Chapter 5
BERLIN: The Palaeontological Collections of the Museum für Naturkunde Berlin

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5.1 Introduction

The palaeontological collections of the *Stiftung Museum für Naturkunde Berlin* contain more than 2.5 million specimens used for research and display. Because of construction work at the museum building, the material is at the time of writing (2017) housed not only within the museum on Invalidenstrasse, but the main invertebrate palaeontology collection has been outhoused in the east wing of the museum building. They are currently stored in a former student canteen on the museum campus but will return to its original collection hall in autumn 2018. More extensive parts of the collection are also stored ca. 5 km away in a separate building in Berlin-Moabit at Reuchlinstrasse. The collections are generally systematically arranged, but important stratigraphic and regional suites do exist. Most specimens are kept in approximately 1400 wooden cabinets, shelves, and glass cases spread over 9 collection halls. The collections are divided into three main sections, the so-called *Hauptsammlungen* ("main collections"): fossil invertebrates, fossil vertebrates, and palaeobotany.

5.1.1 History of the Collections

The oldest parts of the palaeontological collections date back to the eighteenth century and have their origin in the foundation of the *Königliches Mineralienkabinett* (Royal Mineral Cabinet) in 1781, which was derived from the *Naturalienkabinett*

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L. A. Beck, U. Joger (eds.), *Paleontological Collections of Germany, Austria and Switzerland*, Natural History Collections,
https://doi.org/10.1007/978-3-319-77401-5_5

der königlichen Kunstkammer (Natural History Cabinet of the Royal Art Chamber) of the Brandenburg-Prussian Royal family and the *Berliner Bergakademie* (Berlin Mining Academy) that was founded by Frederick the Great in 1770. In 1812, the *Königliches Mineralienkabinett* was transferred to the *Mineralogisches Museum der Universität* (Mineralogical Museum of the University) of the newly founded *Universität zu Berlin* (University of Berlin), the later Humboldt University. The museum was located in the *Prinz-Heinrich-Palais*, Unter den Linden 6, and its first director was Christian Samuel Weiss from 1810 until his death in 1856. He was also professor of "mineralogy", which included *Geognosie* and *Petrefaktenkunde* (the precursors of modern geology and palaeontology, respectively) at that time. The size of the collection was extended by means of new purchases and by personal collections undertaken by scientists and students of the university. Alexander von Humboldt had already donated remains of Pleistocene mammals from South America to the *Mineralienkabinett* in 1801. The geological collection of the *Gesellschaft Naturforschender Freunde zu Berlin* (founded in 1773) was gradually incorporated into the collection after 1827. In 1833, the *Mineralogisches Museum* acquired the palaeontological collections of Ernst Friedrich von Schlotheim (one of the founders of scientific palaeobotany). Among other acquisitions, the museum bought Pleistocene moas from New Zealand in 1850 from the Dutch dealer (*Naturalienhändler*) G. A. Frank and received the geological collection of the famous geologist Leopold von Buch. In 1857, the university purchased the important collection of Carboniferous fossil plants and Early Permian fossil fishes and amphibians from Lebach (Saarland) by Friedrich W. H. Jordan, and the fossil vertebrate collection of the eminent physiologist Johannes von Müller was transferred to the university in 1860. Between 1857 and 1889, the museum purchased four collections of Baltic amber, the collections Thomas, Berendt, Kühl, and Künow. Of significant importance was the acquisition of the second find of a skeleton of the Late Jurassic bird *Archaeopteryx lithographica* from Eichstädt (Bavaria), supported by a loan from the industrialist Werner von Siemens in 1880.

With the move of the rapidly growing collections into the newly constructed museum building under the new name *Museum für Naturkunde* at Invalidenstrasse 43 in 1888/1889, the collections were separated into a zoological, a mineralogical and a palaeontological part. In the late nineteenth and early twentieth century, the collections grew further through intense collecting activities in the field by palaeontologists like Hermann Karsten (1817–1908), Wilhelm Otto Dietrich (1881–1964) or Walter Gross (1903–1973). In the beginning of the twentieth century, two large-scale excavations were undertaken by scientists associated with the *Museum für Naturkunde* and yielded a wealth of fossil reptiles and other vertebrates which are now kept in the museum. In 1909–1912, Otto Jaekel (1863–1929), professor in Greifswald and former curator in Berlin, led the excavation at the Late Triassic locality of Halberstadt (Central Germany). Apart from a number of complete skeletons of the "prosauropod" dinosaur *Plateosaurus*, the Halberstadt locality yielded *Proganochelys*, one of the earliest known completely preserved turtles, phytosaurs, and giant amphibians. Between 1909 and 1913, excavations and extensive collections of dinosaurs at the Late Jurassic Tendaguru locality in today's Tanzania were made by the German Tendaguru Expedition led by Werner Janensch (1878–1969), Edwin Hennig (1882–1977), and Hans (1886–1937) and Ina Reck (1872–1942). The Tendaguru locality

