineral collection he inherited from his father, rich especially in mineralized gold ores of Hungary and Transylvania,[46] was acquired by the School of Chemistry and Metallurgy in Kolozsvár[47] in 1799 for 5000 gold florins.[48]

The director of the Imperial Natural History Cabinet repeatedly sent Leopold Fichtel on buying trips, e.g. in 1806 to acquire the Lever and the Parkinson collection in England.[49] His further travels are less well known. We know that he spent considerable time in East India, since his collection was bought for 10,000 guldens by the Cabinet.[50] Other travels brought him to France, Spain, and Portugal, from where he returned with numerous mammal and bird specimens, a rich insect collection and other specimens, either collected by himself or acquired by purchase.[51]

The Emperor frequently added to the sum set aside for regular buying of natural objects from mineral traders and private persons. In the years between 1806 and 1809, 14,000 guldens was spent on buying besides what was allowed by the annual budget. Seemingly Fichtel sold the largest collection of minerals for the sum of 5132 guldens to the Cabinet during this period.

The younger Fichtel was well-known in scientific circles. He was a member of the

Linnean Society in London and of the Asiatic Society of Bengal in Calcutta.[52] He died on 18th March 1810 in Vienna from tuberculosis.

In 1812 the department of shells (the 'Conchylien-Abtheilung') was enriched with a major collection of foraminifers. This was assembled by Leopold von Fichtel and Johann Paul Carl von Moll, and contained the original material published in their *Testacea microscopica* of 1798. This collection, unique of its kind, exists even today.[53] It was bought – together with the original manuscript and figures, and 503 further plates and drawings of the rest of the collection besides *Argonauta* and *Nautilus* – for the high sum of 150 guldens from Fichtel's mother.[54]

3. Johann Paul Karl von Moll (1735-1812)

Johann Paul Karl von Moll[55] was born in Öttingen, Bavaria, on 30th October 1735. His father was a financial clerk in the court of the Count of Öttingen. He had at least an uncle and a godfather in Vienna, who had a keen interest in natural history. One of them held the fossil collection of the famous naturalist Nicolaus Lang.[56] Living probably with these relatives he acquired his knowledge in fossils.[57]

Moll was an ambitious and idealistic helper of Ignaz von Born in arranging the systematic exhibition and description of the Imperial Natural History Cabinet, while enriching the collection of the freemason lodge *Zur wahren Eintracht* with gifts,[58] and maintaining his own collection of shells.[59] Moll died poor in the city hospice on 20th February 1812.[60]

Both Fichtel and Moll were pioneers of micropalaeontology in Austria-Hungary. Educating no disciples, a generation passed until August E. Reuss started his work on microscopic fossils in the 1840s.

4. Fichtel and Moll: *Testacea microscopica* (1798)

The first well-illustrated major monograph on foraminiferans is the *Testacea microscopica* of Fichtel and Moll,[61] considered by Alcide d'Orbigny (1802-1857), the great French palaeontologist, professor in the Jardin des Plantes of Paris, to be one of the fundamental works in micropalaeontology.[62] It is the most important of the earliest works on the Foraminifera. The still earlier works on which Linné based his few species of Foraminifera were not well illustrated. The work of Fichtel and Moll is for the most part excellently illustrated. Cushman also remarked that in his own copy the colours of the plates are beautifully preserved in spite of their age.[63]

The work of Fichtel and Moll is important for the specific names used. On this basis several genera were erected by numerous later authors.[64] Fichtel and Moll supplied a

general designation of the origin of the described specimens. Precise localities are given only in the case of fossil material.

The significance of this early major work on foraminifers is enhanced by the fact that the original material is preserved in the Natural History Museum in Vienna. A revision, accompanied with scanning electron micrographs, and a colour facsimile of the original plates has been made recently.[65] A further major complete monograph exists in manuscript titled *Microscopische Conchylien*, ready for publication, complete with drawings. Even nine plates have been prepared. This material was obtained from Fichtel's mother after the death of his son.

