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Miocene continental gastropods from Dischingen, Germany

RODRIGO B. SALVADOR, OLAF HÖLTKE & MICHAEL W. RASSER

Abstract

Here is given an account, based on museum collections, of the fossil land and freshwater gastropods from Dischingen (Baden-Württemberg state, SW Germany). The fossiliferous outcrops belong to the Silvana Beds unit of the Upper Freshwater Molasse group, of late Early to early Middle Miocene age (Neogene European Land Mammal Zone MN 5). In total, 35 gastropod species were found (seven freshwater and 28 terrestrial), mainly belonging to Pulmonata, but also with representatives of Neritimorpha and Caenogastropoda. Seven species are reported here for the first time from Dischingen: *Palaina diezi*, *Radix socialis*, *Granaria* sp., *Serrulina*? sp., *Discus pleuradrus*, *Punctum pumilio*, and *Oxyloma minima*.

Key words: Caenogastropoda, Pulmonata, Neritimorpha, Silvana Beds, Upper Freshwater Molasse.

1. Introduction

Dischingen is the easternmost community of Baden-Württemberg state (part of Heidenheim district; Fig. 1), SW Germany, and its name is often mentioned in the paleontological literature due to the several fossiliferous deposits outcropping in the region (e.g., WENZ 1923–1930). Dischingen lies at the northern margin of the Molasse Basin. Miocene marine invertebrates and continental mollusks from the different beds of this locality can be found in several museum collections. According to the labels found in these collections, the locality “Michelsberg/Michelsberg, Dischingen” is seen in the vast majority of cases; this hill is located in the SW part of Dischingen. However, like many other Miocene localities in Baden-Württemberg, there is scarce literature dealing specifically with Dischingen – the outcrops lack detailed documentation and description.

FRAAS (1869) was the first researcher to describe the Miocene marine sediments in this region, providing a list of the invertebrates from the sandpits at Michelsberg. He also noted a younger stratum of freshwater limestone with continental mollusks, mentioning that it was similar to the limestone strata known from Zwiefalten and the Tautschbuch region, also in Baden-Württemberg. Afterwards, QUENSTEDT (1884) listed three land snail species from Dischingen on a broader work about gastropods. Besides this, there is brief mention of the Miocene sediments from Dischingen by FRAAS (1882) and ENGEL (1908) on their works about the geology of Baden-Württemberg.

The gastropod-bearing freshwater limestone of Dischingen was first specifically studied by MENGELE (1916). This author presented a list of 27 terrestrial and freshwater gastropod species from this locality, which was compiled by malacologist CARLO G. H. JOOSS (Table 1). These fossils were later included on the compilation work of WENZ (1923–1930). Much later, GALL (1971) pre-

sented a list of 29 gastropod species compiled with newly collected material (Table 1).

Herein, we examine the original material from the works of MENGELE (1916) and GALL (1971), as well as additional specimens from museum collections in Germany. We present an updated classification of the species, including seven new records, and figure the fossil gastropods from Dischingen for the first time.

Abbreviations

Institutions: BSPG = Bayerische Staatssammlung für Paläontologie und Geologie (Munich, Germany); GPIT = Department of Geosciences, Eberhard Karls Universität Tübingen (Tübingen, Germany; formerly Geologisch-Paläontologisches Institut Tübingen); SMNS = Staatliches Museum für Naturkunde Stuttgart (Stuttgart, Germany).

Shell measurements: H = shell height (parallel to coiling axis); D = greatest shell width (perpendicular to H).

2. Geological setting

Dischingen is located at the northern margin of the Molasse Basin in southern Germany (Fig. 1). The Miocene deposits from Dischingen belong to the units known as Upper Marine Molasse (“*Obere Meeresmolasse*”, abbreviated OMM) and Upper Freshwater Molasse (“*Obere Süßwassermolasse*”, abbreviated OSM). The sediments of the latter can be more specifically assigned to the Silvana Beds, a unit within the OSM characterized by the presence of the land snail *Palaeotachea silvana*. Nevertheless, several other gastropod taxa are also typical of these beds, including some of those listed further below (Table 1), such as *Gyraulus applanatus*, *Hypnophila loxostoma*, and *Leucochroopsis kleini* (ESU 1999; HÖLTKE et al. 2018). This supports a late Early to early Middle Miocene age for the Dischingen fossils (Neogene European Land Mammal Zone MN 5).