can be regarded as one of the world's most important dinosaur sites, and the almost complete skeletons of *Giraffatitan* [*Brachiosaurus*], *Elaphrosaurus*, *Dicraeosaurus*, *Kentrosaurus*, and *Dysalotosaurus* from Tendaguru are on display in the dinosaur hall and attract a large number of visitors. Further notable expeditions in the first half of the twentieth century were the Serengeti and Olduvai expedition of Hans Reck (1886–1937) in 1913 where he collected Pleistocene mammals, and the South Africa expeditions of Werner Janensch in 1929 and Hans Reck in 1932 and 1937, which yielded several remains of Permo-Triassic tetrapods.

During the Second World War, parts of the collections were evacuated, among them all types and originals (figured specimens), and were brought into the galleries of the limestone quarries in Rüdersdorf near Berlin. Although the war damage to the museum building was immense, a surprisingly small part of the fossil collection that remained in the museum was destroyed (e.g. parts of the dinosaur type material from Tendaguru and much of the fossil whale material). However, the most valuable objects like the *Archaeopteryx* skeleton and the skull of *Giraffatitan* were buried in the basement of the museum building and remained undamaged. After the war, the specimens evacuated to Rüdersdorf were brought to Leningrad by the Red Army, but were returned from the Soviet Union in 1958 in a very good curatorial condition.

In 1968, the huge collections of the *Arbeitsstelle für Paläobotanik und Kohlenkunde* (formerly belonging to the Geological Survey and since 1951 to the Academy of Sciences of the German Democratic Republic) were integrated into the museum's osteological collections. Additionally, the following important collections were acquired: the collection of Hugo Rühle von Lilienstern in 1969 (Triassic amphibians and reptiles, *Chirotherium*-tracks, Keuperian plants), the Felsberg collection in 1971 (especially fossil bivalves and gastropods), and the collections R. Völker and of the Landesmuseum Halle in 1984–1986 (cave bears and cave lions from Rübeland). In addition, many more local collections were purchased. Examples of important recent acquisitions of fossil material are a vast number of Devonian fish remains that resulted from field work in the Northwest Territories, Canada led by Hans-Peter Schultze in 1997, the purchase of the Ernst Edinger collection (consisting mainly of Palaeozoic amphibians and Palaeozoic and Mesozoic fishes) in 1998, and a large number of rock samples containing numerous microfossils and invertebrates as well as fusain samples from the Tendaguru locality collected by a Tanzanian-German expedition in 2000.

The *Museum für Naturkunde* was separated from the Humboldt-University in 2009 and transferred to the *Leibniz Gemeinschaft*, a foundation that is supported by the state of Berlin and the Federal Republic of Germany.

5.1.2 General Information

5.1.2.1 Acquisitions

The collections grow continuously through collecting activities during fieldwork, by purchase, by donation, and through bequests. Since 2014, a commission of experts (museum staff members) evaluates donations and applications of purchase

with respect to their scientific value. Objects for acquisition have to fulfil one or more of the following criteria: (1) be the basis of a current research project of the museum scientists, (2) be of general scientific relevance, (3) fill existing gaps in our collections, (4) be of potential use in promoting the public understanding of science, which is one of the main missions of the museum or (5) be of historical significance. There are no constraints regarding the addition of new objects to the collections with respect to their geographical or temporal scope.

5.1.2.2 Access

All parts of the collections are accessible for research purposes with prior notice. Guided tours are offered to the public on special occasions like *Lange Nacht der Museen* (Long Night of Museums) and *Lange Nacht der Wissenschaften* (Long Night of Sciences). Digitalization of the collections including visualization (photographs and 3D-scans) is in progress; approximately 15% of the collection material is digitally recorded in a database, among them 100% of the type material. In the near future at least part of the collection should be accessible via the internet.

5.1.2.3 Loan

All specimens except for types and originals can be loaned to researchers and institutions for scientific investigation and also for external exhibitions.