5. Moll: *Eschara zoophytorum* (1803)

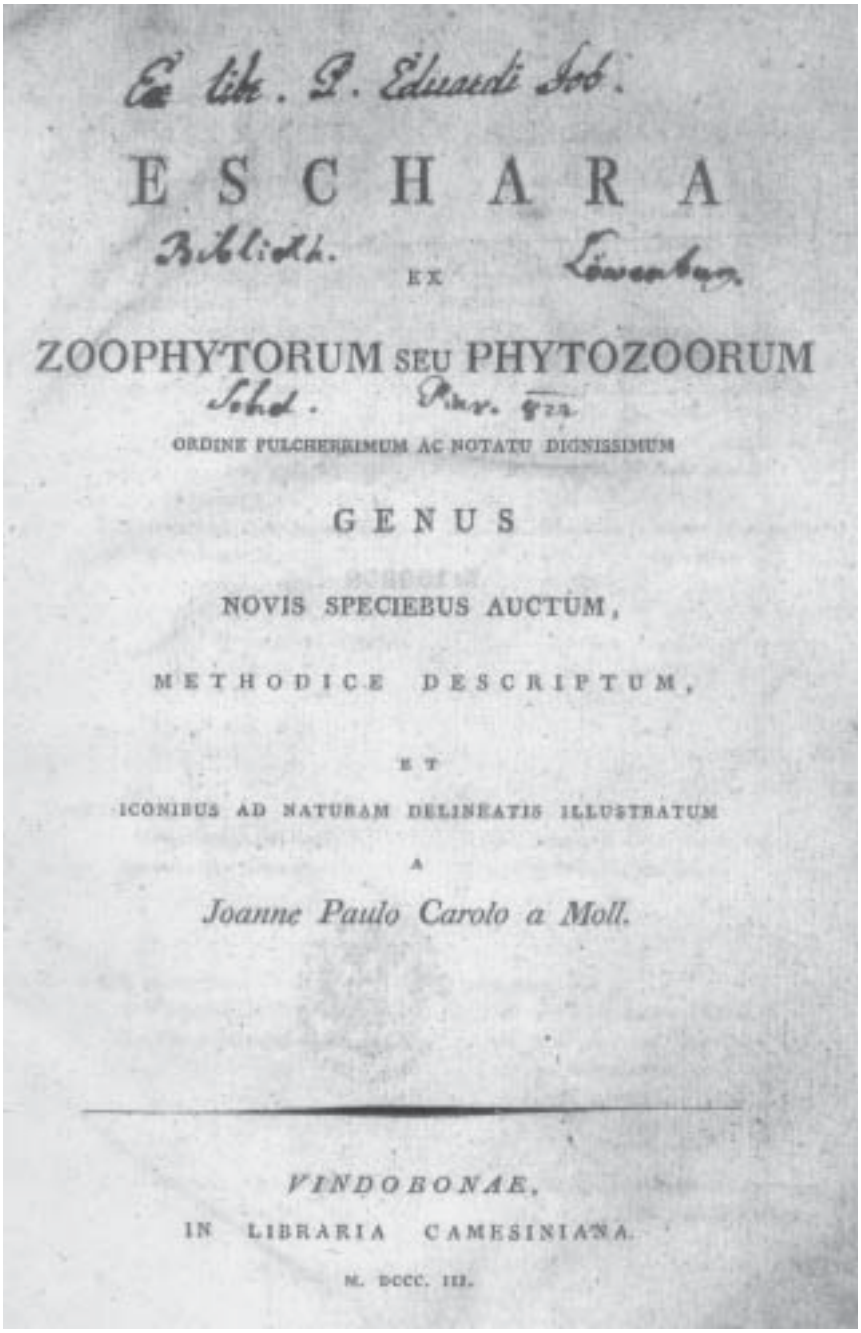
This monograph has both a frequently cited Latin[66] and a rarely mentioned German[67] edition published in the same year. The description below follows the page numbering of the Latin edition.

The volume starts with a list of illustrations on six unnumbered pages (left column in Latin, right column in German). Then follow preliminary contemplations on zoophytes or phytozoa in general (*Preliminares contemplationes de zoophytis seu phytozois in genere*) (pp. 3-24, with abundant notices in the footnotes). Moll describes the anatomy, nutrition, and systematics of the bryozoans, with extensive references.

