Lithological section and biostratigraphy of the Gosheim Formation in its type area (Lower Bajocian, Swabian Alb, SW Germany)

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Abstract

A temporary section of the Lower Bajocian in the vicinity of Gosheim (W Swabian Alb, Germany) exposed the higher part of the ferruginous Humphriesioolith and the marly Blagdenischichten. The Humphriesioolith Member at the base and the overlying Blagdenischichten Member are combined in the herein newly introduced Gosheim Formation. Biostratigraphically, the section studied ranges from the Romani up to the Blagdeni subzones of the Humphriesianum Zone. Within this section we analyzed the ammonite faunas and recognized one ammonite faunal horizon of the Romani Subzone (*romani* horizon), three faunal horizons of the Humphriesianum Subzone (*gervillii/cycloides*, *mutabile*, and *umbilicum* horizons) and a further, still unnamed horizon at the base of the Blagdeni Subzone.

Key words: Humphriesianum Zone, ammonite faunal horizon, SW Germany, Bajocian, correlation.

1. Introduction

The village Gosheim and its surroundings are well known for ammonites and many other invertebrate fossils from the Bajocian "Humphriesi-Oolith". Hugo Fischer, a high school teacher and amateur palaeontologist from Rottweil, was the first who published detailed sections and lists of fossils from these beds (Fischer 1912, 1924). Later, in his revision of the ammonite genus *Stephanoceras*, Weisert (1932) illustrated several specimens from there. He described the "Humphriesi-Oolith" section at the "Autunnel", a tunnel, which was temporarily opened during the construction of the meanwhile deconstructed railway. Dietl (1977, fig. 10) took these written data for an illustration of the section. Subsequently, Dietl (1978) studied the boundary beds between the "Braunjura γ" and "Braunjura δ" units and therein focussed on the basal parts of the "Humphriesi-Oolith". From this lower part of the "Humphriesi-Oolith" Dietze et al. (2008) newly introduced the ammonite faunal horizon of *Stephanoceras macrum*. The latter authors already stated that remarkable lithological changes might appear over very short distances. Dietl & Rieber (1980, figs. 2–3) and Ohmert (1990, fig. 7) provided some additional sections of the "Humphriesi-Oolith" from Gosheim.

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2. Material

In 2009, we noticed a fresh road-cut made for a new parking place within the industrial zone "Am Sturmbühl", only few hundreds of metres north of the centre of the village Gosheim (Figs. 1, 3). There, the topmost 3.5 m of the "Humphriesioolith" and ca. 2 m of the above following Blagdenischichten (Fig. 2) were exposed for several weeks. During that time, we collected ammonites bed-by-bed and documented a detailed profile. The ammonite preservation of this outcrop was not perfect because of occasional transport or reworking processes prior to the final burial of the specimens and because of the strong weathering of these beds located near the top of the present landscape. The illustrated specimens and a few further reference specimens were donated to the Staatliches Museum für Naturkunde in Stuttgart (acronym: SMNS). Specimens coming from other localities than those from the "Sturmbühl" section are emphasized in the text and figure captions.

3. Lithological succession

Remarks. – For the beds lying between the "Blaukalk" and the "Subfurcatenoolith", starting with the Humphriesioolith at the base both in the south-western part of the Swabian Alb and in the Upper Rhine Valley area the lithostratigraphic term "Humphriesioolith-Formation" was first introduced in the "Stratigraphical Table of Germany 2002" ("STD 2002") and subsequently described by Bloos et al. (2005). Therein, the term "Humphriesi-Oolith" itself, which was frequently used in literature, was replaced by "Gosheim-Subformation" (=Gosheim Member in English usage). Since this new term did not fit well with the recommendations for lithostratigraphical nomenclature (STEININGER & PILLER 1999: 8), we here formally introduce the new term Gosheim Formation, which was ratified by the voting members of the German Jurassic Subcommission during the preparation of this study. The ferruginous oolite at the base of this Gosheim Formation is now termed as 'Humphriesioolith Member' (or Humphriesioolith [-Subformation] in German usage) as it was practice until 2002. The upper member of the Gosheim Formation, which consists of an alternating succession of light clayey marlstones and dark marly claystones, is represented by the 'Blagdenischichten Member' (or Blagdenischichten [-Subformation] in German usage).

Near the village of Gosheim, the ferruginous "Humphriesi-Oolith" directly overlies the "Oberer Blaukalk" bed (DIETL 1977, 1978). Its total thickness is ca. 6.5–7.5 m (WEISERT 1932; DIETL 1977, 1978; DIETL & RIEBER 1980; OHMERT 1990). Lithological details and thicknesses of various beds within the sections of the "Humphriesi-Oolith" around Gosheim change over short distances. This variation hampers a precise correlation of the sections. Some beds show different thicknesses, whereas others appear only in lenses and fade out. This is why other sections may differ in some lithological details and in the abundance of ammonites from the herein described one. In the "Sturmbühl" section, especially the beds of the *gervillii/cycloides* horizon are well developed and rich in fossils. In the section described by OHMERT (1990, fig. 7) the beds following above the *gervillii/cycloides* horizon are remarkably thinner than in the "Sturmbühl" section. The beds below that horizon differ by another succession and order of clayey marls and marly limestones.

In the following, we describe the "Sturmbühl" section from the base to the top, in ascending order of bed numbers. We determined our ammonite finds in a purely