5.1.2.4 Collection-Based Research

In accordance with the strategy of the *Museum für Naturkunde*, palaeontologists and zoologists of the museum focus their collection-based research on fundamental issues in earth and life sciences, especially on questions addressing evolution, biodiversity, palaeoclimate, and palaeoenvironment. Apart from thin sections of rocks, fossil bones, shells, and plants that can be produced in the preparation lab, non-invasive research methods like μCT-scanning play an increasingly important role. The museum has its own μCT-lab in which almost 2000 scans for internal and external partners in palaeontology and zoology are performed per year. The collections are open to national and international research, and numerous scientists from all over the world work with the collections every year. An overview on current collection-based research can be found in the annual reports of the Museum für Naturkunde which can be downloaded here:

https://www.naturkundemuseum.berlin/en/insights/about-us/publications-and-downloads

5.2 The Collections of Fossil Invertebrates

5.2.1 General Information

Curators: PD Dr. Martin Aberhan (Porifera, brachiopods, bivalves, gastropods), PD Dr. Dieter Korn (cephalopods, corals, Devonian regional collection), Dr. Christian Neumann (echinoderms, arthropods, bryozoans, Vermes, trace fossils), Dr. David Lazarus (Micropalaeontological collection).

Collections managers: Manuela Tilling, Andreas Abele

The fossil invertebrate collections comprise approximately 1.5 million macroinvertebrates, microfossils and trace fossils with an estimated number of more than 14,000 type and figured macroinvertebrate specimens. The geographical range is worldwide with German and European material predominant and well represented. These include excellent collections from famous *Lagerstätten* like the Devonian Hunsrück Slate, the Jurassic of Holzmaden and Solnhofen, the Cretaceous Crato Formation of Brazil, as well as Eocene Baltic amber. Foreign material stems from northern and eastern Africa, the Middle East and many other regions. Stratigraphic and regional suites comprise the Devonian of Germany (the former collection of the *Königlich Preußische Geologische Landesanstalt*), the Cretaceous of Germany and Spain, and glacial erratics, to name the most important. Some of the collections are historical, for example those from Gottfried Ehrenberg, Friedrich von Schlotheim, Heinrich Cotta, Leopold von Buch, Georg Schweinfurth and Georg Carl Berendt.

5.2.2 The Particular Fossil Invertebrate Collections

Fossil Porifera (5300 specimens). The fossil sponge collection contains mostly material from the Phanerozoic of Germany and neighbouring countries.

Fossil corals (8000 specimens). The fossil coral collection is rooted in the nineteenth century and contains specimens from the Schlotheim collection and others. Fossil corals from the Jurassic of the dinosaur locality Tendaguru hill (Tanzania) are currently a subject of research.

Fossil molluscs (380,000 specimens). The collection of fossil molluscs includes cephalopods (100,000 specimens), bivalves (115,000 specimens) and gastropods (165,000 specimens). Whereas the focus of the cephalopod collection is Palaeozoic and Mesozoic, containing the largest collection of Devonian ammonites world-wide, the bulk of the gastropods are from the Cenozoic era (e.g., collections of Bambach and Schweinfurth). Moreover, it includes collections from Schlotheim, von Buch, Beyrich, and Quenstedt and the Binkhorst collection from the type area of the Maastrichtian stage. Important regional suites are from the Middle East (e.g., Schweinfurth collection) and Morocco (Ebbighausen collection).

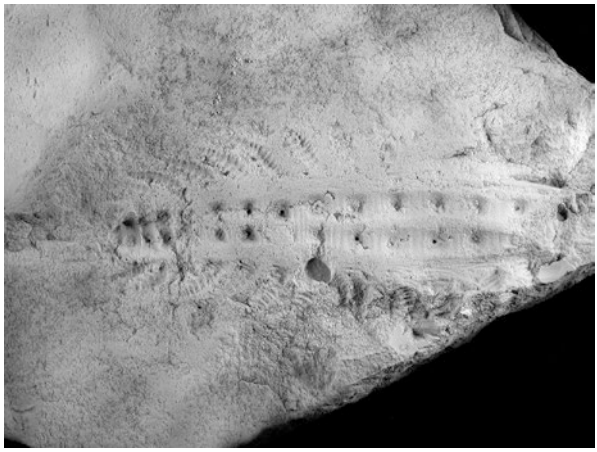

Fig. 5.1 The famous specimen of the Early Cambrian lobopod *Xenusion auerswaldae* Pompeckj, 1927 (length: 192 mm) from glacial erratics of Sewekow/ Wittstock, N Germany. © Museum für Naturkunde—Leibniz Institute for Evolution and Biodiversity Science, photo: C. Neumann