The systematic subdivision of the Bryozoa (i.e. *Eschara*) (pp. 25-30) follows, accepting Pallas's terminology and nomenclature. Descriptions are grouped under a first section: Escharae described by Pallas in his *Elenchus Zoophytorum* (pp. 30-50), and under second section: Escharae, undescribed either by Pallas in his *Elenchus Zoophytorum* or by others.

A full revision of Moll's species is still to be undertaken. Here a few remarks are given to emphasize the importance of the work. Pallas's species are the following:

Eschara fascialis (pp. 30-34) = *Pentapora fascialis* (Pallas, 1766)
  variety α proprie *fascialis* (Pl. I, figs 1A-F)
  variety β *lamellosa* (Pl. I, fig. 2)
Eschara spongites (pp. 34-35; Pl. I, figs 3A-B) = *Stylopoma spongites* (Pallas, 1766)
Eschara annularis (pp. 36-37; Pl. I, figs 4A-B)
Eschara pilosa (pp. 37-44) = *Electra pilosa* (Linnaeus, 1766)
  variety α *loeflingiana*
  variety β *ellisiana* (Pl. I, figs 5A-D)
  variety γ *reaumuriana* (Pl. II, figs 6A-H)
Eschara foliacea (pp. 44-48; Pl. II, figs 7A-E) = *Pentapora foliacea* (Ellis & Solander)
Eschara papyrea (pp. 48-50; Pl. II, figs 8A-B) = *Charbasea papyrea* (Pallas, 1766)



Ex libr. P. Eduardi Jos.

ESCHARA

Bibliothecae Lovaniensis

EX

ZOOPHYTORUM SEU PHYTOZOORUM

Schol. Phys. 924

ORDINE PULCHERRIMUM AC NOTATU DIGNISSIMUM

GENUS

NOVIS SPECIEBUS AUCTUM,

METHODICE DESCRIPTUM,

ET

ICONIBUS AD NATURAM DELINEATIS ILLUSTRATUM

A

Joanne Paulo Carolo a Moll.

VINDOBONAE,

IN LIBRARIA CAMESINIANA.

M. DCCC. III.

Figure 3. Title-page of Eschara zoophytorum.

The new species are as follows:

Eschara impressa, nova species (pp. 51-54 Pl. II, figs 9A-I) = *Calpensia nobilis* (Esper, 1796)
Eschara vulgaris (pp. 55-56). Type species of the genus *Escharina* Milne-Edwards, 1836.
variety α, nova species (with fixed lower labium) (Pl. III, figs 10A-B)
variety β, nova with integrated lower labium (Pl. III, figs 11A-C)
Eschara cyclostoma, nova species (pp. 56-57. Pl. III, figs 12A-D)
Eschara Pallasiana, nova species (pp. 57-58; Pl. III, figs 13A-B). Type species of the genus *Cryptosula* Canu & Bassler, 1929.
Eschara Borniana, nova species (pp. 58-60; Pl. III, figs 14A-C)
Eschara Otto-Mülleriana, nova species (pp. 60-62; Pl. III, 15A-C) = *Pentapora ottomulleriana* (Moll, 1803)
Eschara sedecimdentata, nova species (pp. 62-63; Pl. III, figs 16A-C) = ? *Electra* sp.
Eschara radiata, nova species (pp. 63-64; Pl. IV, figs 17A-I) = *Puellina radiata* (Moll, 1803)
Eschara bimucronata, nova species (pp. 65-66; Pl. IV, figs 18A-C) = *Haplopoma bimucronata* (Moll, 1803)
Eschara planata (p. 67; Pl. IV, fig. 19)
Eschara patellaria (pp. 68-69; Pl. IV, figs 20A-B) = *Mollia patellaria* (Moll, 1803)
Eschara depressa (pp. 69-70; Pl. IV, fig. 21) = *Calpensia nobilis* (Esper, 1796)

Genus, species and variety names are invariably given both in Latin and in German in the title line. A second line with smaller letter gives the name translated into the French.

