The vertebrates in the paleontological collection Georg Gasser (1857–1931)

→ Alexander Wagensommer[1], Irene Tomelleri[1], Silvio Renesto[2], Giuseppa Forte[1] & Evelyn Kustatscher[1]

[1] Museum of Nature South Tyrol, Bozen/Bolzano, Italy
[2] Dipartimento di Scienze Teoriche ed Applicate, Università degli Studi dell'Insubria, Varese, Italy
E-mail: wagensommer@tiscali.it; irenetomelleri@gmail.com; silvio.renesto@uninsubria.it; giusy.forte@naturmuseum.it; Evelyn.Kustatscher@naturmuseum.it

ABSTRACT

The Museum of Nature South Tyrol houses about 3500 fossils belonging to the early 20th century private collection of Georg Gasser. Vertebrates make up only 10 % of this collection but could potentially have acted as an attractor for Gasser's museum, as vertebrate fossils are often perceived by the non-professional public as more "spectacular" than invertebrates. However, big, complete or otherwise impressive specimens are rare in the collection, a fact that probably reflects the limits – both economical and logistic – that Gasser experienced in his collecting effort. Fish and mammal remains are the most represented, reptiles forming a minority of the specimens in the collection. The collection is clearly biased towards younger periods of Earth history, with about 68 % of the specimens belonging to the Cenozoic, 15 % to the Mesozoic and only 4 % to the Paleozoic. About 13 % are of indeterminate age. The bulk of the collection is from localities within countries that around 1900 belonged to the German speaking world. Some celebrated *Fossil-Lagerstätten* are represented, but also many less well-known sites.

KEY WORDS

Permian, Triassic, Jurassic, Pleistocene, Mammalia, Reptilia, Central Europe

1. INTRODUCTION

In the late 19th and early 20th century, Georg Gasser (1857–1931), a private collector from Bozen/Bolzano (South Tyrol, northern Italy), compiled a vast collection of natural history objects (minerals, fossils and zoological specimens), which he made accessible to the public by displaying his collections at first in his private house, and from 1904 to 1931 in the *Stadtmuseum* (town museum) of Bozen. Gasser is most renowned for collecting minerals and publishing on this topic, whereas his fossil collection received little attention until very recently. About 3500 fossil specimens of the Gasser collection are today stored in the Museum of Nature South Tyrol (NMS) in Bolzano/Bozen. This heritage became the focus of a dedicated research project ("Die Fossiliensammlung von Georg Gasser (1857–1931)", CUP H54I19000540005) aimed at inventorying and preserving the fossils, putting them in a historical context by studying the documents linked to the collection, and publishing the results to make basic information about the collection available to the scientific community (Kustatscher et al., this volume). The aim of this paper is to present the vertebrate fossils within the paleontological collection of Georg Gasser, with an eye on the taxonomic groups represented, as well as the age and source areas of the fossils.

2. MATERIALS AND METHODS

As preserved today, the Georg Gasser paleontological collection comprises 3502 specimens, including plant and animal remains as well as ichnofossils. As part of the review and research project by the NMS, all specimens were cleaned from dust and other impurities accumulated during the past century and restored if necessary. All available information on every single fossil was entered in the NMS's database and every specimen was assigned an inventory number, preceded by the prefix PAL for paleobotanical specimens and PZO for paleozoological specimens. Photographs of every specimen and the accompanying label(s) were added to the database. For details about the conservation and inventory process, see Kustatscher et al. (this volume).

Just over 90 % of the fossils in the Gasser collection are animal body fossils. Plants account for about 8 %, whereas just over 1 % are animal trace fossils. As can easily be foreseen, invertebrates account for the bulk of the collection (80 %). Vertebrate fossils comprise 356 specimens (just over 10 % of the collection). These will be the focus of the present paper, whereas plants and invertebrates will be treated in separate dedicated papers (Tomelleri et al., this volume a, b, c).

Almost all vertebrate specimens are body fossils, few vertebrate ichnofossils are included in Gasser's collection. The register of the Gasser Collection, compiled around 1895 (Wagensommer et al., this volume a) lists a mammoth coprolite under the inventory number 1905 and, under number 1908, various coprolites from Triassic, Neogene and Pleistocene localities. Only the

FIG. 2: Pleistocene mammal remains from the "Warstein Cave" (northern Germany). **A–B**: *Ursus spelaeus*; various bone fragments mounted on glass plates for display in Gasser's museum (PZO 13543–49). **C**: *Ursus spelaeus*; limb bone, PZO 13545 (old Gasser catalogue number: 1901.3). **D**: *Ursus spelaeus*; rib, PZO 13576 (old Gasser catalogue number: 1901.6). **E**: Bovid cranial fragment with partial horn core, PZO 13613 (old Gasser catalogue number: 1901.2).

specimens identified with the number 1908 are preserved in the collection (see also BAUCON et al., this volume).

Many of the vertebrate specimens are too fragmentary for a low-level taxonomic assignment. For 232 specimens (65 % of the total vertebrate sample) only the class or subclass has been determined, although a more in-depth revision (still pending) of the mammal skeletal material would probably allow determination to at least order level. Of 27 specimens (7 % of all vertebrate remains) nothing can be said beyond them being vertebrate bone fragments. Only 97 specimens (about 27 % of all vertebrates in the Gasser collection) have been determined at genus or species level.

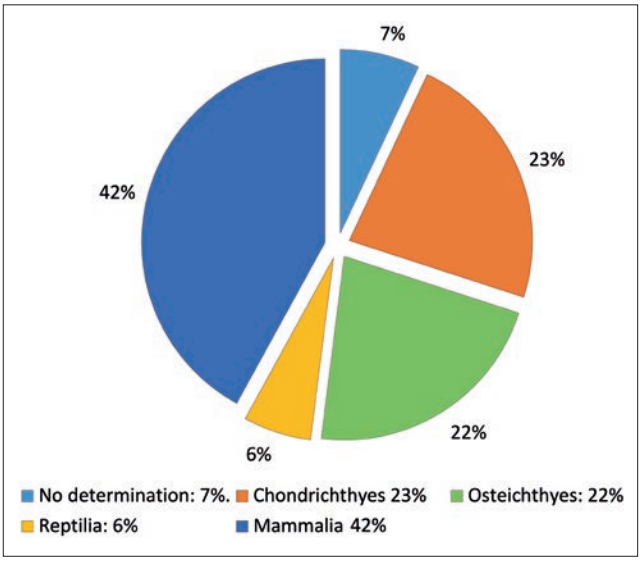

FIG. 1: Composition of Gasser's fossil vertebrates collection.

3. A CLOSER LOOK AT GASSER'S VERTEBRATE FOSSILS

At a first glance, the collection appears to comprise mostly isolated mammal bones (150 out of 356 specimens or 42 %) and various fish remains (159 specimens or 46 % of all vertebrates in the collection). Reptiles are a minor component (20 out of 356

FIG. 3: Examples of mammal fossils from Tyrol in the Gasser collection. **A**: Sirenian rib fragments (classified by Gasser as *Halitherium*) from Bad Häring, North Tyrol (Austria); PZO 13455 (old Gasser catalogue number 4043). **B**: Large bovid rib (*Bison* or *Bos*) from the peat bogs of Schwarzsee, North Tyrol (Austria); PZO 13612 (old Gasser catalogue number 1911). **C**: A set of four Pleistocene horse teeth mounted on a glass plate, PZO 13614–17. The first and fourth have reportedly been found at Siebeneich near Bolzano. The central two are from Stuttgart/ Cannstadt (Germany). **D**: *Panthera spelaea*; partial mandible, from St. Pauls / Eppan near Bolzano, PZO 13727.

specimens, or less than 6 %), amphibians and birds are missing. 27 specimens (about 7 %) are too fragmentary to be determined even at class level (Fig. 1).

Among the mammals, most specimens belong to "ice age" larger fauna, such as mammoth, cave bear, horses and bovids. Only a few specimens are older than Pleistocene; these include sirenian ribs from the Oligocene of Bad Häring (Tyrol), a brontotheriid molar from the Badlands of Dakota, a cetacean vertebra from northern Germany, and a few others. In a few cases, a number of specimens from a same site are present and provide a glimpse at the diversity at this site. This is the case for the Pleistocene fauna from the Warstein Cave (North Rhine-Westphalia; 21 specimens, Fig. 2) and from Bietigheim (Baden-Württemberg, 17 specimens), or the micromammal remains from Goldberg (near Nördlingen, southern Germany, 11 specimens). Only 9 specimens come from Tyrol (Fig. 3) and can be regarded as part of Gasser's regional collection ("Lokalsammlung" *sensu* Wagensommer et al., this volume b). They do not form a close sample from a specific site but are rather heterogeneous with regard of locality, age, taxonomic group and depositional environment, including Pleistocene horse teeth from fluvial deposits near Siebeneich (PZO 13614 and 13616), a *Bison* rib from a peat deposit near Schwarzsee (PZO 13612), and early Oligocene rib fragments assigned to the sirenian *Halitherium*, from Bad Häring (PZO 13455).

The category "fishes" (Fig. 4) includes both Chondrichthyes (81 specimens) and Osteichthyes (78 specimens) and covers a wider range of geological time and preservation modes. About 75 % of all fish specimens (119 out of 159) are isolated skeletal elements, mostly teeth, but also vertebrae, scales and selachian fin-spines. The majority of teeth belong to selachians, but also actinopterygians like *Lepidotes* are represented. About 25 % of all fish specimens (39 out of 159) are articulated remains, ranging from very fragmentary to complete specimens. All articulated remains belong to the Osteichthyes. Famous *Lagerstätten* are represented in the collection, such as Mansfeld (Permian), Solnhofen (Jurassic) and Monte Bolca (Eocene). 19 isolated fish teeth and fragmentary remains come from localities in Tyrol.