Fossil arthropods. The fossil arthropod collection (about 150,000 specimens) contains fossil chelicerates, trilobites, crustaceans and insects. The amber collection (mostly Baltic amber) is also included. Unique characteristics of this arthropod collection are the holotype and only known complete specimen of the lobopod *Xenusion auerswaldae* from Cambrian glacial erratics of Brandenburg (Fig. 5.1), rich collections from famous *Konservat-Lagerstätten* (Hunsrück slate, Solnhofen lithographic limestone, Crato formation). The amber collection comprises 60,000 fossil inclusions preserved in Eocene Baltic amber (Figs. 5.2 and 5.3). Among these, about 1500 type specimens are included. Here, the historic collections of Berendt, Künow and Simon are to be emphasized. Whereas the larger part of the fossil arthropods is placed in the main invertebrate palaeontology collection, the amber and the trilobite collections are stored in separate rooms. Ostracods, although belonging to crustaceans, are stored and curated separately in the micropalaeontology collection.

Graptolites. The museum possesses a good systematic collection and a huge stratigraphic/regional collection of Silurian graptolites from Europe (Jäger collection).

Fossil bryozoans (15,000 specimens). Fossil bryozoans contain important collections from the Cretaceous of Europe, especially type material from Hagenow, Binkhorst, and Voigt.

Fossil brachiopods (55,000 specimens). Fossil brachiopods from the Devonian of the Rhenish Massif are of special importance.

Fossil echinoderms (36,000 specimens). Among the 900 type and figured specimens, types from Jaekel, Ubaghs, and Sieverts-Doreck, among others are included. Especially worth mentioning are Palaeozoic crinoids (Crawfordsville, Moscow, Bundenbach), asterozoans (Bundenbach slate), Jurassic crinoids (Holzmaden, Solnhofen, for instance large plates with *Seirocrinus*) and an exquisite collection of Mesozoic and Cenozoic echinoids from Europe, Africa, Middle East and North America. Recently acquired collections comprise the Ernst collection (10,000 echi-

Fig. 5.2 A view into the amber collection donated by Prof. Walter Simon, Königsberg (now Kaliningrad). © Museum für Naturkunde—Leibniz Institute for Evolution and Biodiversity Science, photo: C. Radke

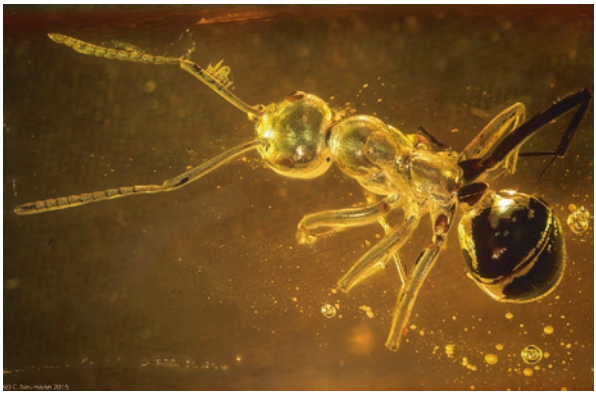

Fig. 5.3 The fossil ant *Yantaromyrmex (Hypoclinea) geinitzi* (Mayr, 1868) from Eocene Baltic amber (length: 2.1 mm). © Museum für Naturkunde—Leibniz Institute for Evolution and Biodiversity Science, photo: C. Neumann

noid specimen from the Upper Cretaceous of Europe) and the W. Maidorn collection (8000 specimens; mostly Mesozoic and Cenozoic echinoids from Western Europe and from the Arabic peninsula).

Micropalaeontological collection (100,000 samples). This collection includes mostly radiolarians and diatoms (Ehrenberg collection, 50,000 samples) and ostracods. The Ehrenberg collection from the early nineteenth century is the world's oldest micropalaeontological collection. Recent acquisitions comprise a collection of calcareous dinoflagellates (Keupp collection). The radiolarian collection was built up during the last 30 years as a part of the global deep-sea drilling program (DSDP, ODP, IODP).

Trace fossil collection (5000 specimens). The trace fossil collection consists of ichnofossils mostly from Europe and adjacent areas. With *Asteriacites* von Schlotheim, 1820, the collection contains the type to the oldest valid ichnogenus world-wide. A representative collection of bioerosional trace fossils is currently being erected.