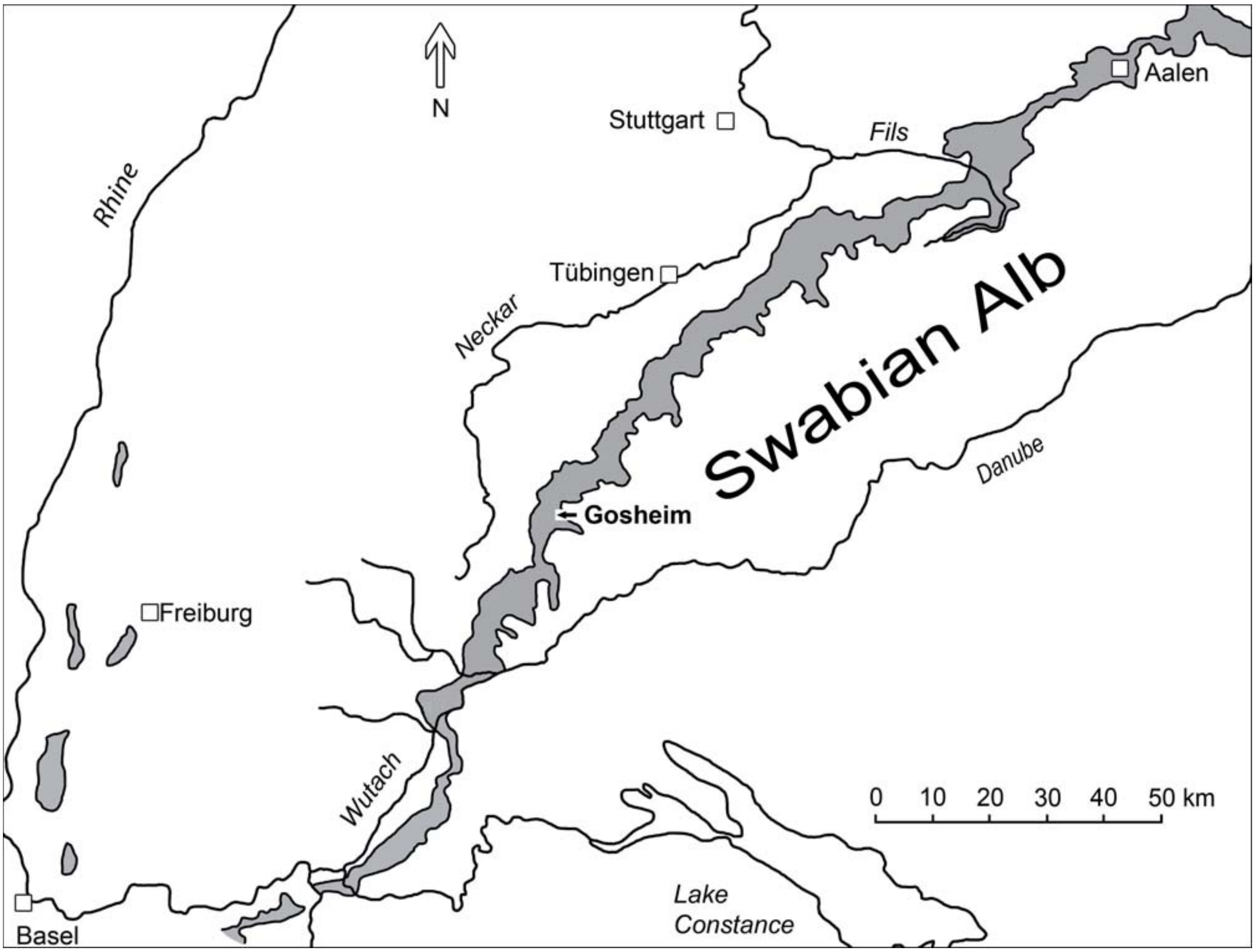


Fig. 1. Middle Jurassic beds in SW Germany. The location Gosheim in the western part of the Swabian Alb is indicated by an arrow.

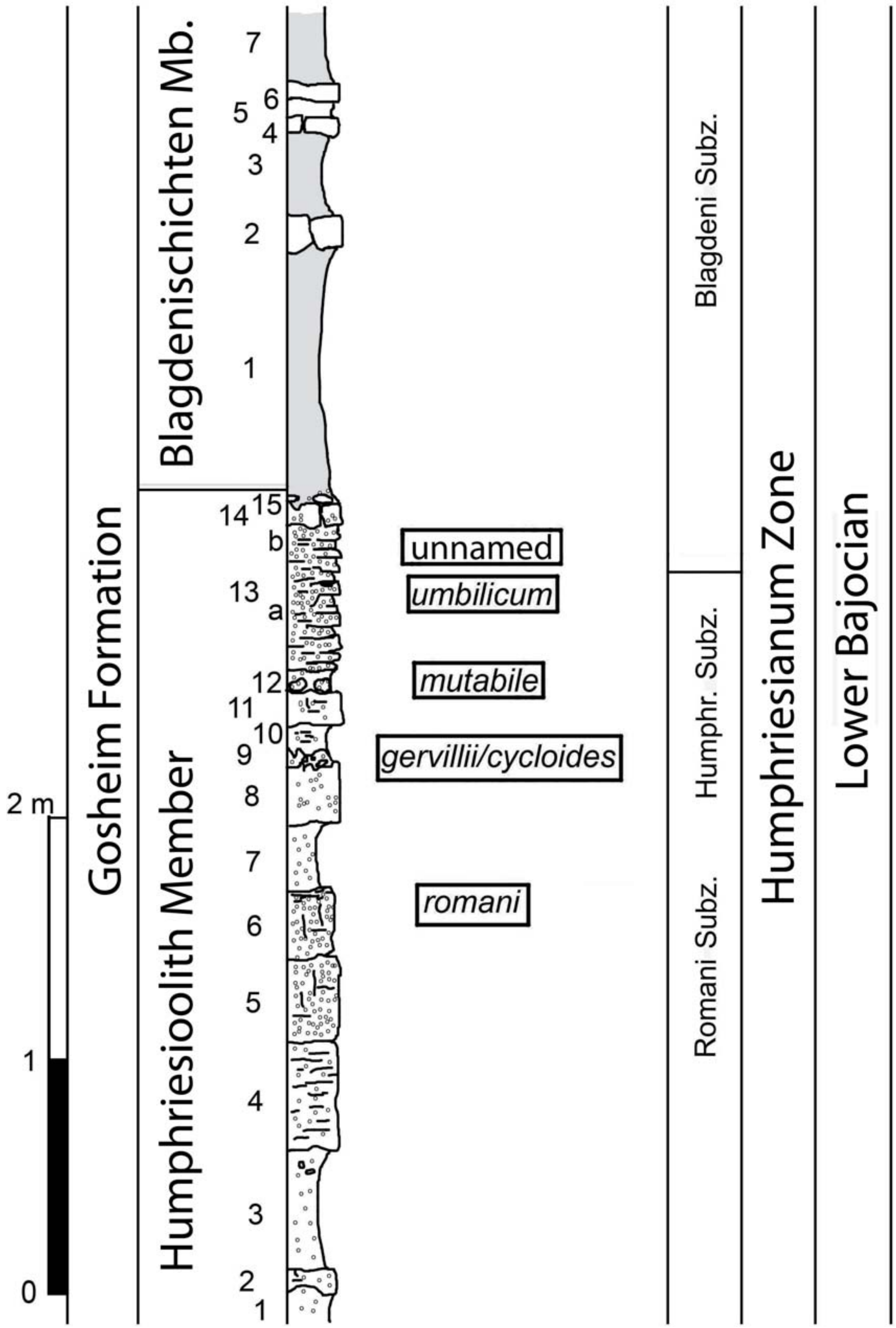


Fig. 2. The higher part of the Gosheim Formation (upper parts of Humphriesioolith Member and basal parts of the Blagdenischichten) in the "Sturmbühl" secion at Gosheim.

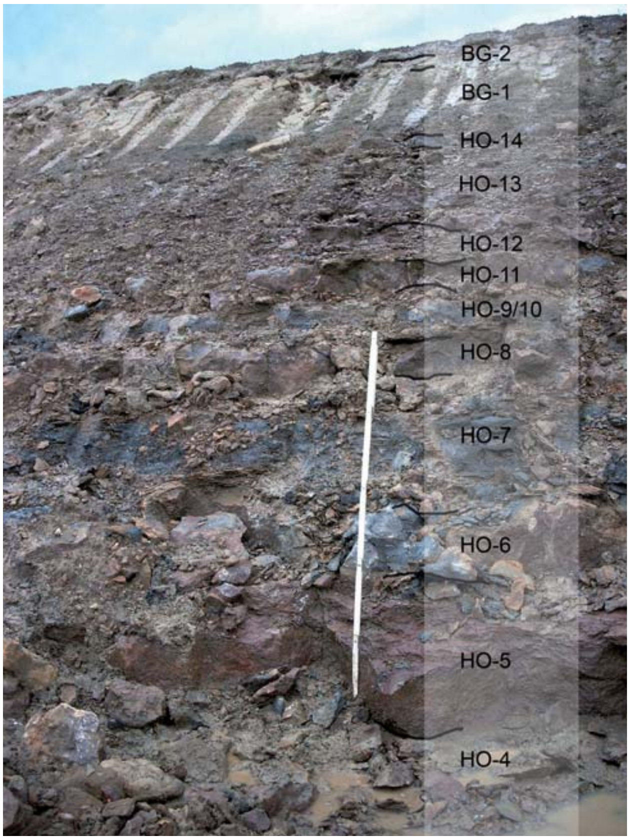


Fig. 3. Outcrop in the "Schörzinger Weg" showing the temporarily exposed "Sturmbühl" section in 2009. Due to the inclination of the ramp, the higher parts of the section appear to be somewhat reduced in their thickness.

morphospecific manner. Therefore, the number of taxa mentioned as collected from the same bed does not necessarily reflect the real palaeo-biodiversity.