Reptiles (Fig. 5) are represented by 20 specimens. All are isolated and often fragmentary skeletal elements (vertebrae, limb bone fragments, teeth, osteoderms). Some were originally mistaken by Gasser as fish remains, such as PZO 13440, an ichthyosaur

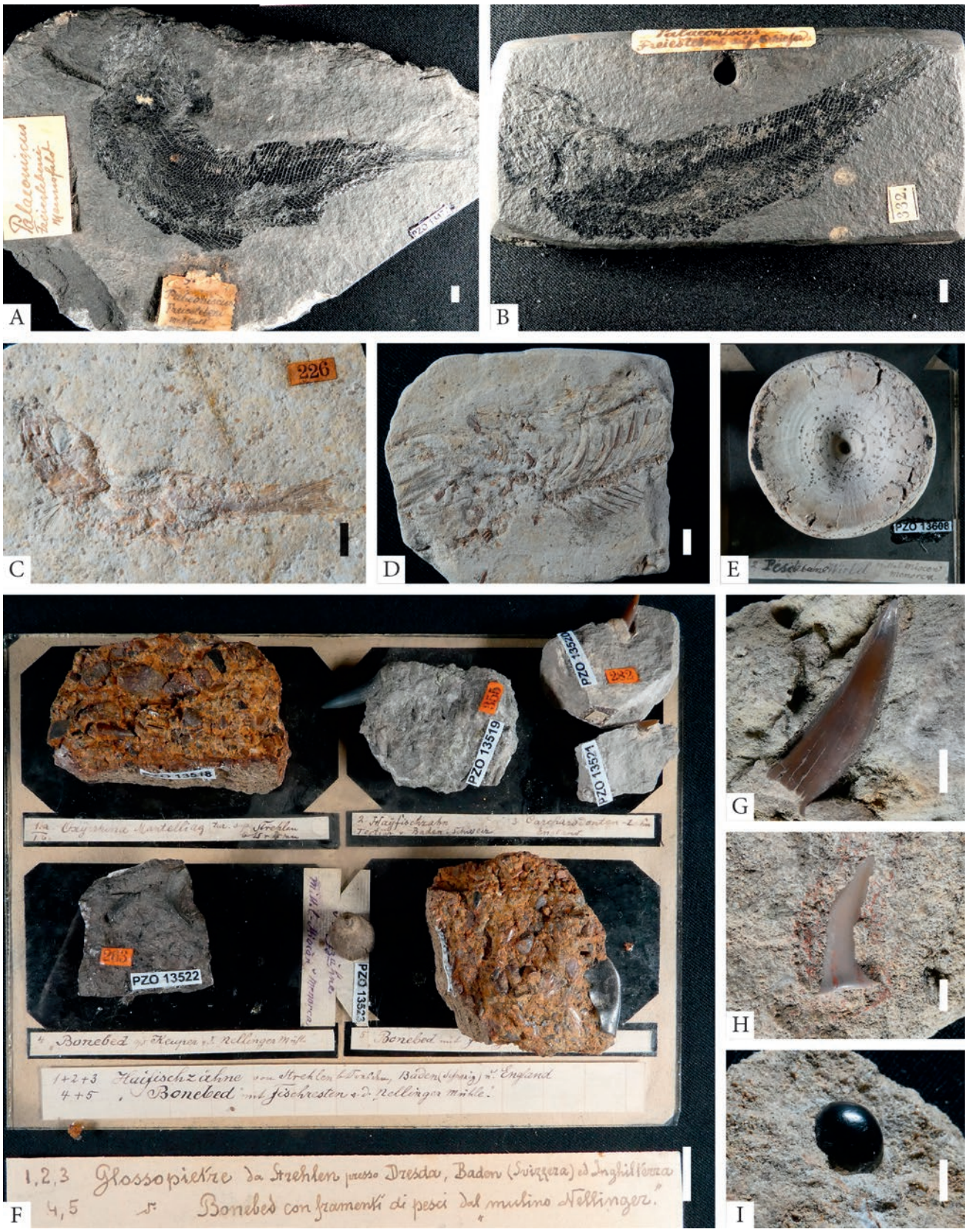

FIG. 4: Examples of fish fossils in the Gasser collection. **A–B**: *Palaeoniscum freieslebeni* from the Permian *Kupferschiefer* near Mansfeld (Germany); PZO 13477 and PZO 13439. **C**: *Leptolepides sprattiformis* from the Solnhofen *Plattenkalk* (Germany); PZO 13483. **D**: Indeterminate fish fragment of unknown age and locality, PZO 13459. **E**: Shark vertebra, reportedly from the Miocene of Menorca (Baleares, Spain); PZO 13608. **F**: A selection of different fish teeth and an isolated crocodilian tooth, scales and other fragments from various localities, mounted on a glass plate for display in Gasser's museum. PZO 13518–24. **G–H**: *Enchodus* teeth, unknown locality; PZO 13443–44. **I**: *Lepidotes* tooth, unknown locality; PZO 13442.

FIG. 5: Examples of reptile fossils in the Gasser collection. **A**: Four teeth of the marine crocodilian *Dakosaurus* from the Late Jurassic of Sigmaringen (southern Germany); PZO 13514–17. **B**: Indeterminate reptilian tooth, probably from the Early Jurassic "Posidonia Shale" of southern Germany; PZO 13450. **C**: Ichthyosaur vertebra, unknown locality; PZO 13440.

vertebra labelled by Gasser as fish vertebra. All specimens are Mesozoic in age (predominantly Triassic and Jurassic), except for a crocodilian tooth from the Miocene of Menorca, mistaken by Gasser as a fish tooth (PZO 13523). Only a set of teeth belonging to the Late Jurassic marine crocodilian *Dakosaurus* (PZO 13514–13516 and PZO 13538) has been determined at genus level, all other remains being too fragmentary and undiagnostic for a closer determination. Source area of the specimens is mostly southern Germany (Baden-Württemberg and Bavaria). No Tyrolian specimens are present.

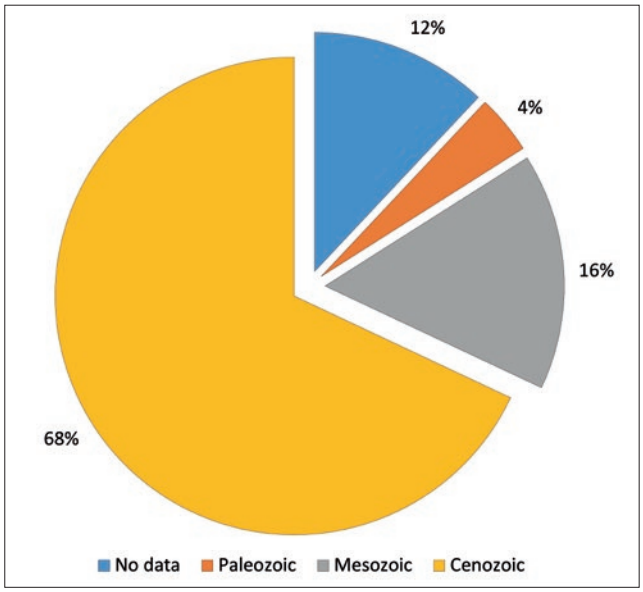

FIG. 6: Distribution of the specimens by age.

4. CHRONOSTRATIGRAPHIC DISTRIBUTION OF THE SPECIMENS

Vertebrates have an extensive stratigraphic record spanning from Cambrian (Janvier, 2015) to present. Although very little was known in Gasser's days about the early history of vertebrates during the older periods of the Paleozoic, various localities from the Silurian onwards had yielded abundant material by the late 19th to early 20th century (Chamberlain, 1900),