5.3 The Collection of Fossil Vertebrates

5.3.1 General Information

Curators: PD Dr. Oliver Hampe (fossil mammals); Dr. Daniela Schwarz (fossil reptiles, birds, and tetrapod ichnofossils); PD Dr. Florian Witzmann (fossil fishes, amphibians, otoliths, and histological collection).

Collections manager: Thomas Schossleitner.

The collection of fossil vertebrates encompasses all major taxonomic groups of vertebrates and is subdivided into the collection of fossil fishes, amphibians, reptiles including tetrapod ichnofossils (i.e. tracks), birds, mammals, and hominids. Further parts of the collection of fossil vertebrates are the collection of histological slides and the collection of otoliths. The geographic range of the collection is world-wide with German and African material predominant. The collection is housed in five different collection rooms in two different buildings. The majority of specimens are stored in the main collection (*Hauptsammlung*) on the first floor of the museum building (Fig. 5.4). This room provides workspace for scientific visitors with a binocular microscope. Because of their size and weight, most of the massive bones of dinosaurs and large mammals are located in a cellar room of the museum building, informally named the "*Knochenkeller*" ("bone cellar") Pleistocene remains of bovids, cervids,

Fig. 5.4 The main collection of fossil vertebrates. © Museum für Naturkunde—Leibniz Institute for Evolution and Biodiversity Science, photo: C. Radke

and horses are stored in an adjacent room, the "bone cellar 2". Cave bears and a comparative anatomical skeletal collection are kept in a room on the third floor. The fifth collection room is located in a separate building at Reuchlinstrasse in Berlin-Moabit and contains ichnofossils (slabs with tetrapod tracks) and vertebrate material from the Cretaceous of Sudan (formerly belonging to the Technische Universität Berlin).

5.3.2 The Particular Fossil Vertebrate Collections

5.3.2.1 Fossil Fishes

This part of the collection comprises 20,000 inventoried specimens of jawless fish, placoderms, chondrichthyans, acanthodians, and osteichthyans, ranging from the Ordovician to the Holocene. The collection contains ca. 70 type specimens (among them the holotype of the Devonian near-tetrapod fish *Panderichthys* Gross, 1941) and more than 1200 originals. Famous Devonian material is derived from Bad Wildungen (collections of Jaekel and Stracke), the Rhenish Massif and the Baltic states (Gross collection), and the Canadian arctic (Schultze collection). The Edinger collection contains one of the most comprehensive collections of Devonian fishes from Scotland worldwide. Important specimens of Early Permian acanthodians come from Lebach, Saarland (Jordan collection). Numerous specimens of Mesozoic fishes are derived from the late Jurassic of Solnhofen (collections of Redenbacher and Kaufmann) and the Early Cretaceous of Lebanon (Blanckenhorn collection) and Brazil (Santana Formation). A large number of Cenozoic fishes come from the Eocene of Monte Bolca (Northern Italy; Meneguzzo collection) and the Oligocene of Glarus (Switzerland; Meyrath collection).

5.3.2.2 Fossil Amphibians

This collection encompasses 1547 specimens including 10 types and 254 originals. It contains Late Carboniferous temnospondyls and lepospondyls in exceptional preservation from Nýřany (old German version: Nürschan), Czech Republic, and from Linton, Ohio, USA (Jaekel collection). The comprehensive collection of early Permian temnospondyls from Döhlen (Saxony), Odernheim (Rhineland-Palatinate, Edinger collection), and Lebach (Saarland, Jordan collection) is famous for their extensive growth series from small larvae to adults. Mesozoic material contains the beautifully preserved holotype and only known skull of *Parotosuchus helgolandicus* (Fig. 5.5), numerous *Trematosaurus* and *Parotosuchus* specimens from Bernburg, Saxony-Anhalt (Burmeister collection), and the collection Rühle von Lilienstern (Bedheim, Thuringia) with vast material of *Mastodonsaurus* and other temnospondyls. Important Cenozoic amphibian fossils comprise frogs (including tadpoles) and salamanders with skin preservation from the Miocene of Libros, Teruel (Spain) and from the late Oligocene of Orsberg (Rhineland-Palatinate).