3.3. Gosheim Formation

- Humphriesioolith Member (="Humphriesi-Oolith" in older literature), 3.5 m of the upper part.

Calcareous marlstone bed [HO-1] (0.1 m exposed; dark grey, ferruginous ooids).

Limestone bed [HO-2] (ca. 0.1 m: grey, with echinoderm debris and small brown ferruginous ooids, like in the marlstone above; large epibenthic bivalves with calcitic shells).

Calcareous marlstone bed [HO-3] (ca. 0.5 m: grey, with small ferruginous ooids; in the upper part occasionally with calcareous concretions; infaunal bivalves: *Pholadomya*).

Calcareous marlstone bed [HO-4] (0.4–0.5 m: grey-brownish, weathering in irregular lenses; oolitic, with brown ferruginous ooids; ammonite fragment at its base):

Dorsetensia tecta Buckman [M] [Pl. 1, Figs. 1–2]

Calcareous marlstone bed [HO-5] (0.3–0.4 m: deeply red in colour, finely oolitic, hard. With brachiopods and belemnites.

Limestone bed [HO-6] (0.25–0.3 m: grey-bluish, hard, and finely oolitic; with coarse fragments of bivalve shells (occasionally only the topmost 0.2 m of the bed shows this lithology). At the base [0.05–0.1 m] a finely ferruginous oolite occurs, like in the limestone bed below. In the top, a platy bed with reworked ammonites).

Dorsetensia romani (Oppel) [Pl. 1, Figs. 3–6]

Marly clay bed [HO-7] (ca. 0.25–0.3 m: grey, with abundant echinoid spines of *Rhabdocidaris* sp.).

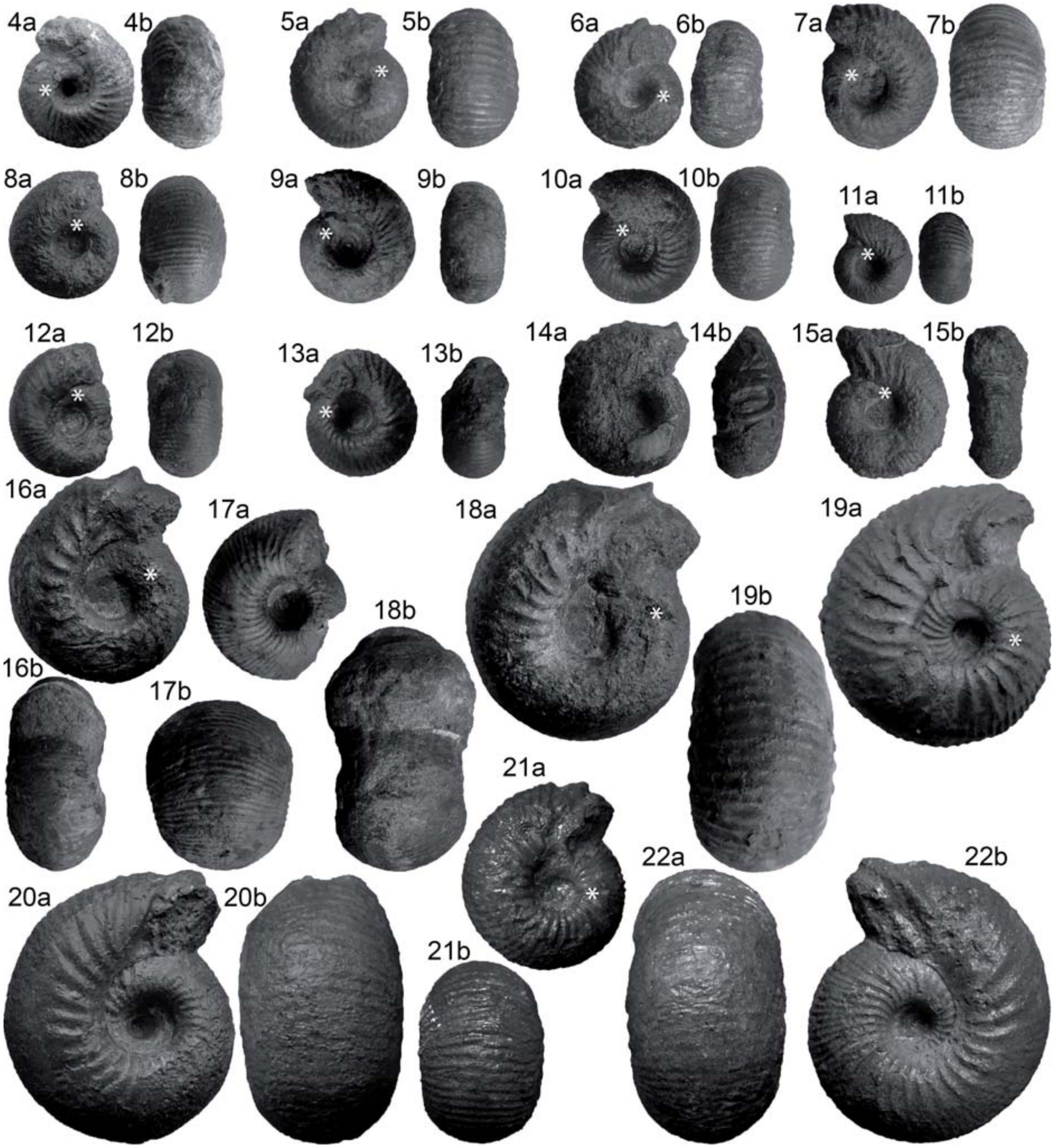
Calcareous marlstone bed [HO-8] (0.2–0.3 m: brownish-yellow, fresh bluish, hard, with cloudy dispersed ferruginous ooids).

Calcareous marlstone bed [HO-9] (0.02–0.1 m: partly with calcareous nodules which are lithified at their bases and cemented onto the bed below; partly reddish and strongly oolitic, but mostly grey with few ferruginous ooids; numerous epibenthic bivalves, especially *Oxytoma inaequivalvis* (Sowerby), *Modiolus* sp.), calcareous sponges and larger driftwood; ammonites rather common, especially *Chondroceras*).