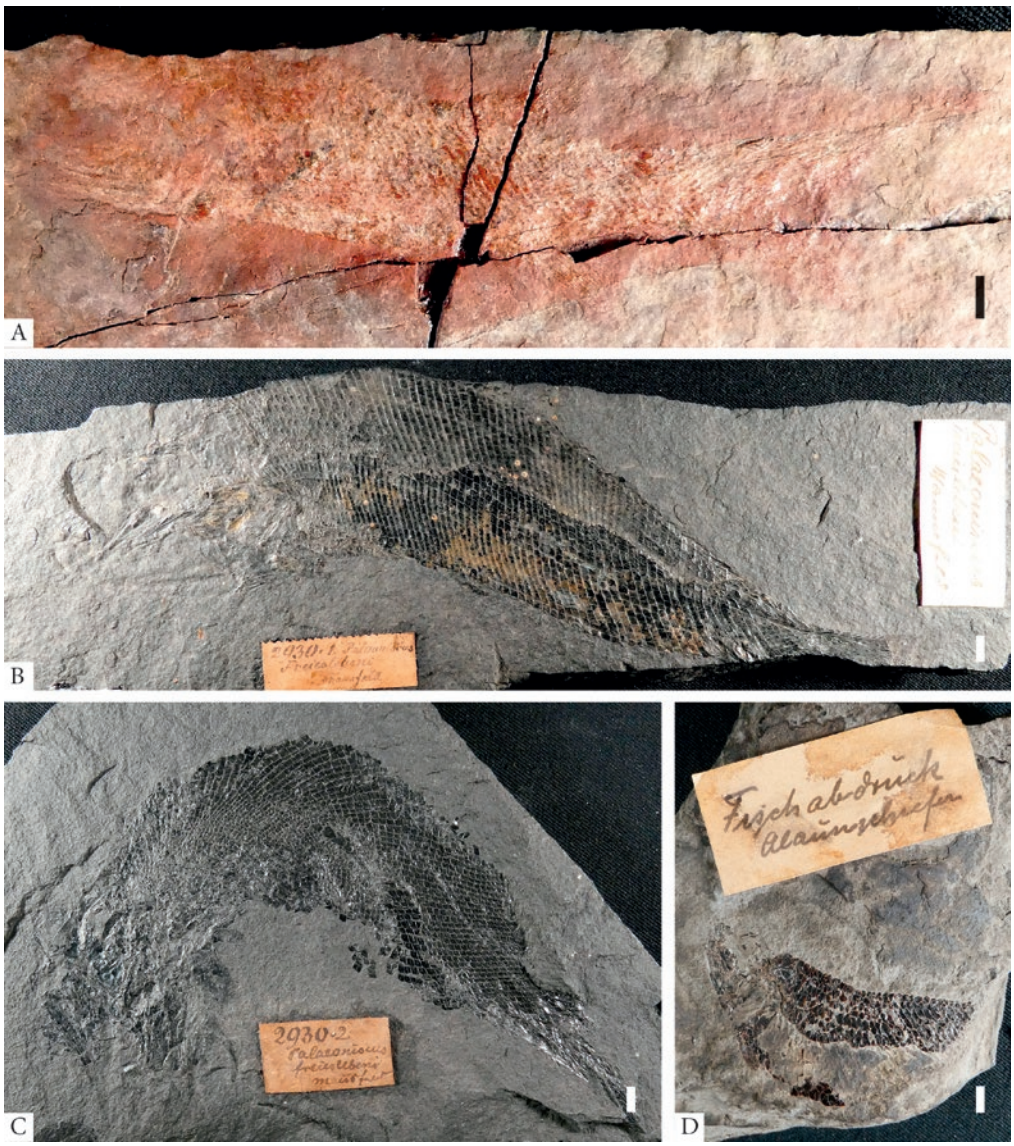

FIG. 7: Paleozoic fishes in the Gasser collection. **A**: Palaeonisciform fish, reportedly from the Devonian of Bohemia; PZO 13488. **B–C**: *Palaeoniscum freieslebeni* from the Permian Kupferschiefer near Mansfeld (Germany); PZO 13435 and 13456. **D**: Fish fragment from the *Alaunschiefer*, unknown locality; PZO 13485.

ensuring that Gasser could have learned about them and potentially could have tried to acquire representative specimens. Instead, the vertebrate remains in the Gasser collection are heavily biased towards younger geological periods (Fig. 6), which betrays that Gasser put little effort in these acquisitions: he simply gathered the specimens that were most commonly found and thus easiest to get from other collectors, and/or cheapest to buy from dealers.

4.1. PALEOZOIC

Paleozoic vertebrate remains are extremely limited in the Gasser collection. Only 14 specimens (4% of all vertebrate fossils) are present, all palaeonisciform actinopterygians. The oldest specimen is a fairly complete fish on a reddish siltstone plate (PZO 13488; Fig. 7 A), reportedly from the Devonian of Bohemia (no exact locality is given by the accompanying label). The bulk of all Paleozoic vertebrates in the Gasser collection (10 out of a total of 14) are complete and incomplete specimens of *Palaeoniscum freieslebeni* from the Permian *Kupferschiefer* ("Copper Slate") of Mansfeld (Fig. 7 B–C). Two fragmentary fish specimens on black slates (PZO 13438 and 13449) have no accompanying data but might be from the *Kupferschiefer* as well. Another fragment (PZO 13485), on a less dark rock as the *Kupferschiefer* specimens, is reported as being from the *Alaunschiefer* ("Alum Slate"), with no locality data (Fig. 7 D). While the term *Kupferschiefer* clearly refers to a lithological unit in the German Zechstein (Lopingian in age), *Alaunschiefer* refers to different middle to late Paleozoic deposits (Silurian to Permian). So, the 14 specimens can be dated as follows: 1 Devonian, 10 Permian, 3 indeterminate, but probably Permian as well. It may be worth mentioning that Gasser never used the name Permian, neither in his collection register nor on the labels, and one of the *Kupferschiefer* specimens even bears a label which reports the age as being Carboniferous. While this chronological attribution is wrong by the modern geological timescale, it might not represent a mistake by Gasser (or by whoever gave him the specimen and the information). Rather, the Permian, though introduced in geological literature as a separate stage as early as 1841 (Murchison et al., 1842), has been regarded by some authors as part of the Carboniferous until the mid-20th century (Benton & Sennikov, 2022). A probable misidentification is,

FIG. 8: Triassic ("Keuper") reptile teeth from Aixheim (southern Germany), mounted on a glass plate for display in Gasser's museum.

on the other hand, the label accompanying PZO 14378, a partial fish specimen on a light grey shale plate, labelled as Carboniferous, without information about locality. The rock is lighter and softer than the *Kupferschiefer* and probably comes from the Lower Jurassic "Posidonia Shale" of southern Germany; the fossil probably represents an incomplete *Dapedium* sp. For this reason, we count it among the Mesozoic, not Paleozoic specimens in the Gasser collection.

4.2. MESOZOIC

With 56 specimens, Mesozoic vertebrates account for 15 % of all vertebrates in the Gasser collection. Both reptiles and fishes are represented, the latter including both articulated (partial and complete) specimens and isolated teeth and scales. The Triassic is represented by 7 isolated reptilian teeth and bone fragments from the German Keuper (Fig. 8). Jurassic fossils are the most numerous age group (39 specimens) and include the already mentioned *Dapedium* (presumably from the "Posidonia Shale", Toarcian; Fig. 9A), 16 articulated fish specimens (all Teleostei) from Solnhofen (Tithonian; Fig. 9B–C), 5 isolated teeth of the marine crocodilian *Dakosaurus* from Sigmaringen (?Kimmeridgian), an isolated ichthyosaur vertebra from Tuttlingen (Lower Jurassic), and 17 isolated teeth of the durophagous fish *Lepidotes* from quarries around Trento and in southern Germany (Fig. 10). The Cretaceous is represented by only 3 specimens (Fig. 11). PZO 13518 is a piece from a bonebed with actinopterygian scales and teeth from the Turonian, PZO 13506 a selachian tooth reported as "Cretaceous", without a more precise chronological attribution. Both specimens are from Germany. PZO 13866 is an articulated fish from Lebanon. 6 specimens are surely Mesozoic, but uncertain at a period level. These include 3 isolated teeth of the sarcopterygian fish *Ceratodus* (without locality and age information), an isolated ichthyosaur vertebra from SW-Germany (without locality and age information), an isolated reptile tooth (without information, but probably from the Lower Jurassic "Posidonia Shale" of SW-Germany), and an undetermined reptile bone fragment lacking any information (PZO 13527).

FIG. 9: Examples of Jurassic fishes in the Gasser collection. **A**: *Dapedium* sp., locality unknown, but probably from the Early Jurassic "Posidonia Shale" of southern Germany; PZO 13478. **B**: *Leptolepides sprattiformis* from the Late Jurassic *Plattenkalk* of the Solnhofen area (southern Germany); PZO 13452. **C**: *Tharsis dubius*, Late Jurassic, Solnhofen; PZO 13467. **D**: Disarticulated indeterminate fish, Late Jurassic, Solnhofen; PZO 13482.

FIG. 10: Teeth of the durophagous fish *Lepidotes*; probably all from the surroundings of Trento. **A**: PZO 13441. **B**: PZO 13470. **C**: PZO 13471. **D**: PZO 13448.

FIG. 11: Cretaceous fossils in the Gasser collection.
A: Selection of shark teeth mounted on a glass plate for display in Gasser's museum. The smaller teeth on the left and right fields of the plate are from the Miocene of Ulm (southern Germany); the large tooth in the middle (PZO 13506) is from the Cretaceous of Quedlinburg (central Germany).
B: Sample from a bonebed with fragmentary fish remains, from the Turonian of Strehlen (central Germany); PZO 13518.
C: Cretaceous (Cenomanian?) fish from Lebanon; PZO 13866.

FIG. 12: Examples of Pleistocene vertebrate remains in the Gasser collection.
A: *Ursus spelaeus*, mandible, unknown locality, PZO 13721.
B: *Vulpes vulpes*, mandible, from Mergelstetten (southern Germany), PZO 13722.
C: *Sus scrofa*, mandible, unknown locality, PZO 13707.
D: *Mammuthus primigenius*, molar, "dredged from the Rhine", PZO 13718.

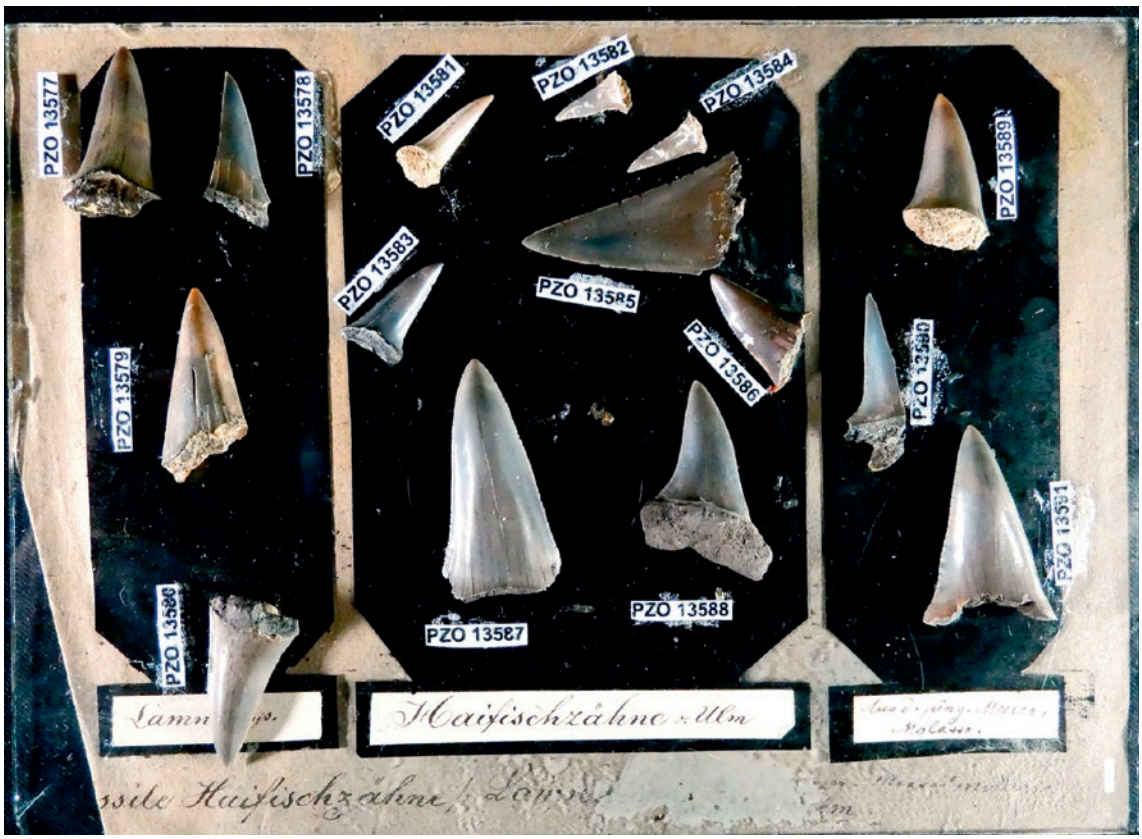

FIG. 13: Selection of shark teeth from the Miocene of Ulm (southern Germany), mounted on a glass plate for display in Gasser's museum. PZO 13577–91.