Moll named three new species after major personalities in contemporary palaeontology:

Peter Simon Pallas (1741-1811) German naturalist and explorer. Professor of natural history at the St. Petersburg Academy of Sciences. Widely travelled in Russia and described the fauna, flora and minerals of Siberia. His first major study was the *Elenchus zoophytorum*, a major study in bryozoology, which founded his fame and brought him the invitation of Catherine II to St. Petersburg.[68]

Ignaz von Born (1742-1791) Hungarian naturalist, organiser of science, freemason, director of the Natural History Cabinet in Vienna. He published several volumes on mining, on mineral and fossil collections and on shells.[69]

Otto Frideric Müller (1730-1784), Danish naturalist, was born in Copenhagen. He studied theology, law and natural history in Denmark. After graduation he visited several European countries. He published a number of monographs and a large number of scientific papers, first in theology, and later in botany (*Flora Danica*) and zoology (insects mostly). He was a member of several European academies. He made a living from being lawyer and the archivist of the Norwegian Chamber. Müller published probably only a single work on bryozoans, titled *Memorie sur un nouveau Genre de Zoophytes* in the

Gazette Litteraire de Berlin.[70]

The bryozoan samples derive from a multitude of localities. They arrived from all over the world, collected during hundreds of years of donations and specialized gathering expeditions to South and Central America, southern Africa, India, and of course Europe.[71] A brief mention in the paragraph 'patria' indicates the Mediterranean Sea, Adriatic Sea, Indian Ocean, Atlantic Ocean, the Cape of Good Hope, American seas, and the North Sea between England and Belgium. The collectors are mostly unnamed; probably were unknown to the authors as well. Reaumur and Baillou are named as persons from whom specimens were derived.

All species are recent, but a few fossil localities are mentioned, too: the famous Kroisbach[72] quarry next to Lake Neusiedl[73] in Hungary, close to the Austrian border,[74] an unidentified locality near Vienna, and at Monte S. Petri next to Trajectum ad Mosam (Maastricht) in The Netherlands. The new species came invariably from the Mediterranean, and one from the Adriatic Sea (one specimen is of unknown origin).

The illustrations are strongly magnified,[75] exactly drawn and not stylised like in several later works of palaeontology.[76] A microscope was used for drawing them. Experimenting with a microscope from a slightly older age, Rögl and Hansen have shown that magnification and resolution was satisfactory for the proper and exact drawing of such minute features such as the ornament of foraminiferans a few tens of micrometres in size.[77] Drawing microscopes were available at that time. Mirrors were applied to view the object and the drawing surface simultaneously.[78] The highly faithful illustrations suggest that the artist – probably the author himself – used such drawing equipment.

Moll put in a few remarks on the ecology of the species. In the North Sea between England and Belgium, *Eschara pilosa* var. *loeflingiana* abundantly encrusts algae. Specimens on the alga *Ulva lactuca* from Flandria are in the collection of Moll.[79] He has observed that *Eschara pilosa* var. *ellisiana* is an encrusting species. Pallas found it on the alga *Sertularia longissima,* while, Moll's specimen is on *Sertularia cupressina*.

6. Discussion

Both Fichtel and Moll are considered as 'Klassiker der Mikropaläontologie in Österreich'.[80] Lamouroux named the genus *Mollia*[81] in 1816. The greatest personalities of foraminifer research have paid visits to the Fichtel and Moll collections in the Natural History Museum in Vienna throughout the twentieth century.[82]

Neither Fichtel nor Moll taught students and there were no immediate successors to the promising beginning in micropalaeontology that they made. Almost half a century passed until the first monographic descriptions on Austrian material appeared: Alcide d'Orbigny

wrote on foraminiferans in 1846[83] and A.E. Reuss on bryozoans in 1848.[84] With the latter's monograph there began a tradition of high-quality micropalaeontological work in Austria-Hungary, which persists even today.[85]

The words '*methodice descriptum*' on the title page of the *Eschara* is a character of the age. Several works claim – justifiedly – in their title that they contain a rational and methodical description, so fitting to the rationalism of the Enlightenment.[86]

Notes

1 L.J. Fitzinger, 'Geschichte des kais. kön. Hof-Naturalien-Cabinetes zu Wien. I. Abtheilung. Älteste Periode bis zum Tode Kaiser Leopold II. 1792', *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Classe*, 21 (1856), 433-479, Wien, 468.