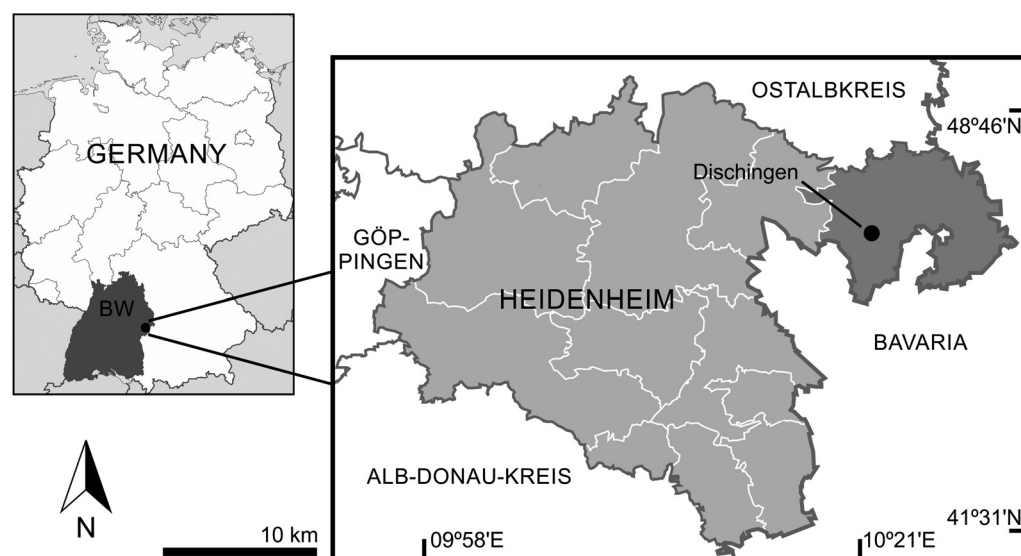


Fig. 1. Map showing the locality of Dischingen, Heidenheim district, Baden-Württemberg state (BW), Germany.

Regrettably, there are no recent outcrops exposed in the region and so only literature data is available for the OSM sediments in Dischingen. FRAAS (1869) first referred to these sediments as “freshwater limestones” (“*Süßwasserkalke*”, in the original), also mentioning detritus from the Nördlinger Ries and Steinheim meteorite events overlying the OSM layers. The Ries event is currently dated as 14.808 ± 0.021 Ma (SCHMIEDER et al. 2018), thus constraining the minimum age of the Dischingen sediments.

GALL (1971) described two strata from Dischingen, starting on the bottom with typically red colored marly clays, the so-called “flame marls” (“*Flammenmergel*”; WENZ 1924). According to WENZ (1924), the *Flammenmergel* belongs to the lower part of Silvana Beds (for the subdivision of the Silvana Beds, see HÖLTKE & RASSER 2016). The second stratum of GALL (1971), overlying the *Flammenmergel*, becomes more calcareous, passing into lighter colored marls bearing limestone nodules. On the top of the profile are the freshwater limestones representing the middle Silvana Beds.

3. Material and methods

The material analyzed for compiling the present account consisted exclusively of specimens from historical museum collections (see the Appendix for a full list of analyzed lots). This includes the voucher material of JOOSS in MENGELE (1916) and GALL (1971), which were respectively deposited in the SMNS and the BSPG. Unfortunately, not all of JOOSS’ specimens were preserved to this day, since a part of the SMNS collection was lost (SALVADOR et al. 2016a).

The best preserved gastropod specimens are illustrated herein (Figs. 2–38), with images obtained either with a Leica

auto-montage apparatus or with a scanning electron microscope (SEM) at the SMNS. Shell measurements were obtained with a digital caliper (for larger specimens) or with the software ImageJ (RASBAND 2012).

4. Discussion

In total, 35 gastropod species, belonging to the Neritimorpha, Caenogastropoda and Pulmonata, were found in museum collections with material from Dischingen (Table 1). The overall gastropod classification follows BOUCHET & ROCROI (2005), with more specific data on the European fossil snails being gathered from NORDSIECK (2014) and SALVADOR et al. (2016a). All these species are commonly found in coeval sediments from the Silvana Beds in southern Germany. Consequently, they have been extensively described and explored elsewhere (e.g., HARZHAUSER et al. 2014; SALVADOR et al. 2015, 2016b; SALVADOR & RASSER 2016) and we will thus refrain from giving a full description of the material here. The best preserved gastropod specimens from Dischingen are shown in Figs. 2 to 38.