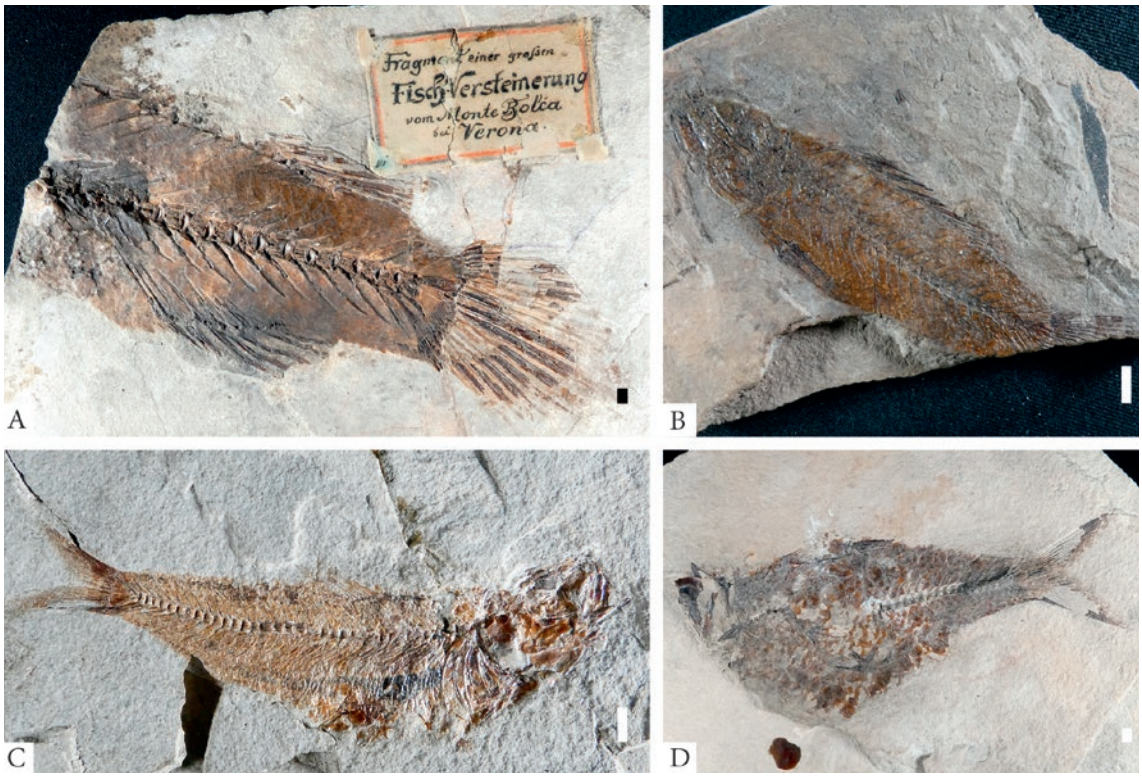

FIG. 14: Eocene fishes from Monte Bolca. **A**: PZO 13436. **B**: PZO 13437. **C**: PZO 13481. **D**: PZO 13496.

4.3. CENOZOIC

With 241 specimens, Cenozoic vertebrates are the most common within the Gasser collection (68% of all vertebrates). About half of all Cenozoic specimens in the collection are the remains of Pleistocene and Holocene mammals (129 complete and fragmentary bones and teeth). The Holocene specimens are limited to a collection of micromammal remains from a Neolithic site at Goldberg in Bavaria (Germany), which includes vertebrae, limb bones, mandibles and isolated teeth. The Pleistocene specimens come from a variety of sites including cave, river and lake deposits. All of them are isolated and often incomplete mammal bones and teeth. Represented taxa are, among others, *Ursus spelaeus* (Fig. 12A), *Vulpes vulpes* (Fig. 12B), *Sus scrofa* (Fig. 12C), and *Mammuthus* sp. (Fig. 12D). Miocene specimens are mostly selachian teeth from different localities in Germany (Fig. 13), but also mammal bone fragments are represented, including two undiagnostic fragments from marine sediments near Engelwies (PZO 13640 and 13641) and a cetacean vertebra from Dingden (PZO 13560). The Oligocene is represented by various selachian teeth from different sites in Germany. The Eocene is represented by 7 articulated fish remains from the famous locality of Monte Bolca (Fig. 14) near Verona, plus a single large mammal tooth attributed to the brontotheriid *Minodus prouti* from the Bad Lands of Dakota (USA).

4.4. INDETERMINATE AGE

Out of a total of 356 vertebrate fossils still preserved in the Gasser collection, 43 (about 12%) lack any age information and cannot be assigned with certainty to any of the three eras of the Phanerozoic. In all cases these are isolated fish teeth, scales or other fragments that often are undiagnostic and, given their complete lack of data, are of virtually no scientific value. Most of them also lack the aesthetic value that would have been appreciated by a collector. Among the few more representative specimens, there are some selachian teeth (e.g., PZO 13443 and 13468). A specialist revision of these would probably lead to a more exact taxonomical attribution and possibly allow a recovery of at least a rough chronological determination.

5. GEOGRAPHIC DISTRIBUTION OF THE SPECIMENS

More than one third of all vertebrates in the collection (132 specimens or 37%) lack any information about their locality of origin. The remainder mostly comes from localities within German speaking countries (Figs. 15–16), as most of the Gasser collection (Wagensommer et al., this volume b). The best represented country is Germany (177 specimens or 50% of all vertebrates in the collection). Austria (within present-day borders) is represented by only 4 specimens (1.1%), all from North Tyrol. Switzerland is represented by a single specimen. Trentino and South Tyrol account for 6.5% of the collection (23 specimens). Bohemia and Slovenia, both part of the Austro-Hungarian Empire until World War I, are represented by a single specimen each. Summing up all these, German speaking (or German ruled) countries are represented by 206 specimens (58% of the collection). Only 18 specimens (5% of the collection) are reported as coming from countries outside German speaking countries. Half of these are from northern Italy (7 articulated fish specimens from the Eocene Monte Bolca *Lagerstätte* and an isolated *Lepidotes* tooth from Vicenza). Two specimens are from England, two more from the Baleares (Spain). Only 5 specimens

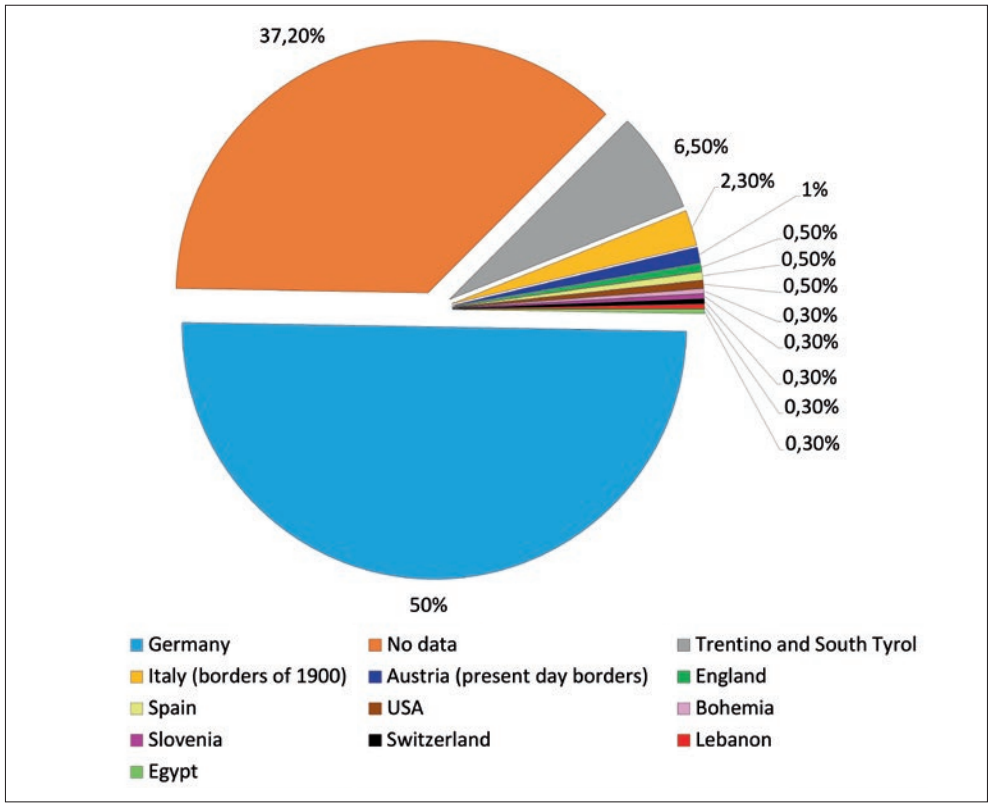

FIG. 15: Distribution of the specimens by country.