2 L. Hendrix, G. Bocskay, J. Hoefnagel and T. Vignau-Wilberg (editors), *Nature Illuminated: Flora and Fauna from the Court of Emperor Rudolf II* (Los Angeles, 1997). Robert John Weston Evans, *Rudolf II and His World. A Study in Intellectual History, 1576-1612* (Oxford, 1984).

3 W.E. Wilson, 'The History of Mineral Collecting', *Mineralogical Record* 25/6 (1994), 1-243, Tucson, Arizona, 38.

4 *Gemmarum et Lapidum Historia* (Lugduni Batavorum, 1609). See M.-C. Maselis, A. Balis and R.H. Marijnissen, *De albums van Anselmus de Boodt (1550-1632), geschilderte natuurobservatie aan het Hof van Rudolf II te Praag* (Tielt, 1989). C. Gysel, 'Anselme Boece De Boodt (1550-1632), lapidaire et médecin de Rodolphe II', *Vesalius* 3 (1997), 33-41.

5 G. Schreiber, *Franz I. Stephan: an der Seite einer grossen Frau*, (Graz, 1986)

6 R. Zedinger, 'Franz Stephan von Lothringen und sein Kreis unter besonderer Berücksichtigung der Tätigkeiten im Gebiet der heutigen Slowakei', in *Die goldene und silberne Reise des Kaisers Franz Stephan von Lothringen in die mittelslowakischen Bergstädte*, (Banská Stiavnica, 2001), 18-28.

7 C. Riedl-Dorn, 'Franz Stephan als Förderer naturwissenschaftlicher Aktivitäten', in *Die goldene und silberne Reise des Kaisers Franz Stephan von Lothringen in die mittelslowakischen Bergstädte*, (Banská Stiavnica, 2001), 29-38.

8 G. Niedermayr, 'The mineral collection of the Museum of Natural History', *Mineralogical Record*, 20 (1989), 347-354, Tucson, Arizona.

9 Wilson, note 3, p. 159.

10 Riedl-Dorn, note 7, pp. 30-32, and C. Riedl-Dorn, Chevalier de Baillou und das Naturalienkabinett, in *Lothringern Erbe. Franz Stephan von Lothringen (1708-1765) und sein Wirken in Wirtschaft, Wissenschaft und Kunst der Habsburgmonarchie*. (= Katalog des Niederösterreichischen Landesmuseums, Neue Folge 429 (St. Pölten, 2000), 111-115.

11 Fitzinger, note 1, p. 439.

12 This collection was bought by the University of Pest upon the retirement of the Princess from court activities, where it still exists as the core of the collection today (G. Papp, Tamás Weiszburg, 'The mineral collection of Archduchess Maria Anna', in *Museum and Collections in the History of Mineralogy, Petrology and Paleontology in Hungary*, edited by G. Vitális and T. Kecskeméti (Budapest, 1991). Annals of the History of Hungarian Geology, Special Issue

3, 135-143).

13 C. Riedl-Dorn, 'Ignaz von Born (1742-1791) – ein siebenbürgischer Naturforscher', *Stapfia* 45 (Linz, 1996), 345-355.

14 I. Born, *Index rerum naturalium Musei Caesarei Vindobonensis. Pars I. Testacea*, (Vindobonae, 1778) and I. Born, *Testacea Musei Caesarei Vindobonensis, quae jussu M. Theresiae Augustae disposuit et descripsit Ig. a Born* (Vindobonae, 1780). Earlier Born published a catalogue of his own collection, the *Lithophylacium Bornianum* (Pragae, 1772). It certainly has contributed to his invitation to the directorship of the Natural History Cabinet in Vienna. Catalogues published during previous centuries and also in Born's time served much more than an inventory of the accumulated specimens. Starting at least with Ulisses Aldrovandi, these were systematic treatments of all knowledge related to objects collected, and offered a system of classification. One of Born's catalogues (*Catalogue méthodique et raisonné de la Collection des Fossiles de Mlle Eleonore de Raab* [Viennae, 1790]) provided data on the chemical composition and reactions of several hundred mineral species.