Fig. 5.5 The skull and holotype of *Parotosuchus helgolandicus* (MB.Am.841) from the Buntsandstein (Early Triassic) of Helgoland in (**a**) dorsal and (**b**) palatal view. © Museum für Naturkunde—Leibniz Institute for Evolution and Biodiversity Science, photo: H. Götz

5.3.2.3 Fossil Reptiles (Including Tetrapod Ichnofossils)

The reptile collection consists of about 18,000 specimens with more than 30 types and more than 600 originals. Basal reptiles (parareptiles) are represented by a complete skeleton of the pareiasaur *Bradysaurus* from the Permian of South Africa (Reck collection) and by the secondarily aquatic *Mesosaurus* from the Permian of Brazil. Important Triassic specimens from Halberstadt are the "prosauropod" *Plateosaurus* and the theropod *Halticosaurus*, the early turtle *Proganochelys*, and the enigmatic diapsid reptile *Elachistosuchus* (Jaekel collection). Further Triassic vertebrates are synapsids from the Triassic of the Karroo (South Africa; collections of Janensch and Reck), the dinosaurs *Liliensternus* and *Plateosaurus* from the Triassic of Thuringia (Rühle von Lilienstern collection), and *Nothosaurus* from the Muschelkalk of Rüdersdorf (Raab collection). World-renowned are the Late Jurassic dinosaurs from the Tendaguru locality in Tanzania, among them *Giraffatitan*, *Dicraeosaurus*, *Barosaurus*, *Tornieria*, *Kentrosaurus*, *Dysalotosaurus*, and *Elaphrosaurus*. Marine reptiles are represented by ichthyosaurs, plesiosaurs, and crocodilians from the Early Jurassic of Ohmden and Holzmaden (Bamberg collection). The von Fischer collection comprises pterosaurs from the Late Jurassic of Solnhofen, and the Selenka collection consists mainly of crocodile remains from the Plio- and Pleistocene of Java (Indonesia). The collection of tetrapod ichnofossils (tracks) contains about 400 specimens with ca. 5 types and ca. 10 originals, among

them the famous *Chirotherium* and *Ichniotherium* trackways from the Triassic of Thuringia (Hessberg near Hildburghausen) and a large Triassic slab from the H. Rühle von Lilienstern collection that contains the oldest known turtle trackways.

5.3.2.4 Fossil Birds

About 3000 specimens are stored in the collection of fossil birds, including 11 types and ca. 250 originals. Iconic fossils are the beautifully preserved isolated feather of *Archaeopteryx lithographica* from the Late Jurassic limestone of Eichstätt (Bavaria; Fig. 5.6), and the to date best preserved skeleton of *Archaeopteryx*, the "Berlin specimen" which is probably the most famous fossil in the world. Another excellent

Fig. 5.6 The beautifully preserved single feather of *Archaeopteryx lithographica* (MB. Av.0100) from the Late Jurassic limestone of Eichstätt (Bavaria). The length of the feather measures 58 mm. © Museum für Naturkunde—Leibniz Institute for Evolution and Biodiversity Science, photo: C. Radke

bird fossil is a complete *Confuciusornis* from the Early Cretaceous of Liaoning (China). Further significant bird remains originate from the Palaeogene of Quercy (France; collection Rossignol), Pleistocene birds from Java (Indonesia; collection Selenka), as well as the skeletons of two subfossil giant moas from New Zealand (*Dinornis* and *Emeus*; collection Frank).

5.3.2.5 Fossil Mammals

With a total of 1,080,000 specimens, the fossil mammal collection is the largest part of the collection of fossil vertebrates, including more than 20 types and more than 1500 originals. The geologically oldest specimens of the mammal collection are the important *Brancatherulum*, *Tendagurodon*, and *Tendagurutherium* from the Late Jurassic of Tendaguru (Tanzania; collections of Janensch and Heinrich). Tertiary mammals comprise archaeocete whales (*Basilosaurus*, *Zygorhiza*, and *Pontogeneus*) from the Eocene of Alabama, USA (Koch collection), Palaeogene artiodactyls from the *Bohnerzspalten* of South Germany (Dietrich collection), remains of archaeocetes from the Palaeogene of Mottakam und Fayum (Egypt; Schweinfurth collection), Pliocene primates and horses from Pikermi and Samos (Greece; collections of Krüper and Dames), and beavers from the Pliocene of Tegelen (Netherlands; Krause collection). The collections of Reck and Kohl-Larsen comprise Plio-/Pleistocene mammals from the Serengeti and Olduvay. Pleistocene mammals are represented by marsupialians from Australia (Hartmann collection), the megafauna from Colombia and Venezuela (collection Karsten), giant sloths from South America (collections of Humboldt and Sellow), diverse faunas from Java (Indonesia; Selenka collection), cave bears from West and South Germany (Rosenmüller collection), cave bears and cave lions from Rübeland (Völker collection), and numerous taxa from the Rixdorfer Horizont of Berlin and Brandenburg, among them giant deer, woolly mammoth and woolly rhinos. Late Pleistocene/Early Holocene small vertebrates are derived from the fossil animal burrows at Pisede near Malchin in Mecklenburg (Heinrich collection).