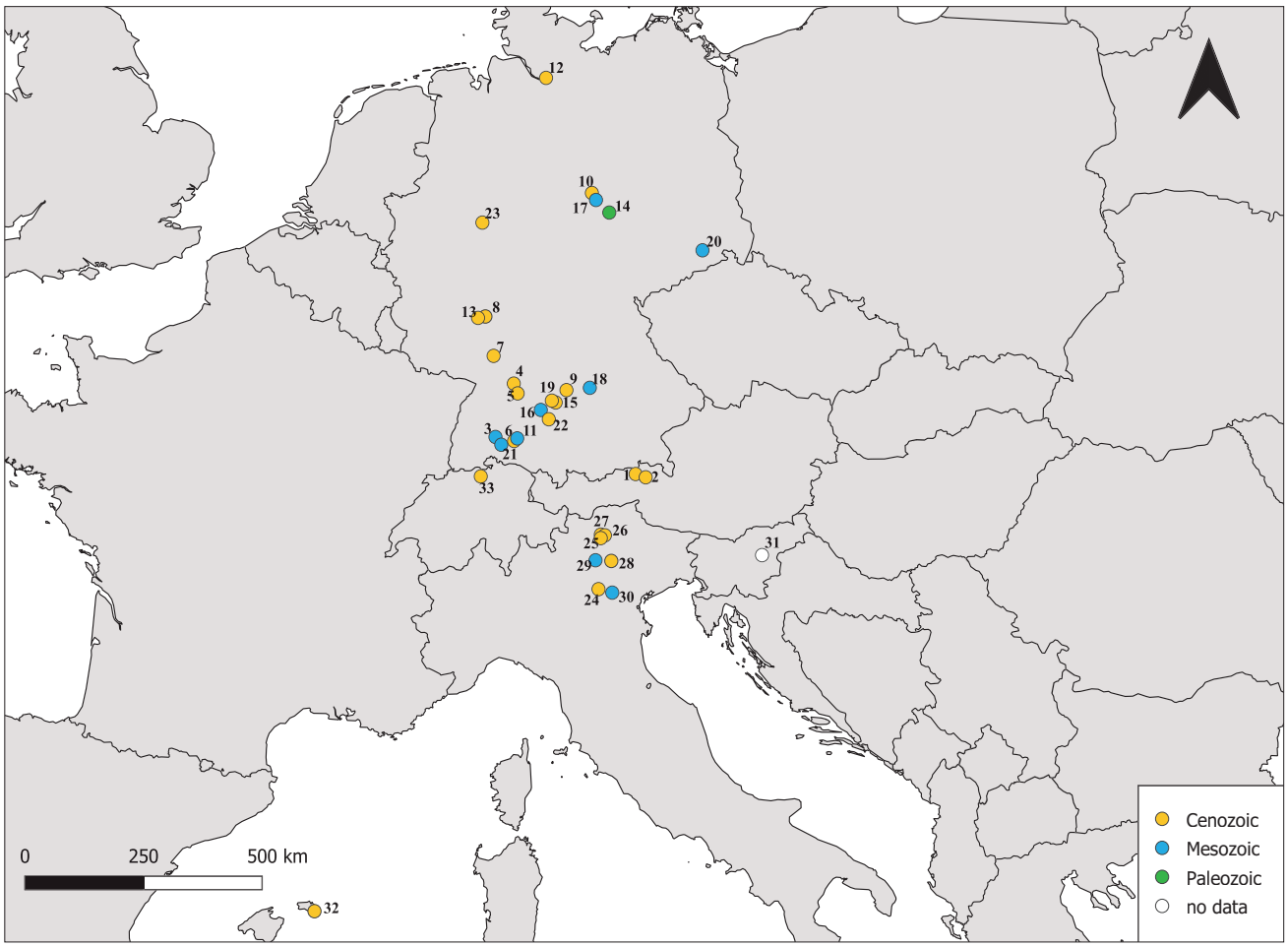

FIG 16: Map of central Europe with the localities where Gasser's vertebrate specimens come from. Only clearly defined localities are taken into account; the many specimens with vague locality data (regions or countries) or with no locality data at all cannot be pinpointed and are not considered in this map. The only four localities outside Europe are not considered here; they account for one specimen each. 1. Bad Häring; 2. Schwarzsee, Kitzbühel; 3. Aixheim; 4. Bietigheim; 5. Cannstadt; 6. Engelswies; 7. Eppelheim; 8. Flörsheim am Main; 9. Goldberg; 10. Halberstadt; 11. Laiz/Sigmaringen; 12. Langenfeld?; 13. Mainz; 14. Mansfeld; 15. Mergelstetten; 16. Nellingen; 17. Quedlinburg; 18. Solnhofen; 19. Steinheim; 20. Strehlen; 21. Tuttlingen; 22. Ulm; 23. Warstein; 24. Bolca; 25. Eppan/Appiano; 26. Rentsch/Rencio; 27. Siebeneich/Settequerce; 28. Strigno; 29. Trento; 30. Vicenza; 31. Laško; 32. Menorca; 33. Baden

come from localities outside Europe, two of these from the USA, two from Egypt and one from Lebanon.

In the following we discuss most of the localities represented by the vertebrate specimens in the Gasser Collection (Figs. 15, 16). We left out only those localities that have to vague indications (e.g., when only a country or region is given, the age is not determinable at least at period level, and the specimens are difficult to determine at low taxonomic levels).

5.1 AUSTRIA

Bad Häring (Tyrol)

Age: early Oligocene

This locality is one of the most famous fossiliferous sites in the European Paleogene, especially well known for its plant remains, but rich in animal fossils too (e.g., Butzmann & Gregor, 2002; Heyng et al., 2003; Tomelleri et al., this volume a, among others). The locality yielded coal deposits that have been mined for about 200 years until shortly after World War II.

Collection Georg Gasser: In addition to 21 plant specimens (see Tomelleri et al., this volume a), the Gasser collection also contains 3 vertebrate specimens. These are an undetermined selachian tooth (PZO 13468), a fish fragment (PZO 13461), and a rock sample with rib fragments referred to the dugongid sirenian *Halitherium* (PZO 13455)

Remarks: The historical register ("catalogue") of the Gasser collection reports the *Halitherium* vertebrae (PZO 13455) under number 4043. Number 4044 is an unspecified "fish" and can probably be identified with PZO 13461. Number 4045 is a "shark tooth" for which no locality information is given, but as it is listed among the specimens from Bad Häring (number 4046 is left free, numbers 4047–4053 are invertebrates from Häring, 4054–4056 plants from the same locality), it can be assumed that it comes from this locality too and therefore can probably be identified with PZO 13468. As for the mammalian ribs, both the label and the catalogue report *Halitherium* as being a cetacean. This is wrong and would have been so even in Gasser's days, as *Halitherium* was recognized as a sirenian since its description in the first half of the 19th century (Kaup, 1838). The name *Halitherium* has long been used as a waste basket for Paleogene sirenian remains and is considered invalid today (Voss, 2014). PZO 13455 is a rather undiagnostic couple of rib fragments. The attribution to a sirenian is probably correct in view of the stoutness of the fragments.

Schwarzsee near Kitzbühel (Tyrol)
Age: Late Pleistocene?
The Schwarzsee is a small alpine lake (about 16 hectares of surface) about 2 km West of Kitzbühel. It is surrounded by boglands that surely contain peat deposits accumulated over thousands of years, but to the best of our knowledge there are no publications on mammal or other fossil or subfossil remains from these deposits.
Collection Georg Gasser: 1 specimen, a single but complete rib, referred to as belonging to either *Bison bonasus* or *Bos primigenius* (PZO 13612; old Gasser catalogue number: 1911.2)
Remarks: Both the label still attached to the rib and the entry in Gasser's "catalogue" (collection register) report the specimen as coming from "the peat bog of the Schwarzsee near Kitzbichl". No more precise information is given. "Kitzbichl" is a vernacular version of the name "Kitzbühel".

5.2 EGYPT

Cairo
Age: Oligocene
The only two vertebrate fossils in the Gasser collection that come from the African continent are two shark teeth, glued on a glass plate together with similar remains from European localities like the Mainz Basin (Germany). The label reports them as Oligocene shark teeth from Cairo. No more exact information is available.
Collection Georg Gasser: 2 specimens, selachian teeth (PZO 13889–90)

5.3 GERMANY

Aixheim (Baden-Württemberg)
Age: Late Triassic
In the area of Aixheim Late Triassic rocks of the German Keuper crop out that occasionally yield reptile and amphibian bones. The specimens in the Gasser collection are preserved in light yellowish coarse sandstone, which in the provenance area is characteristic of the Norian Löwenstein Formation or "Stubensandstein" (e.g., Hungerbühler, 2002; Milner & Schoch, 2004).
Collection Georg Gasser: 4 specimens, indeterminate reptil teeth (PZO 13498–13501). A fifth specimen that almost certainly comes from the same site is PZO 13534, a set of bone fragments in the same kind of light sandstone. In this case, the accompanying label explicitly refers the specimen to the Stubensandstein, but reports the locality as "Aischaim", probably a misspelling.