15 Whether this person is identical with Johann Paul Carl von Moll, see F. Rögl, ´L.v. Fichtel und J.P.C. von Moll und ihre wissenschaftliche Bedeutung', *Annalen des Naturhistorischen Museums in Wien*, 84/A (1982), 63-77. Moll was Protestant, hence a use of his last given name is justified.

16 Fitzinger, note 1, p. 450.

17 D. Lindner, *Ignaz von Born, Meister der Wahren Eintracht. Wiener Freimauerei im 18. Jh* (Wien, 1986), 243.

18 Fitzinger, note 1, pp. 477-478 and his endnote 2.

19 It was not Born's only attempt to improve the scientific organisation of the Habsburg Empire. He founded an academy of science in Bohemia, with a journal (*Abhandlungen einer Privatgesellschaft in Böhmen, zur Aufnahme der Mathematik, der vaterländischen Geschichte, und der Naturgeschichte*, 1775-84). Born was the convenor of the first international scientific conference held at Skleno, Hungary, in 1786. On this occasion the first international scientific society, the 'Societät für Bergbaukunde' (again with a journal) was founded, of which Born was a president. See M. Teich, 'Born's amalgamation process and the international metallurgical gathering at Skleno in 1786', *Annals of Science*, (1975); and L. Molnár and A. Weiss, *Ignaz Edler von Born und die Societät der Bergbaukunde* (Wien, 1986).

20 E. Weigl, *Schauplätze der deutschen Aufklärung. Eine Städterundgang*, Rowohlts Enzyklopädie, (Reinbek bei Hamburg, 1997), 207-229.

21 S. Sheets-Pyenson, *Cathedrals of Science: The development of colonial natural history museums during the late nineteenth century* (Kingston, Ontario, 1988), 144. C. Riedl-Dorn, *Das Haus der Wunder. Zur Geschichte des Naturhistorischen Museums in Wien* (Wien, 1998).

22 Fitzinger, note 1, p. 460.

23 H. Zapfe, *Catalogus Fossilium Austriae. Heft XV: Index Palaeontologicorum Austriae* (Wien, 1971), 78.

24 A number of scattered data are supplied by Fitzinger, note 1, pp. 449, 463, 479, and L.J. Fitzinger, 'Geschichte des kais. kön. Hof-Naturalien-Cabinetes zu Wien. II. Abtheilung. Periode unter Franz II. (Franz I. Kaiser von Österreich) bis zu ende des Jahres 1815', *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Classe*, 57 (1868), 1013-1092 (1019, 1036, 1038, 1040-1, 1044, 1050, 1064, 1078.

25 H. Küpper, 'Österreichs Beiträge zur Entwicklung der Mikropaläontologie', *Erdöl-Zeitschrift*

75/5 (1959), 114-121 (115)

26 G. Papp, 'An ardent vulcanist from Hungary. Sketches to the scientific portrait of Johann Ehrenreich von Fichtel (1732-1795)', in *Volcanoes and History*, edited by Nicoletta Morello (Genova, 1998), 505-522.

27 The *Index bio-bibliographicus notorum hominum*, edited by Jean-Pierre Lobies (Osnabrück, 1973-) registers 27 encyclopedias and biographic collections up to 1961 recording data about the elder Fichtel.

28 Nagyszeben in Hungarian, Sibiu in Romanian, the seat of the autonomous government of Transylvania.

29 F. Schlichtegroll, *Nekrolog auf das Jahr 1795*. Vol. 6/2 (Gotha, 1798), 346, Zapfe (note 18), 29-30.

30 *Slovensky biograficky slovnik*, 2 (Bratislava, 1987), 85.