5.3.2.6 Fossil Hominids

With 500 specimens, the hominid collection is the smallest part of the fossil vertebrate collection, but contains an original tooth of *Australopithecus afarensis* from the southern Serengeti (Tanzania; Kohl-Larsen collection). The collection contains more than 20 originals.

5.3.2.7 Otoliths

The collection of otoliths contains ca. 5000 specimens with ca. 60 types and ca. 130 originals and is based on the collections of Koken (Eocene of the USA and Oligocene–Pliocene of Germany) and Heinrich (late Miocene of Germany).

5.3.2.8 Histological Collection

The histological collection consists of more than 4000 slides (histological thin sections) including more than 270 originals of fossil bones and scales. Although the collection ranges taxonomically from agnathans to mammals and from the Silurian to the Holocene, its focus lies on fishes from the Late Silurian and Devonian of Germany and Latvia (Gross collection).

5.4 The Palaeobotanical Collections

5.4.1 General Information

Curators: N.N., acting responsible Mrs. Melanie Rühl.

Collections managers: Conny Hiller, Catrin Puffert, Lothar Maitas (herbarium).

Laboratory assistant and collection manager: Melanie Rühl (hydrofluoric acid laboratory).

The palaeobotanical collections are estimated to comprise 280,000 "collection units", organizationally divided into three areas (formerly "Custodies"), the Cenophytic, the Mesophytic, and the Palaeophytic. They include all groups of fossil plants with the focus on Carboniferous, Lower Cretaceous, and Neogene plants and an outstanding collection of Early Permian (Rotliegend) plants. The collection is completed by a very diverse, historical herbarium (*Schrader Herbar*—1830–1898) with about 45,000 leaves including 200 families and about 500 slides of recent wood. Important is the collection of fruits and seeds with approximately 25,000 collection units containing more than 400 families. Overall there are over 9300 types, isotypes (herbarium) and figured specimens. The geographical range is worldwide with a strong emphasis on Central European material, predominantly from Germany and neighbouring countries. A special slide collection of structurally preserved material contains around 2500 slides and peels mainly from German localities.

Most of the palaeobotanical collections are currently stored in two collection halls. An outstation at Berlin-Moabit (Reuchlinstrasse) is used for the storage of the Ceno- and Palaeophytic collections because of shortage of space in the main museum building. The main collections are housed in different types of wooden cabinets many of which are approximately 130 years old and come from the *Geologische Landesanstalt*. In addition many cabinets are from the 1960s to 1970s. All these cabinets contain approximately 8700 drawers in about 270 cabinet units and 60 glass cabinets.

The collections cover the entire taxonomic range of palaeobotany, comprising megafossils through the geologic history, microfossils, and Recent plants. Therefore the specimens range considerably in size and weight, from massive large blocks (for example, fossil tree trunks) requiring heavy-handling, to minute items that must be studied under the microscope. The number of items is estimated to be about 280,000 "collection units"

(incl. herbarium), but many of these "units" include more than one specimen or individual. The absolute number of specimens is considerably higher, but to estimate the total sum does not appear meaningful because of the nature of the material—some blocks of matrix may contain several thousand individual specimens and yet, for practical reasons, are treated as one item. Holotypes and originals (figured specimens) count around 9300 specimens, mainly from Carboniferous and Tertiary strata.

The arrangement of the collections has its origin in the collection system of the *Königlich Preussische Geologische Landesanstalt* (Royal Prussian Geological Survey) that was a four level system: age—region—age—systematics. This presentation enables scientists to easily study floral assemblages and their palaeoecological context.

Of utmost interest are several historical collections that have been partly curated as integer entities. The so called *Kabinettsammlung* with its catalogue from 1836 (which is still in use today) shows more than 2000 specimens and includes the palaeobotanical part of the collection of Friedrich Ernst von Schlotheim.