Bietigheim near Stuttgart (Baden-Württemberg)
Age: Pleistocene
The Pleistocene fluvial gravel deposits around Bietigheim have been known for their vertebrate remains since the Late 19th century (Wagner, 1929). The site is not far from Steinheim, where similar deposits yielded the famous hominid skull known as "*Homo steinheimensis*", discovered in 1933 and estimated to be about 300.000 years old (Bloos, 2021).
Collection Georg Gasser: 17 specimens, *Bos primigenius* (isolated molars; PZO 13535, 13540–41), *Bison priscus* (molar; PZO 13539), *Equus* sp. (isolated teeth; PZO 13530–33, 13561, 13564), *Mammuthus primigenius* (astragalus; PZO 13729), *Rhinoceros thicorhinus* (PZO 13989–90, 13993-94), indeterminate mammal bone fragments (PZO 13991–92)

Cannstadt
Age: Pleistocene
Located inside the urban area of Stuttgart, (Bad) Cannstadt is a classical locality for vertebrate remains in travertine (Schatz, 1997).
Collection Georg Gasser: 4 specimens, *Equus sp*. (isolated teeth; PZO 13615 and 13617), *Ursus spelaeus* (vertebra; PZO 13715), indeterminate tooth fragment (PZO 13635)

Engelswies (Baden-Württemberg)
Age: Early Miocene
At the Talsberg, SW of Engelswies near Sigmaringen, Early Miocene ("Karpatian" = late Burdigalian) freshwater limestones have been quarried until the mid-20th century. They yielded a diverse continental flora and fauna, the latter including both invertebrates and vertebrates (Ziegler, 1995). The locality had been known since the late 19th century (Quenstedt, 1885) and became famous in the early 20th century for its mammal remains (Klähn, 1922; 1924; 1925; 1926). Although abandoned today, the quarry has been the target of scientific excavations in more recent years, that also yielded the oldest hominoid material outside Africa (a single dryopithecin molar; Tobien, 1973; Böhme et al., 2011).
Collection Georg Gasser: 3 specimens, indeterminate bone fragments (PZO 13621 and 13640–41)
Remarks: The three specimens from this locality are dark mineralized bone fragments in a light yellowish limestone matrix. Although heavily broken, none of the specimens has sharp edges, their outline being smooth and rounded. This points to a considerable amount of transport and/or rework by water (waves, currents) before final burial.

Eppelheim (Baden-Württemberg)
Age: Pleistocene
Eppelheim is a town in the NW of Baden-Württemberg. It is not particularly renown as a fossiliferous locality.
Collection Georg Gasser: 2 specimens, *Agriotherium sp*. (molars; PZO 13562–63)
Remarks: The two molars are glued on a glass plate, together with a label which only reports: "*Agnotherium* v. Eppelheim, Württemberg". Although the animal's name is misspelled as "*Agnotherium*", it is quite clear that the bear genus *Agriotherium* was meant.

Flörsheim am Main (Hessen)
Age: Oligocene?
Flörsheim lies within the Mainz Basin, which bears Oligocene shallow marine deposits (e.g., Grimm, 1998).
Collection Georg Gasser: 5 specimens, unidentified bone fragments (PZO 13490–91), hybodontiform shark teeth (PZO 13492–93), *Lamna cuspidata* (isolated tooth; PZO 13510)
Remarks: PZO 13490–93 belong to a set of originally 9 fish teeth and bone fragments collectively reported in the historical register ("catalogue") of the Gasser collection under the inventory number 2630.

Goldberg (Bavaria)
Age: Holocene
The specimens listed below come with a label reporting the locality as a "Neolithic cultural site near Goldberg", without any further information. Goldberg is the name of a small town in Mecklenburg-Vorpommern (north-eastern Germany), but also of a hill at the margin of the Ries impact crater (western Bavaria, southern Germany). Since Gasser possessed more fossils from southern Germany than from the northern half of the country, we consider it more likely that the specimens come from the Goldberg in Bavaria, rather than Goldberg in Mecklenburg-Vorpommern. This assumption becomes even more probable if we take into account that Goldberg/Ries was famous at the beginning of the 20th century for the discovery of an important Neolithic settlement, object of an archaeological excavation from 1911 on (Bofinger, 2011).
Collection Georg Gasser: 11 specimens, miscellaneous micromammal remains (PZO 13592–602)

Halberstadt (Saxony-Anhalt)
Age: Miocene
Halberstadt is a town in Saxony-Anhalt. The only specimen from this locality is a shark tooth accompanied by a label reporting the information: "*Oxyrhina hastalis* – Miocene – Halberstadt". The locality is not otherwise known as a site for Miocene marine fossils.
Collection Georg Gasser: 1 specimen, *Cosmopolitodus hastalis* (tooth; PZO 13503)
Remarks: The label reports the specimen under the old name of *Oxyrhina hastalis*.

Laiz / Sigmaringen (Baden-Württemberg)
Age: Late Jurassic
Originally a municipality of its own, Laiz is part of the city of Sigmaringen since 1974. It is located at the margins of the Swabian Jura, a classical region for Jurassic fossils.
Collection Georg Gasser: 5 specimens, *Dakosaurus maximus* (teeth; PZO 13514–17 and 13538)
Remarks: *Dakosaurus* is a large metriorhynchid crocodylomorph with a wide distribution during the Late Jurassic, first described in the 19th century from outcrops in Baden-Württemberg (Young et al., 2012).

Langenfeld (?) near Hamburg
Age: Miocene
The specimens listed below bear a label which assigns them to the Miocene. The locality is given as Langenfeld near Hamburg. The specimens are probably identical with those reported in the Gasser collection catalogue under the inventory number 1974; this entry reports 12 shark teeth from the Miocene of Langenfeld near Hamburg. Under inventory number 1924 a cetacean vertebra from the same locality is reported. While n. 1924 of the Gasser catalogue is probably lost, the 9 missing shark teeth from "Langenfeld" may still be present in the collections of the NMS but remain unrecognized due to the loss of their labels. No information is available for the locality.
Collection Georg Gasser: 3 specimens, selachian teeth (PZO 13895–97)

Mainz
Age: Oligocene
The Mainz Basin is a classical region for Cenozoic (mostly Oligocene) marine fossils (Grimm, 2006). It is highly probable that under the locality name "Mainz", Gasser merged different localities within the Mainz Basin, rather than referring to the city of Mainz. The locality of Flörsheim, discussed above, also belongs here.
Collection Georg Gasser: 9 specimens, selachian teeth (PZO 13879–83, 13891–94)

Mansfeld (Saxony-Anhalt)
Age: late Permian
Mansfeld is a classical site for fishes from the late Permian (Lopingian) *Kupferschiefer* deposits, intensively quarried until the late 20th century for their copper content (e.g., Paul, 2006).
Collection Georg Gasser: 10 specimens, *Palaeoniscum freiselebeni* (PZO 13435, 13439, 13456, 13473, 13477, 1379, 13485–87, 13497)

Mergelstetten (Baden-Württemberg)
Age: Pleistocene
Mergelstetten is located in the Swabian Jura, where numerous caves in the Late Jurassic limestones have produced Pleistocene vertebrate fossils (e.g., Münzel et al., 2011). No information is available as for the exact site that yielded the specimens in the Gasser collection.
Collection Georg Gasser: 4 specimen, *Canis lupus* (PZO 13722), *Equus* sp. (PZO 13945–47)

Nellingen (Baden-Württemberg)
Age: Late Triassic
Nellingen is a small town in eastern Baden-Württemberg. No information could be found about a Triassic bonebed in its surroundings. Nevertheless, Late Triassic (Keuper) strata crop out near the town.
Collection Georg Gasser: 2 specimens, indeterminate bone fragments (PZO 13522, 13524)
Remarks: The labels that accompanies the specimens state that they come from a "bonebed near Nellingen".

Quedlinburg (Saxony-Anhalt)
Age: Cretaceous
Triassic to Cretaceous rocks crop out in the surroundings of Quedlinburg. Since Gasser himself only reported the age as "Cretaceous" and the locality as "Quedlinburg", more exact information is not available for this specimen.
Collection Georg Gasser: 1 specimen, *Cretoxyrhina mantelli* (tooth; PZO 13506; old Gasser catalogue number: 1972)
Remarks: The known stratigraphic range of *Cretoxyrhina mantelli* is Albian to Campanian (Kenshu, 1997).

Rhine River
Age: Pleistocene
Gasser reports a single mammoth molar as having been "dredged from the Rhine" in 1885. No more detailed information is given for this specimen.
Collection Georg Gasser: 1 specimen, *Mammuthus primigenius* (molar; PZO 13718; old Gasser catalogue number: 1904)

Solnhofen (Bavaria)
Age: Late Jurassic
The Late Jurassic *Plattenkalk* deposits of the Altmühl Valley area build one of the most celebrated examples of Fossil-Lagerstätte in the world. As pointed out by Röper & Rothgaenger (2000), the different *Plattenkalk* sites encompass a variety of depositional environments and are quite different also in their age, spanning from the late Kimmeridgian to early Tithonian. This notwithstanding, they have long collectively been termed as "Solnhofen" by fossil collectors, and only the last decades of the 20th century brought the awareness of the importance to distinguish among localities. Thus, it is not surprising that all *Plattenkalk* specimens in the Gasser collection too report "Solnhofen" (sometimes spelled "Solenhofen" or "Solenhoven") as locality, although the different features of the limestone plates – yellowish or white colour, presence/absence of dendrites – make it probable that different sites are represented in the collection, possibly including not only the Solnhofen Formation, but also the slightly younger Mörnsheim Formation.
Collection Georg Gasser: 10 specimens, teleostei (PZO 13452–53, 13457, 13460–62, 13464–67).
Remarks: All ten specimens in the Gasser collection represent common teleostean fishes, probably all referable to either *Leptolepides sprattiformis* or *Tharsis dubius*. However, the taxonomy of smaller teleostei from Solnhofen has undergone major changes during the last years (e.g., Arratia et al., 2015). More careful analyses of the material accumulated over more than two centuries of collecting in the Solnhofen area has revealed an unexpected diversity. A specialist revision of the fishes in the Gasser collection would be needed to exactly assess which taxa are represented.

Steinheim Basin (Baden-Württemberg)
Age: Miocene
The Steinheim Basin is an impact crater formed in Middle Miocene times (Buchner et al., 2022) and filled with the sediments of a lake that formed inside the crater after the impact event. The lake sediments are a well-known locality for Miocene mammal fossils (e.g., Jäger, 1835–1839; Aiglstorfer et al., 2017).
Collection Georg Gasser: 2 specimen, artiodactyls horn core fragments (PZO 13725, 13944)

Strehlen (Saxony)
Age: Late Cretaceous
Strehlen is today a part of the city of Dresden. Limestones of Turonian age are quarried in the area and known as the Strehlen Limestone (Tröger, 1987).
Collection Georg Gasser: 1 specimen, sample of a bonebed with indeterminate fish remains (PZO 13518)
Remarks: The specimen is labelled as "*Oxyrhina mantelli* from the Turonian of Strehlen near Dresden". The material however represents scales and bone fragments, including teeth, referable to actinopterigian fishes rather than to the shark *Cretoxyrhina mantelli*.