31 Zapfe, note 23, pp. 29-30; F. Rögl and H.J. Hansen, 'Foraminifera described by Fichtel & Moll in 1798. A revision of *Testacea microscopica*', *Neue Denkschriften des Naturhistorischen Museums in Wien* 3, (1984), 1-143 (15).

32 Sclichtegroll, note 29.

33 M. Kirchmayer, 'Johann Fridvaldszky, Johann Ehrenreich von Fichtel und dessen Sohn Leopold von Fichtel. Forscher der Periode 1750-1840 der Entwicklung der Naturwissenschaften in Österreich (Beitrag zur Geschichte der Geologie in Österreich)', *Verhandlungen der Geologischen Bundesanstalt* (1961) 113-115.

34 G. Gioeni, *Saggio di litologia vesuviana* (Napoli, 1790), 208. Fichtel's German translation is Joseph Ritter von Gioeni, *Versuch einer Lithologie des Vesuvs*. Aus dem italieneischer übersetzt, und mit einigen Anmerkungen begleitet von Leopold von Fichtel (Wien, 1793), 392. On Gioeni, see F. Aradas, *Elogio del Cav. Giuseppe Gioeni.* (Catania, 1869), 28.

35 Papp, note 26.

36 G. Buccieri, 'Gioeni, Giuseppe', in *Dizionario Biografico degli Italiani*, (2000, Roma), 115-118

37 W. Hamilton, *Observations on Mount Vesuvius, Mount Etna, and other volcanos* (London, 1772), 179.

38 E. Vaccari, 'Lazzaro Spallanzani and his geological travels to the "Due Sicilie": the volcanology of the Aeolian Islands', in *Volcanoes and History*, edited by Nicoletta Morello (Genova, 1998). 621-651.

39 Rögl and Hansen, note 31.

40 Fitzinger (note 24), p. 1036. At this time the director of the cabinet received 1500 guldens annually.

41 Rögl, note 11, casts doubts on it, since no trace of their applications was found in the archives, while other five applicants' documentation is still available.

42 Fitzinger, note 24, p. 1039.

43 Fitzinger, note 24, p. 1040.

44 Fitzinger, note 24, p. 1078 and endnote 2.

45 Fitzinger, note 24, p. 1019. Other parts of Cook's collections were given to Trinity College, Dublin and now are in the National Museum of Ireland in Dublin (see Wyse Jackson, P.N. 'The geological collections of Trinity College, Dublin', *The Geological Curator*, 5(7) (1992), 263-274).