Seven species are reported from Dischingen for the first time: *Palaina diezi*, *Radix socialis*, *Granaria* sp., *Serrulina*? sp., *Discus pleuradrus*, *Punctum pumilio*, and *Oxytoma minima*. From the species listed by JOOSS in MENGELE (1916), the following three could not be confirmed by the presently available material (Table 1): *Gastrocopta nouletiana*, *Janulus gyrorbis* (considered dubious by MANGANELLI et al. 2011), and *Pleurodiscoides orbicularis*.

The composition of the gastropod fauna from Dischingen is very similar to other OSM localities (e.g., SALVADOR et al. 2017; HÖLTKE et al. 2018). The continental

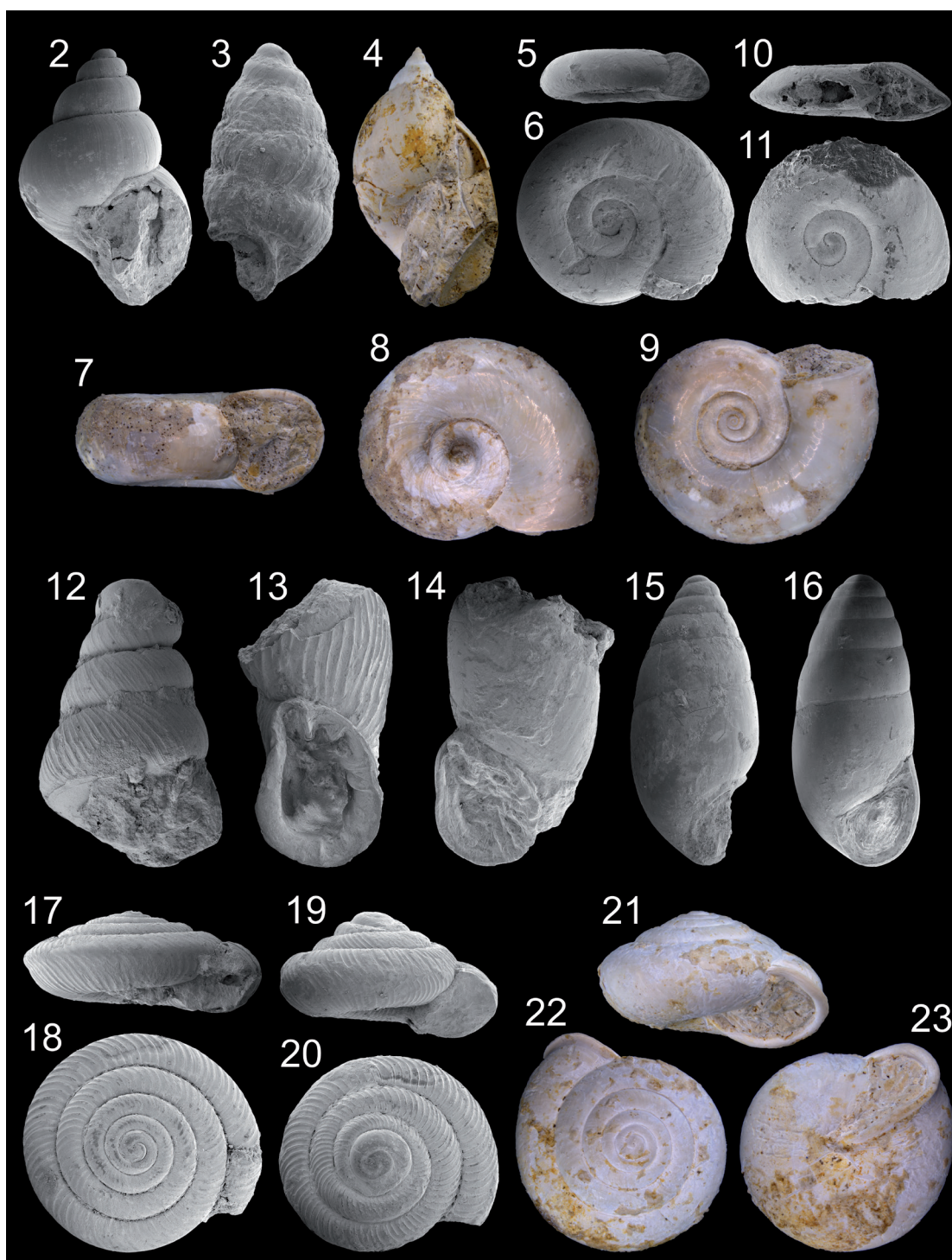
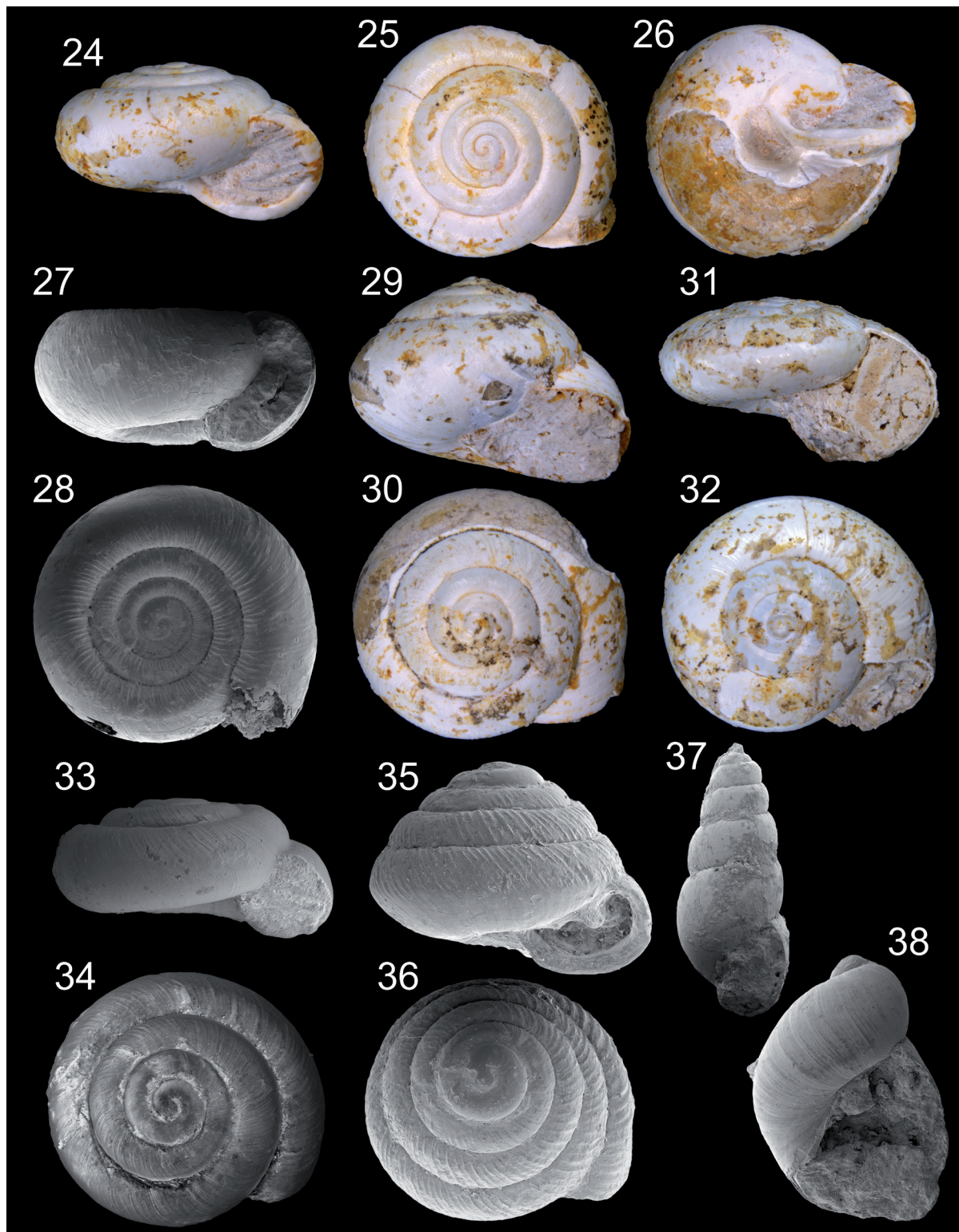