Tuttlingen (Baden-Württemberg)
Age: Early Jurassic
Tuttlingen is located at the SW edge of the Swabian Jura. Jurassic outcrops are common in the area.
Collection Georg Gasser: 1 specimen, ichthyosaur vertebra (PZO 13603)

Ulm (Baden-Württemberg)
Age: Miocene
Early Miocene marine sand deposits known as *Obere Meeresmolasse* crop out in the surroundings of Ulm. They have long been known by fossil collectors for their abundant shark teeth (e.g., Höltke, 2009).
Collection Georg Gasser: 24 specimens, selachian teeth (PZO 13502, 13504–05, 13507–09, 13511–13, 13577–91)

Warstein Cave (North Rhine-Westphalia)
Age: Pleistocene
A number of Caves in the surroundings of Warstein yielded late Pleistocene mammal remains. The name "Warstein Cave" (Warsteiner Höhle) was commonly used around 1900 to designate the Bilsteinhöhle near Warstein. Yet this cave was discovered in 1887, whereas an entry in the Gasser collection catalogue states that the cave the specimens came from was discovered in 1868 and investigated in the following years (Wagensommer, this volume). A label attached to one of the specimens (PZO 13543) reports the year 1892. Some 50 km away from Warstein there is the Dechenhöhle (near Iserlohn), which was discovered in 1868. Both the Bilsteinhöhle and the Dechenhöhle yielded Pleistocene vertebrate remains (Baales, 2005).
Collection Georg Gasser: 21 specimens, all isolated bones and bone fragments, including *Ursus spelaeus* and herbivores (indeterminate bovids) (PZO 13543–13549, 13575–13576, 13610–11, 13613, 13623, 13626, 13712–13, 13939–40, 13960–63)

5.4 ITALY

Monte Bolca (Verona Province)
Age: Eocene
Monte Bolca is one of the earliest known and most celebrated Fossil-Lagerstätten in Italy. Famous, among other fossils, for its fishes, the locality has provided specimens for museum and private collections for most of the 19th and early 20th century (Bellwood, 1996; Marramà & Carnevale, 2015).
Collection Georg Gasser: 7 specimens, *Bolcaichthys catopygopterus* (PZO 13446, 13481), clupeomorpha (PZO 13496), indeterminate Percomorpha (PZO 13436–37), ?*Trollichthys bolcensis* (PZO 13484)
Remarks: The specimen, PZO 13480, appear composed by an assemblage of three different skeleton remains: it gives an insight on a classic treatment used in the past as expedient, in order to create, also from different isolated fragments, a single specimen with aesthetic value.

Eppan/Appiano sulla Strada del Vino (Bozen/Bolzano Province)
Age: Pleistocene
Being only a few kilometres from Bolzano, Eppan/Appiano sulla Strada del Vino is among the few localities that Gasser might have visited personally. It is not otherwise known as a site for Pleistocene mammal finds. How Gasser acquired the two specimens from this locality is unknown.
Collection Georg Gasser: 2 specimens, *Panthera spelaea* (PZO 13727, 13988)

Rentsch/Rencio (Bozen/Bolzano Province)
Age: Pleistocene?
Rentsch is today part of the urban area of Bolzano. It is not otherwise known as a site for Pleistocene mammal finds. Nothing is known about how Gasser acquired the specimen.
Collection Georg Gasser: 1 specimen, indeterminate bone fragment (PZO 13724)

Siebeneich/Settequerce (Bozen/Bolzano Province)
Age: Pleistocene
Near Siebeneich/Settequerce Gasser's father possessed clay pits for brick manufacturing. In his book on the minerals of Tyrol, Gasser himself mentions the "alluvial clay deposits in the Adige Valley, used for brick manufacturing in Siebeneich and elsewhere" (Gasser, 1913; our translation). Though speculative, it is possible that the specimens come from these clay pits.
Collection Georg Gasser: 2 specimens, *Equus* sp. (molars; PZO 13614, 13616; old Gasser catalogue number: 1907)

Strigno (Trento Province)
Age: Paleogene?
Both Eocene and Oligocene rocks crop out at this locality.
Collection Georg Gasser: 9 specimens, selachian spine (PZO 13565), and isolated osteichthyan teeth (PZO 13567–74).
Remarks: PZO 13565 still bears a label with Gasser's inventory number 3973.2. The corresponding entry in the Gasser collection catalogue reports it as a coral or *Dentalium* from Strigno.

Trento (Trento Province)
Age: Jurassic?
Isolated teeth of the Mesozoic durophagous fish *Lepidotes* are known from different localities around Trento. They have been attributed magical powers in past centuries (Gregorova et al., 2020).
Collection Georg Gasser: 8 specimens, *Lepidotes maximus* (teeth; PZO 13470–72, 13474 and 13929–31)
Remarks: Two of the specimens still bear old labels with the original inventory number of the Gasser Collection. PZO 13474 = n. 3970.2; PZO 13471 = n. 3970.3; PZO 13472 = n. 3970.8. Gasser's collection catalogue records 9 specimen under the inventory number 3970, all *Lepidotes* teeth from Trento. The generic name *Lepidotes* has long been used as a "waste basket" for different Mesozoic durophagous fishes. The teeth in the Gasser collection are probably best identified as *Sheenstia maxima* (Gregorova et al., 2020). Three identical teeth without a locality attribution, but probably from the surroundings of Trento too, are mislabelled as teeth of the Triassic marine reptile *Placodus* (PZO 13441–42, 13448).

Vicenza (Vicenza Province)
Age: Jurassic?
As for the *Lepidotes* teeth from the surroundings of Trento.
Collection Georg Gasser: 1 specimen, *Lepidotes maximus* (tooth, PZO 13932)

5.5 LEBANON

Haqil ?
Age: Late Cretaceous?
A single fish specimen on a limestone plate from Lebanon is present in the Gasser collection. The accompanying label reports: "Klepsis – limestone – Lebanon". Although no more precise data are given, the specimen probably originates from the famous Cenomanian Fossil-Lagerstätte around Byblos.
Collection Georg Gasser: 1 specimen, unidentified fish (PZO 13866)

5.6 SLOVENIA

Laško (Styria)
Age: unknown
The town and municipality of Laško in eastern Slovenia is part of the historical region of Styria, today split up into an Austrian region of Steiermark and a Slovenian region of Štajerska. Gasser reports the locality under its former German name of Tüffer.
Collection Georg Gasser: 1 specimen, indeterminate fragmentary fish (Osteichthyes) remains (PZO 13878; old Gasser catalogue number: 4070.1)

5.7 SPAIN

Menorca
Age: Miocene
Miocene sediments are widespread on Menorca, covering the Mesozoic to Paleogene basement over much of the island's south-west. They encompass different facies (Johnson et al., 2011).
Collection Georg Gasser: 2 specimens, crocodilian tooth, cf. *Tomistoma* sp (PZO 13523) and shark vertebra (PZO 13608)

5.8 SWITZERLAND

Baden (Aargau)
Age: Cenozoic
The only specimen from Switzerland in the Gasser collection is a shark tooth, which reports, on the label, to come from the "Tertiary" near Baden in Switzerland. In the surroundings of Baden there are outcrops of Triassic to Late Jurassic and ?late Oligocene to Miocene rocks (Schindler, 1977), including Early Miocene marine deposits that might have yielded the specimen in the Gasser collection.
Collection Georg Gasser: 1 specimen, selachian tooth (PZO 13519)

5.9 U.S.A.

Badlands (Dakota)

Age: Eocene?

The Badlands of Dakota are one of the most important Lagerstätten of Paleogene (late Eocene to Oligocene) vertebrates in the world. Its scientific investigation begun by the mid-19th century. It is thus not surprising that one of the rare non-European specimens in the Gasser collection is a mammal tooth from the Dakota Badlands.

Collection Georg Gasser: 1 specimen, *Brontotheriidae* indet. (molar, PZO 13630)

Remarks: The tooth is labelled as "*Minodus prontii*" (sic) from the Badlands of Dakota. Correctly, this would have been *Menodus prouti*. No more information is available.

Georgetown

Age: unknown

A fragmentary fish tooth in the Gasser collection is reported, both on the label and on the corresponding catalogue entry, as "Fish remains from Georgetown, N.A.", where "N.A." probably means North America. No information is given about age. There are different localities named Georgetown in the U.S.A., including Georgetown in South Carolina, Georgetown in Texas and a number of townships in Illinois, Indiana, Michigan and Minnesota. Where exactly the specimen came from is unknown.

Collection Georg Gasser: 1 specimen, indeterminate fragmentary fish tooth (PZO 13454, old Gasser collection catalogue number: 2631)

CONCLUSIONS

If Gasser's purpose was that of building a didactic collection suitable to illustrate the history of life to the visitors of his museum (Wagensommer et al., this volume, b), it would have made sense for him to acquire various vertebrate specimens, representative of the major taxonomic groups that lived over the different periods of Earth's history. While this is true for plant and invertebrate fossils too, it is even more so for vertebrates, given the greater interest that the average museum visitor would have been likely to pay to large vertebrate fossils. Instead, the actual vertebrate specimens in the Gasser collection are often unspectacular and reflect the history of vertebrate evolution only very patchily. This is probably due to the high prices that more impressive vertebrate specimens would have had, prices that Gasser evidently was not willing to pay. On the other hand, he did acquire eye-catching recent zoological specimens, and rare minerals, for which he probably had to pay high prices. Overall, his collection reflects his interests, and apparently, he was not willing to invest as much money and effort in his paleontological collection as he did for other branches of his wider natural history collection. In at least one case, Gasser tried to compensate the lack of expensive original specimens by acquiring (plaster?) casts instead. The collection register or "catalogue" compiled around 1895 reports two specimens, n. 3630 and 3631, described as "models" of Solnhofen fossils. 3630 is described as "model of a *Pterodactylus spectabilis* from Solnhofen, after an original specimen in the Haarlem Museum" (our translation). 3631 is described as "model of a dragonfly". The word "model" in this context surely stands for "cast" or "reproduction". Since both specimens are lost, we know nothing about the accuracy of these "models".