5.4.2 The Particular Palaeobotanical Collections

Many important collections represent the progress of palaeontology/palaeobotany during the 19th and first part of the twentieth century, such as those of Manfred von Richthofen (material from China), Friedrich Nindel and Otto Gimm (mainly Rotliegend/Early Permian of Thuringia), and Hugo Rühle von Lilienstern (mainly Triassic of Thuringia). The geographical range is worldwide, with German material predominant and extraordinary well represented in Carboniferous and Tertiary material (due to the economic importance of coal mining). But there is also a representative collection of Lower Cretaceous plants from Brazil and of Upper Cretaceous specimens from the northern edge of the Harz Mountains (Central Germany). Also extensive are the collections of plants of Tertiary age from Austria, Poland, Greece and the Czech Republic.

5.4.2.1 Silicified Wood

An integral component with around 1400 specimens of fossil silificated wood is the collection of Heinrich Cotta. Although even Goethe already knew this collection, whose purchase was strongly supported by Alexander von Humboldt in the 1830s, there is still a great deal of research potential in this structurally preserved material.

5.4.2.2 Devonian-Collection

The approximately 5000 specimens containing collection (among others the Rebske-Collection) has been expanded considerably in the last decades. The focus of collecting was the Rheinisches Schiefergebirge with its highly diverse early landflora (Fig. 5.7). Parts of this collection have not yet been scientifically analysed.

Fig. 5.7 *Foozia minuta* (= *Koeppenia eifelensis*), an about 400 million years old, highly developed progymnosperm(?) from the Emsium of Waxweiler in the Eifel. © Museum für Naturkunde—Leibniz Institute for Evolution and Biodiversity Science, photo: St. Schultka

5.4.2.3 Carboniferous-Collection

Nearly 80,000 specimens are housed in the Carboniferous collection, mainly from coal deposits of former Prussian territories. The main focus lies on the Westphalian D with about 5000 specimens from Piesberg near Osnabrück (Stoßmeister-Collection), more than 2000 specimens from the Zwickau Basin, 1500 specimens from the Saar Basin and around 1300 specimens from Bulgaria (Tenchov-collection).

5.4.2.4 Rotliegend-Collection

Of particular importance are also the approximately 15,000 Lower Permian specimens (Fig. 5.8), enriched by the collection of Bergrat Johann Christian Mahr, who was one of Johann Wolfgang von Goethe's collectors.

5.4.2.5 Triassic-Collection

The about 2000 specimens of this collection prove a rich vegetation in a time segment which has generally produced only a small amount of fossil plant material. Particularly noteworthy is the collection of the Royal personal physician Johann Lucas Schönlein from the second half of the nineteenth century (Triassic of Bavaria).

Fig. 5.8 *Annularia spinulosa* (= *A. stellata*) (Mb.Pb.2007/0461), an about 296 million years old widespread articulate from the Rotliegend of the Döhlen Basin (Saxony). © Museum für Naturkunde—Leibniz Institute for Evolution and Biodiversity Science, photo: H. Götz

5.4.2.6 Cretaceous-Collection

An important time period of palaeobotanical research is the Cretaceous, in particular the development of early angiosperms, which is reflected in this part of the collection. The focus lies on the lower part of the Cretaceous with more than 7000 specimens (Fig. 5.9).

5.4.2.7 Tertiary-Collection

Originals of the publication of E.A. Rossmässler—by whom modern Tertiary palaeobotany was founded—can be found in the Cenophytic collections with their main focus on mid-German brown coal deposits. Based on this collection, H.D. May 1995 wrote his successful textbook *Tertiäre Vegetationsgeschichte Europas* (Tertiary vegetation history of Europe).

Fig. 5.9 *Pterophyllum* sp. (Mb.Pb.2010/0113), an about 135 million years old Cycadophyte from the Wealden of the clay pit Bock near Duingen (Lower Saxony). © Museum für Naturkunde—Leibniz Institute for Evolution and Biodiversity Science, photo: H. Götz

5.4.2.8 Pollen, Spores and Cuticules

The micro-palaeontological collections (cuticles, pollen and spores) are mainly focussed on Palaeogene and Neogene sediments, but also contain many boxes of Cretaceous material from southern high latitudes. They include some 27,500 slides arranged in geographical order. About 400 slides contain type or figured material. In addition, there are 3500 slides and 100 stubs ready for SEM research with ODP material and about 200 stubs of fusain mainly from the famous dinosaur *Lagerstätte* Tendaguru hill, Tanzania.

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