Fig. 2. *Bithynia glabra*, BSPG 1968 II 97 (H = 5.1 mm, D = 3.4 mm). **Fig. 3.** *Palaina dietzi*, SMNS 68553 (H = 2.3 mm, D = 1.3 mm). **Fig. 4.** *Lymnaea dilatata*, SMNS 67687 (H = 19.8 mm, D = 11.0 mm). **Fig. 5.** *Gyraulus applanatus*, SMNS 67783 specimen #1 (H = 1.0 mm, D = 3.0 mm). **Fig. 6.** *Gyraulus applanatus*, SMNS 67783 specimen #2 (D = 4.0 mm). **Figs. 7–9.** *Planorbarius mantelli* SMNS 67843 (H = 7.1 mm, D = 16.1 mm). **Figs. 10, 11.** *Segmentina lartetii*, BSPG 1968 II 92 (H = 0.5 mm, D = 1.7 mm). **Fig. 12.** *Granaria* sp., SMNS 67467 (H = 2.7 mm). **Fig. 13.** *Pseudidyla moersingensis*, SMNS 66936 (H = 3.9 mm). **Fig. 14.** *Serrulina?* sp., SMNS 66923 (H = 5.3 mm). **Fig. 15.** *Azeca lubricella*, BSPG 1968 II 84 (H = 4.6 mm, D = 2.0 mm). **Fig. 16.** *Hypnophila loxostoma*, SMNS 67252 (H = 5.1 mm, D = 2.2 mm). **Figs. 17, 18.** *Discus euglyphoides*, SMNS-65807 (H = 1.7 mm, D = 4.3 mm). **Figs. 19, 20.** *Discus pleuradrus*, SMNS 65830 (H = 2.1 mm, D = 3.8 mm). **Figs. 21–23.** *Apula coarctata*, SMNS 66293 (H = 6.9 mm, D = 11.5 mm).



Figs. 24–26. *Klikia giengensis*, SMNS 66279 (H = 5.4 mm, D = 9.0 mm). **Figs. 27, 28.** *Protodrepanostoma involutum*, SMNS 66009 (H = 2.6 mm, D = 5.0 mm). **Figs. 29, 30.** *Leucochroopsis kleinii*, SMNS 65950 (H = 6.1 mm, D = 9.0 mm). **Figs. 31, 32.** *Aegopinella subnitens*, SMNS 65691 (H = 7.3 mm, D = 12.8 mm). **Figs. 33, 34.** *Punctum pumilio*, syntype SMNS 106420 (H = 1.1 mm, D = 2.0 mm). **Figs. 35, 36.** *Strobilops costatus*, SMNS 68544 (H = 1.6 mm, D = 2.2 mm). **Fig. 37.** *Opeas minutum*, SMNS 67038 (H = 5.1 mm, D = 2.1 mm). **Fig. 38.** *Oxyloma minima*, SMNS 67067 (H = 2.6 mm, D = 1.9 mm).

gastropods have been constantly used as proxies for the paleoenvironment from an actualistic standpoint, i.e., using the knowledge of living congeners (see SALVADOR et al. 2015, 2016b, for a full analysis of OSM localities from Baden-Württemberg). As such, it can be surmised that the palaeoenvironment at Dischingen during the deposition of these sediments was likewise similar, consisting of humid forests and a well-vegetated low-energy water body (SALVADOR et al. 2015, 2016b, and references therein).

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Appendix – Material analyzed

Below is listed the material analyzed for producing the present compilation. The species are presented in the same order as in Table 1. An asterisk (*) after the lot's number indicates that it is a rock sample with several incrustated specimens.