46 Robert Townson, *Travels in Hungary with a short account of Vienna in the year 1793* (London, 1797), 506.

47 Klausenburg in German, Cluj-Napoca in Romanian.
48 Wilson note 3, p. 170.
49 Fitzinger, note 24, pp. 1040 and 1078, endnote 2.
50 Fitzinger, note 1, p. 479, also records his insect collection in Vienna.
51 Fitzinger, note 24, pp. 1040-1041.
52 Rögl, note 15, p. 73.
53 Rögl, note 15; Rögl and Hansen, note 31.
54 Fitzinger, note 24, p. 1064.
55 J.P.C. Moll has been repeatedly confused with another, however unrelated, scientist of the same family name. The two scientists bore no relation whatsoever. Karl Ehrenbert Freiherr von Moll (1760-1838) was a mineralogist, founding editor of a scientific journal (*Annalen der Berg- un Hüttenkunde*, 1797-1826), high official in the court at Salzburg, and politician. See O. Kühn, 'Die Autoren der *Testacea microscopica*, Wien, 1798', *Anzeiger der Österreichischen Akademie der Wissenschaften, Mathematisch-naturwissenschaftliche Klasse* 106/5 (1969), 89-93.
56 Nicolaus Lang (1670-1741), medical doctor in Luzern, Switzerland, author of *Historia lapidum figuratorum Helvetiae* (Venetiis, 1708), one of the last books proposing inorganic origin of fossils.
57 Rögl, note 15, p. 71.
58 Fitzinger, note 1, pp. 477-478, endnote 2; Kühn, note 55, pp. 90-91; Lindner note 17, p. 243.
59 Fitzinger, note 1, p. 479.
60 Zapfe, note 23, p. 78.
61 *Testacea microscopica aliaque minuta ex generibus* Argonauta *et* Nautilus *ad naturam delineata et descripta a Leopoldo a Fichtel et Jo. Paolo Carlo a Moll.* XII + 123 p., 24 plates. Anton Pichler, Wien. The second edition is identical, except the publisher was Camesianische Buchhandlung, Wien.
62 A. d'Orbigny, *Foraminiféres fossiles du bassin tertiaire de Vienne (Autriche)* (Paris, 1846), 312.
63 J.A. Cushman, 'The work of Fichtel and Moll and of Montfort', *Contributions from the Cushman Laboratory for Foraminiferal Research* 3 (1927), 168-171 (168)
64 Cushman, note 63, p. 168.
65 Rögl and Hansen, note 31.
66 *Eschara ex zoophytorum seu phytozoorum ordine pulcherrimum ac notatu dignissimum genus novis speciebus auctum, methodice descriptum, et iconibus ad naturam delineatis illustratum a Joanne Paulo Carolo a Moll. Vindobonae, in libraria Camesiniana. M. DCCC. III*. 9, 70 p., 4 plates, 4to.
67 Moll, Johann Paul Karl von, *Die Seerinde, aus der ordnung der Pflanzenthiere das schönste und merkwürdogste Geschlecht, mit neuen Arten vermehrt, methodisch beschrieben, und durch nach der Natur gezeichnete Abbildungen erläutert.* Camesinaiche Buchhandlung, Wien, 1803. 77 p., 4 plates, 4to.
68 F. Wendland, 'Peter Simon Pallas (1741-1811): Materialen einer Biographie', *Veröffentlichungen der Historischen Kommission zu Berlin*, 80 (Berlin, 1992)
69 Lindner, note 17.
70 C. Jonas in Bricka, C.F.: *Dansk Biografisk Lexikon*, 19 vols, Copenhagen, 1887-1905, fide Scandinavian Biographical Archive, fiche A-222, pages 231-259, Knaur, München.
71 Fitzinger, notes 1 and 24 faithfully records the most important collecting trips and their results enriching the museum's collections.

72 Kroisbach: now Fertörákos (Hungary).
73 Lake Neusiedl: Fertö-tó (Austria and Hungary).
74 Moll, note 67, 35.
75 Magnification is an obvious requirement today. However, in the time of Moll there were works where natural objects were illustrated in their original size, which makes comparisons hard, if not even impossible. The figures of insects in Robert Townson's *Travels in Hungary* (1797) have been draught in natural size, severely hindering the use of the illustrations. See O. Merkl, 'Robert Townson's "Entomologia"', in *Robert Townson's Travels in Hungary*, edited by P. Rózsa (Debrecen, 1999), 99-116.
76 Rögl, note 15, p. 69, emphasizes the extraordinary faithfullness of the original drawings of Fichtel and Moll, now preserved in the Natural History Museum in Vienna.
77 Rögl and Hansen, note 31, pp. 20-24.
78 Rögl, note 15, p. 66.
79 Moll, note 67, p. 40.
80 H. Hiltermann, 'Zur Geschichte der angewandten Mikropaläontologie', *Bericht der Naturhistorischen Gesellschaft zu Hannover* 109 (1965), 23-47.
81 J.V.F. Lamouroux, *Histoire des polypiers coralligenes flexibles, vulgairement nommés zoophytes* (Caen, 1816), 560.
82 Rögl, note 15, pp. 67-68; Rögl and Hansen, note 27, p. 40.
83 A. d'Orbigny, *Foraminiferes fossiles du bassin tertiaire de Vienne (Autriche)* (Paris, 1846), 312.
84 A.E. Reuss, 'Die fossile Polyparien des Wiener Tertiärbeckens', *Haidinger's Naturwissenschaftliche Abhandlungen* 2 (1848), 1-109.
85 N. Vávra, *Catalogus Fossilium Austriae, Heft Vb/3: Bryozoa tertiaria* (Wien, 1977), 210.
86 Born, note 14.