Despite these limits, in the context of the late 19th to early 20th century the Gasser collection was surely a valuable tool for teaching the essentials about paleontology and give the public in Bozen, and South Tyrol as a whole, an opportunity to see specimens from many different localities, including many much-celebrated fossil sites.

ACKNOWLEDGEMENTS

Many people contributed to make this study possible. We are particularly grateful to Giorgio Carnevale (University of Torino) and Andrea Villa (Institut Català de Paleontologia Crusafont) for help in the determination of many of the vertebrate specimens in the collection. This research project would never have been carried out without the support of the Research funds of the Betrieb Landesmuseum ("Die Fossiliensammlung von Georg Gasser (1857-1931)", CUP H54I19000540005). Benno Baumgarten moved the historical collection in 1992 to the Museum of Nature South Tyrol and stored both the collection and historical documents, making them available for study. We thank also the collaborators of the museum Francesco Conci, Francesca Uzzo, Roberta Branz, Barbara Lanthaler, Hendrik Nowak, and several short-time internships that helped with the logistic move of the collection as well as during the inventarisation process. We thank also Fabio Massimo Petti (Rome) for the constructive remarks to the manuscript.

BIBLIOGRAPHY

Aiglstorfer M., Costeur L., Mennecart B. & Heizmann E. P. J., 2017: *Micromeryx? eiselei*, a new moschid species from Steinheim am Albuch, Germany, and the first comprehensive description of moschid cranial material from the Miocene of Central Europe. PLoS ONE, 12 (10): e0185679.

Arratia G., Schultze H.-P., Tischlinger H. & Viohl, G. (eds.), 2015: Solnhofen, ein Fenster in die Jurazeit, Band 1 und 2. Pfeil Verlag, München, 620 pp.

Baales M., 2005: Ein kurzer Gang durch die älteste Geschichte Westfalens. Archäologie in Ostwestfalen, 9: 10–37.

Bellwood D. R., 1996: The Eocene fishes of Monte Bolca: the earliest coral reef fish assemblage. Coral Reefs 15: 11–19.

Benton M. J. & Sennikov A. G., 2022: The naming of the Permian System. Journal of the Geological Society, 179 (1): jgs2021-037.

Bloos G., 2021: The stratigraphic position of *Homo steinheimensis* (late Middle Pleistocene, SW Germany). Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, 302 (2): 169–208.

Bofinger J., 2011: Vor 100 Jahren: Beginn einer archäologischen Großgrabung auf dem Goldberg im Nördlinger Ries. Denkmalpflege in Baden-Württemberg, 3: 155–157.

Böhme M., Aziz H. A., Prieto J., Bachtadse V. & Schweigert G., 2011: Bio-magnetostratigraphy and environment of the oldest Eurasian hominoid from the Early Miocene of Engelswies (Germany). Journal of Human Evolution, 61 (3): 332–339.

Buchner E., Sach V. J. & Schmieder M., 2022: Event- and biostratigraphic evidence for two independent Ries and Steinheim asteroid impacts in the Middle Miocene. Scientific Reports, 12: 18603.

Butzmann R. & Gregor H. J., 2002. Die oligozäne Flora von Bad Häring (Tirol): Pflanzen aus den Bitumenmergeln und deren phytostratigraphisch-paläoökologisch-paläoklimatische Interpretation. Documenta Naturae, 140: 1-116.

Chamberlain T., 1900: On the habitat of the early vertebrates. The Journal of Geology, 1900: 400–412.

Gasser G., 1913: Die Mineralien Tirols einschließlich Vorarlbergs und der Hohen Tauern. Wagner, Innsbruck, 548 pp.

Gregorova R., Bohaty M., Stehlikova D. & Duffin C., 2020: "Crapaudine" (*Scheenstia* teeth): the jewel of kings. Acta Musei Moraviae 105 (2): 277-294.

Grimm K. I., 1998: Correlation of Rupelian coastal and basin facies in the Mainz Basin (Oligocene, Germany). Neues Jahrbuch für Geologie und Paläontologie Monatshefte, 1998, 146–156.

Grimm K. I., 2006: Das Tertiär des Mainzer Beckens in der Stratigraphischen Tabelle von Deutschland 2002. Newsletters on Stratigraphy, 41 (1–3): 347–350.

Heyng A. M., Butzmann R., Fischer T. C. & Gregor H.-J., 2003: Die Oligozäne Flora von Bad Häring (Tirol) – Teil II: Illigeropsis ettingshausenii nov. gen. nov. spec. aus den Zementmergeln – ein neues exotisches Element im europäischen Paläogen. Documenta Naturae, 140 (2): 1-33.

Höltke O., 2009: Die Molluskenfauna der Oberen Meeresmolasse (Untermiozän) von Ermingen und Ursendorf. Paleodiversity, 2: 67–95.

Hungerbühler A., 2002: The Late Triassic phytosaur *Mystriosuchus westphali*, with a revision of the genus. Palaeontology, 45 (2): 377–418.

Jäger G. F., 1835–1839: Über die fossilen Säugetiere welche in Württemberg in verschiedenen Formationen aufgefunden worden sind, nebst geognostischen Bemerkungen über diese Formationen. C. Erhard Verlag, Stuttgart.

Janvier P., 2015: Facts and fancies about early fossil chordates and vertebrates. Nature, 520: 483–489.

Johnson M. E., Baarli B. G., Santos A. & Mayoral E., 2011: Ichnofacies and microbial build-ups on Late Miocene rocky shores from Menorca (Balearic Islands), Spain. Facies, 57: 255–265.

Kaup J. J., 1838: *Halytherium* und *Pugmeodon* im Maynzer Becken. Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefaktenkunde, 1838: 318–320.

Kenshu S., 1997: Paleoecological relationships of the Late Cretaceous lamniform shark, *Cretoxyrhina mantelli* (Agassiz). Journal of Paleontology, 715: 926–933.

Kustatscher E., Tomelleri I. & Wagensommer A., 2022: The paleontological collection Georg Gasser (1857–1931). Geo.Alp, 19.

Marramà G. & Carnevale G., 2015: The Eocene sardine † *Bolcaichthys catopygopterus* (Woodward, 1901) from Monte Bolca, Italy: osteology, taxonomy, and paleobiology. Journal of Vertebrate Paleontology, 35 (5): 10–24.

Milner A. R. & Schoch R. R., 2004: The latest metoposaurid amphibians from Europe. Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, 232 (2/3): 231–252.

Münzel S. C., Stiller M., Hofreiter M., Mittnik A., Conard N. J. & Bocherens H., 2011: Pleistocene bears in the Swabian Jura (Germany): genetic replacement, ecological displacement, extinctions and survival. Quaternary International, 245 (2): 225–237.

Murchison R. I., de Verneuil E. & von Keyserling A., 1842: On the geological structure of the central and southern regions of Russia in Europe, and of the Ural Mountains. 37 pp., Geological Society of London, London.

Paul J., 2006: The Kupferschiefer: Lithology, stratigraphy, facies and metallogeny of a black-shale. Zeitschrift der Deutschen Gesellschaft für Geowissenschaften, 157 (1): 57–76.

Röper M. & Rothgaenger M., 2000: Die Plattenkalke von Schernfeld (Landkreis Eichstätt). Eichendorf Verlag, Eichendorf, 128 pp.

Schatz K., 1997: The faunal remains of the Middle Pleistocene travertines of Stuttgart-Bad Cannstadt, South Germany (preliminary report). Anthropozoologica, 25: 375–382.

Schindler C., 1977: Zur Geologie von Baden und seiner Umgebung. Beiträge zur Geologie der Schweiz, kleinere Mitteilungen, 67: 109-160.

Tomelleri I., Butzmann R., Cleal C., Forte G. & Kustatscher E., 2022a. The plant fossils in the paleontological collection Georg Gasser (1857–1931). Geo.Alp, 19.

Tomelleri I., Lukeneder A., Forte G. & Kustatscher E., 2022b. The ammonoids in the paleontological collection Georg Gasser (1857–1931). Geo.Alp, 19.

Tomelleri I., Nützel A., Karapunar B. Hagdorn H., Forte G. & Kustatscher E., 2022c. The invertebrates fossils in the paleontological collection Georg Gasser (1857–1931). Geo.Alp, 19.

Tröger K. A., 1987: The Strehlen Limestone; the paleontology and biostratigraphy of the uppermost upper Turonian. Zeitschrift für Geologische Wissenschaften, 15 (2): 205–212.

Voss M., 2014: On the invalidity of *Halitherium schinzii* Kaup, 1838 (Mammalia, Sirenia), with comments on systematic consequences. Zoosystematics and Evolution, 90 (1): 87–93.

Wagensommer A., 2023: Georg Gassers Kontakte zu anderen Sammlern. Geo.Alp, 19.

Wagensommer A., Baumgarten B., Tomelleri I. & Kustatscher E., 2023a: Die Kataloge der „Naturhistorischen Sammlungen" von Georg Gasser. Geo.Alp, 19.

Wagensommer A., Tomelleri I., Baumgarten B. & Kustatscher E., 2023b: Die paläontologische Sammlung von Georg Gasser. Geo.Alp, 19.

Wagner G., 1929: Zur Geologie der wichtigsten Fundstellen diluvialer Säugetiere im Neckarlande. Paläontologische Zeitschrift, 11 (3): 194–196.

Young M. T., Brusatte S. L., De Andrade M. B., Desojo J. B., Beatty B. L., Steel L., et al. (2012): The cranial osteology and feeding ecology of the metriorhynchid crocodylomorph genera *Dakosaurus* and *Plesiosuchus* from the Late Jurassic of Europe. PLoS ONE 7(9): e44985. https://doi.org/10.1371/journal.pone.0044985.

Eingereicht am: 18.11.2022
Angenommen am: 22.11.2022