Poecilomorphus cycloides (Orbigny) [Pl. 3, Figs. 1–2, 8–9]
Chondroceras evolescens (Waagen) [Fig. 19]
C. densicostatum Westermann [Fig. 17]
C. delphinus Buckman [Fig. 18]
C. polypleurum Westermann [Fig. 16]
C. minor Westermann [Fig. 4]
C. crassicostatum Westermann [Figs. 5–7]
C. gerzense Westermann [Fig. 8]
C. arkelli Westermann [Figs. 9–10]
C. multicostatum Westermann [Figs. 11–12]
C. crassum Westermann [Fig. 13]
C. schmidti Westermann [Fig. 14]
Stephanoceras subzieteni Schmidtill & Krumbeck [Pl. 2, Figs. 4, 6; Pl. 3, Figs. 5–6; Pl. 5, Figs. 3, 5–7]
S. cf. *subzieteni* Schmidtill & Krumbeck [Pl. 4, Fig. 7]
S. zogenreuthense Schmidtill & Krumbeck [Pl. 4, Figs. 1–2]
S. mutabile (Quenstedt) [Pl. 2, Figs. 1, 5; Pl. 4, Fig. 10]
?*Teloceras* sp. [Pl. 5, Figs. 1–2, 4]
Itinsaites variecostatus Westermann [Pl. 4, Figs. 9, 12]
I. latansatus (Buckman) [Pl. 2, Fig. 7]
I. prorectus Westermann [Pl. 4, Figs. 5–6, 8, 11]
I. vulgaricostatus (Westermann) [Pl. 2, Figs. 2–3]
Strigoceras bessinum Brasil [Pl. 3, Figs. 10–11]

Clayey marlstone bed [HO-10] (0.15–0.2 m: basal 0.1 m grey-bluish, with ferruginous oolitic clouds; bivalves and ammonites compressed; uppermost 0.05 m of the bed brownish, silty, laminated, with a specimen of *Stephanoceras*).

Chondroceras schmidti Westermann
C. crassicostatum Westermann



Figs. 4–22. *Chondroceras* spp. from the Gosheim Formation, Humphriesioolith Member, *gervillii/cycloides* horizon of Gosheim; Lower Bajocian Humphriesianum Zone and Subzone. **4–18**: "Sturmbühl" section. **4–14, 16–18**: bed HO-9. (**4)** *Chondroceras minor* Westermann, SMNS 70282/1; (**5–7)** *Chondroceras crassicostatum* Westermann, **5**. SMNS 70282/2, **6**. SMNS 70282/3, **7**. SMNS 70282/4; (**8)** *Chondroceras gerzense* Westermann, SMNS 70282/5; (**9–10)** *Chondroceras arkelli* Westermann, **9**. SMNS 70282/6, **10**. SMNS 70282/7; (**11–12)** *Chondroceras multicostatum* Westermann, **11**. SMNS 70282/8, **12**. SMNS 70282/9; (**13)** *Chondroceras crassum* Westermann, SMNS 70282/10; (**14)** *Chondroceras schmidti* Westermann, SMNS 70282/11; (**15)** *Chondroceras tenue* Westermann, bed HO-10, SMNS 70282/12; (**16)** *Chondroceras polypleurum* Westermann, SMNS 70282/13; (**17)** *C. densicostatum* Westermann, SMNS 70282/14, (**18)** *Chondroceras delphinus* Buckman, SMNS 70282/15; (**19)** *Chondroceras evolescens* (Waagen), Denkinger Steige, SMNS 70282/16 [leg. K-H. Spieth], **(20)** *Chondroceras densicostatum* Westermann, Gosheim, most likely from the *gervillii/cycloides* horizon, SMNS 70282/17 [leg. K. Biller], (**21)** *Chondroceras gervillii* (Sowerby), Gosheim, most likely from the *gervillii/cycloides* horizon, SMNS 70282/18 [leg. K. Biller], **(22)** *Chondroceras densicostatum* Westermann, Gosheim, most likely from the *gervillii/cycloides* horizon, SMNS 70282/19 [leg. K. Biller]. All ammonites in natural size. Beginning of the body-chamber is indicated by an asterisk.

C. tenue WESTERMANN [Fig. 15]
C. arkelli WESTERMANN
Phaulostephanus paululus BUCKMAN [Pl. 4, Figs. 3–4]
Stephanoceras spp.
Itinsaites spp.

Calcareous marlstone bed [HO-11] (0.1–0.15 m: similar to bed HO-8, ochre-coloured, partly grey, spotted, with few cloudy dispersed ferruginous ooids; *Stephanoceras*).

Marlstone bed [HO-12] (0.08–0.1 m): more yellowish than the subsequent deeply red bed; partly developed as a calcareous marl bed containing relatively broad stephanoceratids; in one place there was another ferruginous oolitic bed with a thickness of 0.05–0.1 m developed in the top containing numerous brachiopods)

Stephanoceras cf. *zieteni* (QUENSTEDT) [Pl. 7, Figs. 1–2]
S. brodiaei (SOWERBY) [Pl. 6, Figs. 3–4]
S. scalare WEISERT [Pl. 6, Figs. 1–2]
Itinsaites sp. [Pl. 7, Figs. 3–4]

Calcareous marlstone beds [HO-13] (ca. 0.4–0.8 m, thickness varies extremely over short distances; numerous thin, ferruginous oolitic beds of deeply red colour; each of them ca. 0.1 m thick and fading out laterally; partly grey-bluish, rich in fossils like large brachiopods, trigoniids and numerous stephanoceratids, especially in the middle part [=upper part of bed HO-13a]; fossils preserved with a typical yellowish surface. In the upper part of this bed or in lenses [bed HO-13b] an ammonite fauna occurs which is different from that of the middle part of this interval).

From bed 13a:

Stephanoceras mutabile (QUENSTEDT) [Pl. 9, Figs. 7–8]
S. umbilicum (QUENSTEDT) [Pl. 8, Figs. 5–6; Pl. 11, Figs. 1–4]
S. rectecostatum WEISERT [Pl. 8, Figs. 1–2; Pl. 10, Figs. 1–2; Pl. 11, Figs. 7, 10]
S. basilense MAUBEUGE [Pl. 11, Figs. 5–6, 12–13]
S. lohndorfense SCHMIDTILL & KRUMBECK [Pl. 10, Figs. 5–7]
S. cf. *lohndorfense* SCHMIDTILL & KRUMBECK [Pl. 8, Figs. 10–11; Pl. 10, Figs. 11–12]
S. zogenreuthense SCHMIDTILL & KRUMBECK [Pl. 10, Figs. 9–10]
S. aff. *zieteni* (QUENSTEDT) [Pl. 9, Figs. 1, 6]
?*Teloceras subcoronatum* (OPPEL) sensu WEISERT [Pl. 8, Figs. 3–4, 7, 13–14; Pl. 11, Figs. 17–18]
Calliphylloceras aff. *disputabile* (ZITTEL) [Pl. 11, Figs. 14, 19]
Itinsaites formosus (BUCKMAN) [Pl. 11, Figs. 11, 16]
I. prorectus WESTERMANN [Pl. 10, Figs. 3–4]
I. n. sp. b aff. *mackenzii* (MCLEARN) [sensu WESTERMANN 1954] [Pl. 9, Figs. 2–3; Pl. 10, Fig. 8]
I. gracilis WESTERMANN [Pl. 9, Figs. 4–5]
I. multicostatus (WESTERMANN) [Pl. 8, Fig. 8]
I. latansatus (BUCKMAN) [Pl. 8, Fig. 9]
I. crassicostatus (WESTERMANN) [Pl. 8, Fig. 12]
Oppelia subradiata (SOWERBY) [Pl. 11, Fig. 15]
O. pleurifera (BUCKMAN) [Pl. 11, Figs. 20–21]
Sphaeroceras brongniarti (SOWERBY) [Pl. 11, Figs. 8–9]

From bed 13b:

Teloceras (Paviceras) n. sp. [aff. *arietis* (MAUBEUGE)] [Taf. 12, Fig. 1–2]
T. latiumbilicatum SCHMIDTILL & KRUMBECK [Figs. 23–24]

Calcareous marlstone bed [HO-14] (0.1–0.15 m: spotted, grey or ochre- to umbra-coloured, with ferruginous oolitic clouds; sometimes with large epibenthic bivales *Ctenostreon* at the top).