Theodoxus crenulatus (KLEIN, 1853): BSPG 1968 II 98 (1 spec.).
Bithynia glabra (v. ZIETEN, 1832): BSPG 1968 II 97 (10 spec.).
Palaina dietzi (FLACH, 1890): SMNS 68553 (1 spec.).
Pomatias conicus (KLEIN, 1853): BSPG 1968 II 94 (6 spec.), BSPG 1968 II 96 (~15 spec.), BSPG 1968 II 102 (1 spec.), GPIT/GA/3920 (6 spec.).
Pomatias consobrinus (SANDBERGER, 1872): GPIT/GA/3917 (17 spec.).
Pomatias sp. (operculum): BSPG 1968 II 95 (1 spec.).
Carychium sp.: SMNS 67175 (1 spec.).
Lymnaea dilatata NOULET, 1854: BSPG 1968 II 88 (3 spec.), BSPG 1968 II 89 (>10 spec.), BSPG 1968 II 90 (8 spec.), SMNS 67687 (1 spec.), SMNS 107260 (1 spec.).
Radix socialis (v. ZIETEN, 1832): BSPG 1968 II 89 (>10 spec.).
Ferrissia deperdita (DESMAREST, 1814): BSPG 1968 II 93 (1 spec.).
Gyraulus applanatus (THOMÄ, 1845): SMNS 67783 (2 spec.).
Planorbarius mantelli (DUNKER, 1848): BSPG 1968 II 91 (>50 spec.), GPIT/GA/2705 (2 spec.), GPIT/GA/2885*, SMNS 67843 (3 spec.).
Segmentina lartetii (NOULET, 1854): BSPG 1968 II 92 (1 spec.).
Granaria sp.: SMNS 67467 (1 spec.).
Pseudidyla moersingensis (O. BOETTGER, 1877): SMNS 66936 (1 spec.).
Serrulina? sp.: SMNS 66923 (1 spec.).
Azeca lubricella O. BOETTGER, 1870: BSPG 1968 II 84 (2 spec.).
Hypnophila loxostoma (KLEIN, 1853): SMNS 67252 (3 spec.).
Discus euglyphoides (SANDBERGER, 1872): BSPG 1968 II 74 (1 spec.), BSPG 1968 II 75 (3 spec.), SMNS 65087 (1 spec.).

Discus pleuradrus (BOURGUIGNAT, 1881): SMNS 65830 (1 spec.).
Apula coarctata (KLEIN, 1853): BSPG 1968 II 81 (>20 spec.), SMNS 66293 (2 spec.).
Klikia giengensis (KLEIN, 1846): BSPG 1968 II 80 (2 spec.), BSPG 1968 II 81 (>20 spec.), SMNS 66279 (16 spec.).
Triptychia kleini SCHNABEL, 2006: BSPG 1968 II 84 (2 spec.).
Gastrocopta acuminata (KLEIN, 1846): BSPG 1968 II 86 (2 spec.), SMNS 67426 (5 spec.).
Palaeotachea silvana (KLEIN, 1853): BSPG 1968 II 68 (5 spec.), BSPG 1968 II 69 (1 spec.), BSPG 1968 II 82 (1 spec.), BSPG 1968 II 83 (>40 spec.), SMNS 66656 (4 spec.), SMNS 66857 (2 spec.), SMNS 66875 (2 spec.).
Palaeotachea turonensis (DESHAYES, 1831): SMNS 66813 (3 spec.).
Pseudochloritis incrassata (KLEIN, 1853): BSPG 1968 II 78 (>30 spec.), BSPG 1968 II 79 (1 spec.), SMNS 66150 (3 spec.), SMNS 66214 (4 spec.).
Protodrepanostoma involutum (THOMÄ, 1845): BSPG 1968 II 77 (1 spec.), SMNS 66009 (2 spec.).
Leucochroopsis kleinii (KLEIN, 1846): BSPG 1968 II 61 (1 spec.), BSPG 1968 II 76 (~20 spec.), SMNS 65942 (1 spec.), SMNS 65950 (7 spec.).
Palaeoglandina gracilis (v. ZIETEN, 1832): BSPG 1968 II (1 spec.), BSPG 1968 II 85 (3 spec.).
Aegopinella subnitens (KLEIN, 1853): BSPG 1968 II 73 (4 spec.), SMNS 65676 (5 spec.), SMNS 65691 (1 spec.).
Punctum pumilio JOOSS, 1918: SMNS 106420 (2 spec., syntypes).
Strobilops costatus (CLESSIN, 1877): SMNS 68544 (1 spec.).
Opeas minutum (KLEIN, 1853): SMNS 67083 (1 spec.).
Oxyloma minima (KLEIN, 1853): SMNS 67067 (1 spec.).
Archaeozonites costatus SANDBERGER, 1872: BSPG 1968 II 67 (1 spec.), BSPG 1968 II 72 (9 spec.), GPIT/GA/4055 (1 spec.).