Calcareous marlstone bed [HO-15] (0.05 m: platy, strongly weathered, slightly ferruginous oolitic, light brown to grey; directly following the bed below).

- Blagdenischichten Member (basal 2.0 m exposed)

Clayey marlstone bed [BS-1] (ca. 1.0 m; grey, with oysters (*Actinostreon*), belemnites (*Megateuthis*) und echinoid spines (*Rhabdocidaris* sp.).

Calcareous marlstone bed [BS-2] (0.15 m, fresh grey-brown in colour, weathered yellowish; *Teloceras* sp. [SMNS 70262/76]).

Clayey marlstone bed [BS-3] (0.3–0.35 m: same lithology as bed BS-1).

Calcareous marlstone bed [BS-4] (0.05–0.08 m: fresh greyish-brown in colour, weathered yellowish-brown).

Clayey marlstone bed [BS-5] (0.05 m: grey).

Calcareous marlstone bed [BS-6] (ca. 0.1 m: same lithology as bed BS-4].

4. Remarks on the ammonite fauna

Due to the biostratigraphical aspects of this study, we determined the ammonite specimens in a morphospecific manner. However, in some cases we will provide an outlook on a possible palaeobiological classification, which should be based on statistical grounds with larger samples from other areas.

4.1. Familiy Sonniniidae BUCKMAN, 1892

Sonniniids are only represented by a few specimens of the genera *Dorsetensia* BUCKMAN, 1892 and *Poecilomorphus* BUCKMAN, 1889. Further specimens lacking any detailed stratigraphic information, which were collected in the centre of the village or in the nearby "Hirnwiesen" locality (DIETZE et al. 2011a, pl. 2, figs. 13–14) indicate that ammonites of the genus *Dorsetensia* become significantly more common when larger outcrops are sampled. Specimens assigned to *Dorsetensia romani* [Pl. 1, Figs. 3–8] show the ventrolateral shoulder typical of this species (see OHMERT et al. 1995: 57–58).

Dorsetensia is the predominant ammonite genus within the beds containing this genus, as observed from other Jurassic areas in southern Germany (Upper Rhine Valley: OHMERT 1990; OHMERT et al. 1995; DIETZE et al.

2013; Middle Swabian Alb: OHMERT 1990; DIETZE et al. 2011a, b; Eastern Swabian Alb: unpublished material in coll. DIETZE). This composition points to very special palaeoecological conditions. In Southern England (CALLOMON & CHANDLER 1990) and in Normandy (GAUTHIER et al. 1996) approximately coeval beds are much more diverse in ammonite taxa even if condensation and reworking processes are considered (PAVIA et al. 2013).

We concur with OHMERT et al. (1995) in assuming a huge variation within *Poecilomorphus cycloides* (ORBIGNY, 1845) concerning whorl section, coiling and ribbing strength (Pl. 3, Figs. 1–2, 8–9). Another specimen from the *gervillii/cycloides* horizon (Pl. 3, Figs. 3–4) comes from the "Wassersteige", a road-cut along the street from Gosheim to Wilflingen, which is located only several hundreds of metres away from the "Sturmbühl" section.

4.2. Family Stephanoceratidae NEUMAYR, 1875

From the beds below HO-9 of the "Sturmbühl" section stephanoceratids are only represented by several loosely collected specimens. The stratigraphically oldest specimens come from HO-9 and HO-10. A specimen of *Phaulostephanus paululus* BUCKMAN (Pl. 4, Figs. 3–4) is slightly pathologic but still identifiable. FERNÁNDEZ-LÓPEZ & PAVIA (in press) introduced a new subfamily Mollistephaninae for this phyletic branch of small-sized stephanoceratids.

Stephanoceras subzieteni SCHMIDTILL & KRUMBECK (Pl. 2, Figs. 4, 6; Pl. 3, Figs. 5–6; Pl. 5, Figs. 3, 5–7) is very typical of bed HO-9 in Gosheim. The latter species is characterized by its large size, its rounded whorls section and evolute coiling and especially by its ribbing style. The sharp distant and radially arranged primary ribs usually diverge into two secondaries. After a weak node at the diverging point, the secondaries bend forward for a short distance and then swing back radially towards the venter. Despite the numerous secondaries the ribbing style appears to be rather coarse. The loosely collected specimen illustrated on Pl. 5, Fig. 3 exhibits coronate inner whorls as in the holotype of this taxon. In our view, this important character points to a close relationship to the extremely evolute genus *Skirroceras* MASCKE. Another very evolute, weakly sculptured specimen is determined here as *Stephanoceras* cf. *subzieteni* (Pl. 4, Fig. 7). *Stephanoceras mutabile* (QUENSTEDT) (Pl. 2, Figs. 1, 5; Pl. 4, Fig. 10) exhibits a similar ribbing style; however, it differs from *Stephanoceras subzieteni* by a significantly more involute coiling and a broad-oval whorl section already in the phragmocone. The umbilical wall is steeper and not curved as in *S. subzieteni*; the whorl section looks more edged. In the larger one of the illustrated specimens and in the lectotype re-illustrated in DIETZE 2010, pl. 2, figs. 1–3, 6) the uncoiling of the bodychamber is evident, and therefore more completely preserved specimens show a much more evolute habit (e.g., OHMERT et al. 1995, pl. 16, fig. 3). A weakly ribbed mould with a broad-oval whorl section (Pl. 4, Figs. 1–2) is determined as *Stephanoceras zogenreuthense* SCHMIDTILL & KRUMBECK. Corresponding microconchs are very similar to those described as *Stephanoceras (S.) humphriesianum* [m] by OHMERT et al. (1995, pl. 15, figs. 2–3) from the *gervillii* horizon of Lörrach. Our specimens show some variation in their whorl sections and umbilical widths but they all share their ribbing style and a rounded venter. Our specimens are assigned to *Itinsaites variecostatus* WESTERMANN (Pl. 4, Figs. 9, 12), *Itinsaites latansatus* (BUCKMAN) (Pl. 2, Fig. 7), *Itinsaites prorectus* WESTERMANN (Pl. 4, Figs. 5–6, 8, 11), and *Itinsaites vulgaricostatus* (WESTERMANN) (Pl. 2, Figs. 2–3).

Only three macroconchiate stephanoceratids are recorded from bed HO-12. The slightly weathered *Stephanoceras scalare* WEISERT (Pl. 6, Figs. 1–2) fits well with the holotype of this taxon (re-illustrated in DIETZE 2010, pl. 3, figs. 1–2). Our sole specimen of *Stephanoceras brodiaei* (SOWERBY) (Pl. 6, Figs. 3–4) is very similar to a specimen illustrated from Lörrach (see OHMERT et al. 1995, pl. 21, fig. 1). The specimen from Gosheim differs from the holotype of this species only in its elongate, but not drop-shaped nodes on the diverging points of the ribs. *Stephanoceras* cf. *zieteni* (QUENSTEDT) (Pl. 7, Figs. 1–2) is quite similar to *Stephanoceras subzieteni* from the slightly older bed HO-9. However, it differs from the holotype of *Stephanoceras zieteni* (re-illustrated in SCHLEGELMILCH 1985, pl. 22, fig. 2) in its slightly longer and denser-spaced primary ribs. A strongly compressed specimen of *Itinsaites* sp. (Pl. 7, Figs. 3–4) exhibits a coronate nucleus and therefore most likely represents the microconchiate counterpart of *Stephanoceras brodiaei* (see OHMERT et al. 1995, pl. 21, fig. 2).

In bed HO-13a of the Humphriesi-Oolith at Gosheim stephanoceratids are by far the most common ammonites. The same was true for the "Sturmbühl" section; however, the circumstances for sampling and the preservation of these fossils were not optimal there. For that reason we here describe additional specimens from the same bed (HO-13a) coming from another temporary outcrop in the south of Gosheim (Hermle factory), close to the road to Böttingen. The biggest and most complete specimen (Pl. 9, Figs. 1, 6) is still very close to *Stephanoceras zieteni*, which is why we determined that specimen in open nomenclature as *Stephanoceras* aff. *zieteni* (QUENSTEDT). It differs from the holotype in its more involute coiling and in a deeper umbilicus. On both flanks, there is a ribbing pathology resulting in more prorsiradiate secondaries, but otherwise the ribbing fits well with that in *S. zieteni*. At least one third of the bodychamber is missing in this specimen. Most of the specimens under study are lacking their bodychamber, which results in a compact habit of the illustrated specimens. The illustrated specimen of *Stephanoceras mutabile* (Quenstedt) (Pl. 9, Figs. 7–8) is closest to the lectotype of this taxon. Like in the latter, it is preserved with the attachment line of the uncoiling body-chamber. *Stephanoceras rectecostatum* Weisert (Pl. 8, Figs. 1–2; Pl. 10, Figs. 1–2; Pl. 11, Figs. 7, 10) is very similar to *Stephanoceras mutabile*, only the primary ribs are longer in the inner whorls of *Stephanoceras rectecostatum* due to a more evolute coiling. In *Stephanoceras mutabile* the maximum width is located slightly lower on the flanks as in *S. rectecostatum*. *Kreterosphinctes kreter* Buckman is morphologically close to *Stephanoceras mutabile* as well. We assigned denser ribbed forms somewhat resembling the genus *Cadomites* to *Stephanoceras lohndorfense* Schmidtill & Krumbeck (Pl. 8, Figs. 10–11; Pl. 10, Figs. 5–7) and included a remarkably involute, weakly ribbed specimen (Pl. 10, Figs. 9–10) in *Stephanoceras zogenreuthense* Schmidtill & Krumbeck. The latter exhibits the slightly kinking secondaries of the aforementioned taxa. Because of its very steep and partly even overhanging umbilical wall, it is transitional to the broadest species occurring within these beds, *Stephanoceras umbilicum* (Quenstedt). The latter exhibits secondaries, which are more radially arranged. The illustrated specimens of *Stephanoceras umbilicum* (Quenstedt), all of them preserved with their calcified shell (Pl. 8, Figs. 5–6; Pl. 11, Figs. 1–4), fit well with moulds of this species from the type locality Essingen (near Aalen, Eastern Swabian Alb) including the lectotype (see Dietze 2010, pl. 1, figs. 1–8). *Stephanoceras basilense* Maubeuge (Pl. 11, Figs. 12–13) differs from *Stephanoceras umbilicum* only in a more trapezoidal whorl section. All specimens grade into each other and thus they could in fact represent a single chronospecies. After our study of the material from Gosheim we do no longer concur with the previous view of Ohmert et al. (1995), who interpreted *Stephanoceras umbilicum* as belonging to a different phyletic lineage than *Stephanoceras mutabile*, since well-preserved specimens of *Stephanoceras umbilicum* in shell preservation exhibit nodes at the diverging points of the ribs. Some of the illustrated specimens (Pl. 8, Figs. 3–4, 7, 13–14; Pl. 11, Figs. 17–18) and a further one of still bigger size in the private collection of Dietmar Schreiber (Dürbheim) exhibit all characters of the genus *Teloceras*. However, we here only tentatively assigned these specimens to that genus because of their incomplete preservation. Although these ammonites exhibit a more coronate whorl section and more widely spaced primary ribs than in *Stephanoceras umbilicum*, they may represent the extreme variation of the (palaeo-)biological species, which leads to the genus *Teloceras* sensu stricto via *Paviceras* (e.g. Pavia 1983, pl. 19, fig. 1, 5; pl. 21, figs. 3–5). The same must be said for specimens of ?*Teloceras subcoronatum* sensu Weisert (see Weisert 1932, pl. 18, figs. 6–7 from Gosheim and from nearby "Himmelberg" locality and from Lörrach (Ohmert et al. 1995, pl. 25, figs. 7–8). An assignment to the subgenus *Paviceras* Gauthier et al., 1996 is possible, but not verifiable. *Teloceras*-like morphologies of nuclei appear already in the *gervillii/cycloides* horizon (Pl. 5, Figs. 1–2, 4).

The microconch stephanoceratids from the *umbilicum* horizon are morphologically rather diverse and often show broad-oval whorl sections with a more rounded umbilical edge. The illustrated specimens are assigned to *Itinsaites multicostatus* (Westermann) (Pl. 8, Fig. 8), *Itinsaites latansatus* (Buckman) (Pl. 8, Fig. 9), *Itinsaites crassicostatus* (Westermann) (Pl. 8, Fig. 12), *Itinsaites prorectus* Westermann (Pl. 10, Figs. 3–4), *Itinsaites formosus* (Buckman) (Pl. 11, Figs. 11, 16), *Itinsaites* n. sp. b aff. *mackenzii* (McLearn) [sensu Westermann 1954] (Pl. 9, Figs. 2–3; Pl. 10, Fig. 8), and *Itinsaites gracilis* Westermann (Pl. 9, Figs. 4–5).

Only two specimens are recorded from bed HO-13b; however, these are of special interest. The specimen illustrated in Figs. 23–24 is closest to *Teloceras latiumbilicatum* Schmidtill & Krumbeck (1938, pl. 12, fig. 8). This specimen exhibits features of the genus *Teloceras*, but shows an extremely narrow whorl section. *Ammonites blagdeni* Orbigny non Sowerby is very close to our specimen as well (see Pavia 1983, fig. 29). In contrast, *Teloceras acuticostatum* Weisert exhibits a much broader whorl section. Fernández-López (1985, pl. 31, fig. 2) illustrated another comparable specimen from the Blagdeni Subzone of the Iberian Ranges as "*Teloceras* sp. nov. 2". Surprisingly, the paratype of "*Praegravesia*" *rolkei* Fischer & Zeiss, 1987 is almost identical with our specimen. In the holotype of the latter, the ribbing of the venter is pathologic. Fischer & Zeiss (1987) interpreted their two specimens as coming from the Upper Jurassic (Mid-Kimmeridgian) in the surroundings of Wolfsburg (Lower Saxony). We concur with Schweigert (1999) and Scherzinger et al. (2006) that the specimens found in the hut of a quarry worker without any data about their provenience do not represent ancestors of the Late Jurassic genus *Gravesia* but are in fact Middle Jurassic stephanoceratids. They come either from the basal Blagdeni Subzone or from the Pinguis Subzone (*frechi* horizon) of a still unknown locality in Northern Germany or elsewhere. Due to these uncertainties in respect of the type locality and horizon, we do not use this taxon name for our material.