Table 1. Continental gastropods from Dischingen found in the present material, alongside the identifications by JOOSS *in MENGELE* (1916) and GALL (1971) as they appear in the original works (authorship was corrected when pertinent). Discrepancies in identification represent either our revision of their original material (partially housed in the SMNS and BSPG, respectively) or simple nomenclatural changes (*e.g.*, new generic allocations, name corrections, *nomina nova*) that have been published since then. Some species listed by Jooss could not be confirmed by the presently available material.

Present work	Jooss <i>in Mengele</i> (1916)	Gall (1971)
NERITIMORPHA		
NERITIDAE		
<i>Theodoxus crenulatus</i> (Klein, 1853)	—	<i>Theodoxus (Calvertia) crenulatus crenulatus</i> (Klein, 1853)
CAENOGASTROPODA		
BITHYNIIDAE		
<i>Bithynia glabra</i> (v. Zieten, 1832)	<i>Bythinia gracilis</i> Sandberger, 1872	<i>Bulimus glabrus glabrus</i> (v. Zieten, 1832)
DIPLOMMATINIDAE		
<i>Palaina diezi</i> (Flach, 1890)	—	—
POMATIIDAE		
<i>Pomatias conicus</i> (Klein, 1853)	<i>Tudora conica</i> (Klein, 1853)	<i>Tudorella conica conica</i> (Klein, 1853)
<i>Pomatias consobrinus</i> (Sandberger, 1872)	<i>Cyclostoma consobrium</i> [sic] (Sandberger, 1872)	<i>Pomatias consobrium</i> [sic] (Sandberger, 1872)
PULMONATA: ELLOBIOIDEA		
ELOBIIDAE		
<i>Carychium</i> sp.	—	—
PULMONATA: HYGROPHYLA		
LYMNAEIDAE		
<i>Lymnaea dilatata</i> Noulet, 1854	<i>Lymnaeus dilatatus</i> Noulet, 1854; <i>Limnaeus turritus</i> Klein, 1853	<i>Radix (Radix) socialis dilatata</i> (Noulet, 1854); <i>Radix (Radix) socialis praelongata</i> (Gottschick & Wenz, 1916); <i>Limnaea turrita turrita</i> Klein, 1853
<i>Radix socialis</i> (v. Zieten, 1832)	—	—
PLANORBIDAE		
<i>Ferrissia deperdita</i> (Desmarest, 1814)	—	<i>Ancylus deperditus deperditus</i> (Desmarest, 1814)
<i>Gyraulus applanatus</i> (Thomä, 1845)	<i>Planorbis (Gyrorbis) declivis</i> Braun, 1851	—
<i>Planorbarius mantelli</i> (Dunker, 1848)	<i>Planorbarius cornu mantelli</i> (Dunker, 1848)	<i>Planorbarius cornu mantelli</i> (Dunker, 1848)
<i>Segmentina lartetii</i> (Noulet, 1854)	<i>Planorbis (Segmentina) lartetii</i> Noulet, 1854	<i>Segmentina (Segmentina) lartetii</i> (Noulet, 1854)
PULMONATA: STYLOMMATOPHORA		
CHONDRINIDAE		
<i>Granaria</i> sp.	—	—
CLAUSILIIDAE		
<i>Pseudidyla moersingensis</i> (O. Boettger, 1877)	<i>Pseudidyla moersingensis</i> (O. Boettger, 1877)	—
<i>Serrulina?</i> sp.	—	—