The second specimen, coming from bed HO-13b (Pl. 12, Figs. 1–2), is difficult to classify since a similarly coarse-ribbed and node-bearing specimen with a slender and rounded venter has never been named yet. The closest one appears to be "*Stephanoceras*" *arietis* Maubeuge, although the holotype of the latter shows a less rounded venter and it is said to come from beds older than the Romani Subzone of Halanzy (Belgium) (Maubeuge 1951). Similarities occur in specimens described from transitional

Figs. 23–24. *Teloceras latiumbilicatum* SCHMIDTILL & KRUMBECK, phragmocone lacking the bodychamber; Gosheim, "Sturmbühl" section, Gosheim Formation, Humphriesioolith Member, bed HO-13b¸ Lower Bajocian, Humphriesianum Zone, Blagdeni Subzone, unnamed horizon; SMNS 70282/20 [leg. D. SCHREIBER]. Natural size.

beds of the Humphriesianum and Blagdeni subzones in the French Sea Alps and from Normandy as *Teloceras* (PAVIA 1983), which were later included in the new subgenus *Paviceras* GAUTHIER et al., 1996. Phyletic relationships to *Stemmatoceras* must be taken into account, and the irregular ribbing of the venter in our specimen even reminds *Kumatostephanus* (CHANDLER et al. 2013). PAVIA (1983, pl. 17, fig. 2) illustrated a very similar specimen from the Romani Subzone of the French Sea Alps as *Kumatostephanus (Stemmatoceras)* sp., and the latter illustrated another well-comparable specimen from the Blagdeni Subzone (PAVIA 1983, pl. 21, fig. 3) as *Teloceras (*subgen.?*) subcoronatum* (OPPEL). Similar coarse-ribbed stephanoceratids with marked nodes and a rounded venter were illustrated from the Humphriesianum Subzone of Oborne (Dorset) as *Kumatostephanus triplicatus* (RENZ) (CHANDLER et al. 2013, fig. 8a–b), although the holotype of this taxon comes from the transition of the Laeviuscula and Sauzei zones in the Western Swabian Alb. Finally, *Teloceras (Paviceras) triptolemus* (BUCKMAN) shares some characters with our specimen, but it is much less strongly nodose. PAVIA (1983, pl. 20, fig. 2) illustrated a plaster cast of its holotype from Scarborough (N England). We here tentatively classified our specimen as *Teloceras (Paviceras)* n. sp. [aff. *arietis* (MAUBEUGE)]. These specimens and the single illustrated find of *Stephanoceras brodiaei* may belong to a separate evolutionary lineage, which possibly originates in the coarsely ribbed genus *Kumatostephanus.*

4.3. Family Sphaeroceratidae BUCKMAN, 1920

Chondroceras specimens preserved as internal moulds occur in a single faunal horizon, the *gervillii/cycloides* horizon at the base of the Humphriesianum Subzone. The genus *Chondroceras* has not been seriously revised since

WESTERMANN's (1956) monograph, despite his own taxonomic update (WESTERMANN 1964). Unfortunately, the PhD thesis of PARSONS (1980) including a thorough revision of the Sphaeroceratinae, is still unpublished. Therefore, literature data alone provide only numerous taxa of *Chondroceras*, which appear to be morphologically hardly distinguishable. The true biological relationships within this genus are still poorly understood due to the lacking of statistically relevant samples collected bed-by-bed, which would allow recognizing both variations within defined time-slices as well as evolution. Only the early sphaeroceratids up to the Sauzei Zone – the ammonite genera *Labyrinthoceras* and *Frogdenites* – have been recently revised on the basis of numerous well-stratified specimens from Spain and Southern England (SANDOVAL & CHANDLER 2014).

Our *Chondroceras* material presented here may serve as a first step for a later revision. Most specimens are relatively small-sized. Due to the egression of the bodychamber, which is present in almost all specimens, we interpret this material as adults, contrary to OHMERT et al. (1995: 180). The poor preservation of the apertures does not allow any recognition of possible sexual dimorphism. WESTERMANN (1956) introduced numerous morphospecies for such small-sized specimens and assigned them to the two subgenera *Chondroceras* and *Schmidtoceras*. We do not follow this separation, because WESTERMANN (1956, 1964) did not provide reasonable arguments for a morphological distinction between his two subgenera. OHMERT et al. (1995: 180) included the sphaeroconic morphologies in *Chondroceras* and the more evolute forms in *Schmidtoceras*, both as subgenera of *Chondroceras*. Most of the holotypes of the small-sized taxa are imprecisely collected specimens from the Gerzen clay-pit near Alfeld (Northern Germany). They mostly come from the upper part of the so-called *romani*-(*complanata*)Schichten II (WESTERMANN 1954; OHMERT 1990) (=Humphriesianum Zone in GERAGHTY & WESTERMANN 1994); that means from above the last acme of the genus *Dorsetensia*. Relatively sphaeroconic forms with a narrow umbilicus and a late egression of the bodychamber are assigned to *Chondroceras minor* WESTERMANN (Fig. 4). Slightly more evolute, but still broad forms belong to the morphospecies *Chondroceras crassicostatum* WESTERMANN (Figs. 5–7). A weaker ribbed form is *Chondroceras gerzense* WESTERMANN (Fig. 8). *Chondroceras arkelli* WESTERMANN (Figs. 9–10) resembles the latter but exhibits a slightly narrower whorl section. For densely ribbed forms WESTERMANN (1954) introduced *Chondroceras multicostatum* WESTERMANN (Figs. 11–12), and for coarser ribbed specimens *Chondroceras crassum* WESTERMANN (Fig. 13). For more evolute, coarse-ribbed forms we used the taxon *Chondroceras schmidti* WESTERMANN (Fig. 14). Extremely slender, evolute forms are included in *Chondroceras tenue* WESTERMANN (Fig. 15). According to our material most of the various evolute morphospecies seem to represent a single chronospecies. This is confirmed by their co-occurrence within isochronous concretions from Gerzen (coll. V.D, see below). Variation within such a chronospecies is rather high and concerns both whorl widths as well as strength of the ribbing. OHMERT et al. (1995) included the smaller-sized, evolute and relatively slender specimens from the *gervillii/cycloides* horizon of the Upper Rhine Graben area in *Sphaeroceras (Chondroceras) schmidti*. Only two weakly sculptured, not illustrated specimens were assigned with some reservation to *Sphaeroceras (Chondroceras) tenue*, one of them coming from the *umbilicum* horizon sensu OHMERT et al. (1995). One of us (V.D) purchased ammonite-bearing concretions from Gerzen, which are full of small-sized *Chondroceras* specimens. Within these concretions two types are distinguishable: one type contains exclusively evolute specimens of *Chondroceras* (*C. crassicostatum*, *C. gerzense*, *C. arkelli*, *C. multicostatum*, *C. crassum*, *C. schmidti*, *C. tenue* etc.) and lacks *Stephanoceras*, whereas the other type bears more involute and thicker specimens of *Chondroceras (C. minor, C. gervillii*, etc.) associated with stephanoceratids. Possibly these two types of concretions come from two different stratigraphic levels within the interval between -13.0 m ("Banike's concretion horizon" with *Stephanoceras mutabile* sensu GERAGHTY (GERAGHTY 1990; GERAGHTY & WESTERMANN 1994)) and -15.75 m (last common occurrence of *Dorsetensia*) (WESTERMANN 1954: 25).