Present work	Jooss in Mengele (1916)	Gall (1971)
COCHLICOPIDAE		
<i>Azeca lubricella</i> O. Boettger, 1870	<i>Cochlicopa lubricella</i> (O. Boettger, 1870)	<i>Azeca (Azeca) lubricella lubricella</i> O. Boettger, 1870
<i>Hypnophila loxostoma</i> (Klein, 1853)	<i>Azeca loxostoma</i> (Klein, 1853)	<i>Cochlicopa subrimata loxostoma</i> (Klein, 1853)
DISCIDAE		
<i>Discus euglyphoides</i> (Sandberger, 1872)	<i>Patula (Charopa) euglyphoides</i> Sandberger, 1972; <i>Janulus supracostatus</i> (Sandberger, 1872)	<i>Discus euglyphoides euglyphoides</i> (Sandberger, 1872); <i>Janulus supracostatus</i> (Sandberger, 1872)
<i>Discus pleuradrus</i> (Bourguignat, 1881)	—	—
ELONIDAE		
<i>Apula coarctata</i> (Klein, 1853)	<i>Klikia coarctata</i> (Klein, 1853)	<i>Klikia (Apula) cf. coarctata</i> (Klein, 1853)
<i>Klikia giengensis</i> (Klein, 1846)	<i>Klikia osculum giengensis</i> (Klein, 1846)	<i>Klikia (Klikia) giengensis giengensis</i> (Klein, 1846)
FILHOLIIDAE		
<i>Triptychia kleini</i> Schnabel, 2006	<i>Triptychia (Clausilia) grandis</i> (Klein, 1846)	<i>Triptychia (Triptychia) grandis</i> (Klein, 1846)
GASTROCOPTIDAE		
<i>Gastrocopta acuminata</i> (Klein, 1846)	<i>Pupa (Leucochilus) quadriplicatum quadridentatum</i> Klein, 1853	<i>Gastrocopta (Albinula) acuminata acuminata</i> (Klein, 1846)
—	<i>Pupa (Leucochilus) neuletianum</i> [sic] <i>gracilidens</i> Sandberger, 1875	—
GASTRODONTIDAE		
—	<i>Patula (Janulus) gyrorbis</i> (Klein, 1846)	—
HELICIDAE		
<i>Palaeotachea silvana</i> (Klein, 1853)	<i>Otala silvana</i> (Klein, 1853)	<i>Cepaea silvana silvana</i> (Klein, 1853); <i>Cepaea eversa larteti</i> (Boissy, 1839)
<i>Palaeotachea turonensis</i> (Deshayes, 1831)	—	<i>Cepaea cf. dentula</i> (Quenstedt, 1867)
<i>Pseudochloritis incrassata</i> (Klein, 1853)	<i>Pseudochloritis inflexa</i> C. Boettger, 1909	<i>Tropidomphalus (Pseudochloritis) incrassatus incrassatus</i> (Klein, 1853); <i>Tropidomphalus (Pseudochloritis) cf. zelli</i> (Kurr, 1856)
HELICODONTIDAE		
<i>Protodrepanostoma involutum</i> (Thomä, 1845)	<i>Helicodonta scabiosa</i> (Sandberger, 1875)	<i>Helicodonta (Helicodonta) involuta scabiosa</i> (Sandberger, 1875)
HYGROMIIDAE		
<i>Leucochroopsis kleinii</i> (Klein, 1846)	<i>Trichiopsis carinulata</i> (Klein, 1853)	<i>Leucochroopsis kleini kleini</i> [sic] (Klein, 1846)
OLEACINIDAE		
<i>Palaeoglandina gracilis</i> (v. Zieten, 1832)	—	<i>Palaeoglandina gracilis porrecta</i> (Gobanz, 1852)
OXYCHILIDAE		
<i>Aegopinella subnitens</i> (Klein, 1853)	—	<i>Oxychilus subnitens subnitens</i> (Klein, 1853); <i>Vitrina cf. suevicus</i> (Sandberger, 1875)

Present work	Jooss <i>in</i> Mengele (1916)	Gall (1971)
PLEURODISCIDAE		
—	<i>Hyalina orbicularis</i> (Klein, 1846)	—
PUNCTIDAE		
<i>Punctum pumilio</i> Jooss, 1918	—	—
STROBILOPSIDAE		
<i>Strobilops costatus</i> (Clessin, 1877)	<i>Strobilus costatus</i> Clessin, 1877	—
SUBULINIDAE		
<i>Opeas minutum</i> (Klein, 1853)	<i>Subulina minuta</i> (Klein, 1853)	—
SUCCINEIDAE		
<i>Oxyloma minima</i> (Klein, 1853)	—	—
ZONITIDAE		
<i>Archaeozonites costatus</i> Sandberger, 1872	<i>Archaeozonites costatus</i> Sandberger, 1872	<i>Archaeozonites costatus</i> Sandberger, 1872