Among the bigger specimens, we assigned one example showing a spherical whorl section (Fig. 21) to *Chondroceras gervillii* (SOWERBY). A loosely collected *Chondroceras evolescens* (WAAGEN) (Fig. 19) from the section along the road "Denkinger Steige" almost certainly comes from the *gervillii/cycloides* horizon. The amateur collector who was the finder reported that he collected ca. 15 specimens of *Chondroceras* of various sizes within a relatively short time. Such an abundance of *Chondroceras* only occurs within beds HO-9/10.

A remarkable dense-ribbed, evolute specimen from bed HO-9 of the "Sturmbühl" section (Fig. 17) is a nucleus of *Chondroceras densicostatum* WESTERMANN, as well as two complete but loosely collected specimens (Figs. 20, 22) from the centre of Gosheim purchased by the SMNS. The latter also must come from the *gervillii/cycloides* horizon, because they were accompanied by several specimens of *Stephanoceras subzieteni*, which is another taxon typical of this faunal horizon. WESTERMANN's assumption (1956) that *Chondroceras densicostatum* was rather small-sized is corroborated by our specimens. Even his own material (WESTERMANN 1956, pl. 3, figs. 5, 6) does not show any uncoiling of the bodychamber and thus it does not represent adults but only juvenile or incompletely preserved specimens. A specimen of the morphospecies *Chondroceras delphinus* BUCKMAN (Fig. 18) exhibits coarse primaries on its bodychamber, a "delphinate" mouth-border and a broad whorl section. A smaller specimen (Fig. 16) with a more slender whorl section but coarse primaries that persist until the peristome is here assigned to *Chondroceras polypleurum* WESTERMANN.

A sole specimen of *Sphaeroceras brongniarti* (J. SOWERBY) (Pl. 10, Figs. 8–9) was found during the extraction of rock material from bed HO-13.

4.4. Further ammonoid families

Family Phylloceratidae ZITTEL, 1884: From bed HO-13a (*umbilicum* horizon) we recorded a specimen of *Calliphylloceras* aff. *disputabile* (ZITTEL) (Pl. 11, Figs. 14, 19).

Family Strigoceratidae BUCKMAN, 1924: A poorly preserved *Strigoceras bessinum* BRASIL (Pl. 3, Figs. 10–11) is recorded from the *gervillii/cycloides* horizon. Concerning this genus, we concur with the specific concept of SCHWEIGERT et al. (2007).

Family Oppeliidae DOUVILLÉ, 1890: The generic assignment of phylogenetically early members of this family is somewhat chaotic and our two finds do not provide any key for resolving this confusion. The smaller one is assigned to *Oppelia subradiata* (SOWERBY) (Pl. 11, Fig. 15), whereas we determined the bigger one as *Oppelia pleurifera* (BUCKMAN) (Pl. 11, Figs. 20–21), taking into account its ribbing style. Although the holotype of the latter comes from the Parkinsoni Zone, our specimen is rather close except for its slightly wider umbilicus.

5. Bio-/chronostratigraphy and correlation of the Gosheim Formation

All beds exposed in the "Sturmbühl" section belong to the Humphriesianum Zone of the Lower Bajocian (Figs. 2, 25). The basal part of the Humphriesioolith Member yields ammonites of the genera *Emileia*, *Sonninia* and *Skirroceras* all of them indicative of the Sauzei Zone (WEISERT 1932; DIETL 1978; DIETL & RIEBER 1980; OHMERT 1990; coll. DIETZE); but the base of the Pinguis Subzone of the Humphriesianum Zone must be located somewhere below bed HO-1 in this section (OHMERT 1990, fig. 7).

Since we did not find any ammonites within the beds HO-1 to HO-3 it is not clear whether these beds still belong to the Pinguis or to the Romani subzones of the Humphriesianum Zone (Figs. 2, 25). *Dorsetensia tecta* from bed HO-4 is not diagnostic for a single faunal horizon. It occurs both in the topmost horizon of the Pinguis Subzone (*deltafalcata* horizon) and in the subsequent Romani Subzone (DIETZE et al. 2011a). Bed HO-5 did not yield any ammonites. Therefore, we cannot assign the latter two beds to a subzone. Following OHMERT (1990, fig. 7) the Romani Subzone starts with bed HO-4.

In our section, the subzonal index *Dorsetensia romani* is recorded from the top of bed HO-6. Thus, this bed is assigned to the *romani* horizon of the Romani Subzone (OHMERT 1990; DIETZE et al. 2011a). In Southern Germany this horizon is well developed both in Franconia, in the entire Swabian Alb and in the Upper Rhine Valley (DORN 1935; OHMERT 1990; OHMERT et al. 1995; DIETZE et al. 2011a, b, 2013).

Beds HO-9 and HO-10 represent the *gervillii/cycloides* horizon of the Humphriesianum Subzone. This placement is confirmed by abundant *Chondroceras* spp., *Poecilomorphus cycloides* and typical stephanoceratids. The *gervillii/cycloides* horizon is recorded from Auerbach in Franconia (SCHMIDTILL & KRUMBECK 1938: bed 3; OHMERT 1994), the northern Ries area (coll. V.D.) and adjacent Eastern Swabian Alb to the Upper Rhine Valley (DIETL et al. 1984; OHMERT 1990; OHMERT et al. 1995; DIETZE et al. 2011a, 2011b, 2013). Interestingly, in the clayey lithology of the basin in the area of the Middle Swabian Alb neither *Chondroceras* nor any stephanoceratids typical of the *gervillii/cycloides* horizon were recorded yet (OHMERT 1990; DIETZE et al. 2011a).

Bed HO-11 did not yield any age-diagnostic ammonites.

The ammonite fauna of Bed HO-12 differs from that of the *gervillii/cycloides* horizon mainly by the lacking of chondroceratids, moreover, *Poecilomorphus cycloides* and *Dorsetensia* have not been recorded yet. However, in larger outcrops single records of these taxa must be expected (see OHMERT et al 1995: 198). Among stephanoceratids both evolute and involute specimens with a broad-oval whorl section occur, like in the *gervillii/cycloides* horizon below. OHMERT (1990, fig. 7) still included bed HO-12 within the *gervilli/cycloides* horizon. This is not confirmed by our observations. In our view, Bed HO-12 represents the *mutabile* horizon, which was recently described from the Middle Swabian Alb (DIETZE et al. 2011a) and from the Upper Rhine Graben Valley (DIETZE et al. 2013). This *mutabile* horizon is part of the *umbilicum/scalare* horizon of OHMERT et al. (1995). In Lörrach this faunal horizon is located within the "Obere Fossilknollen". There it is reduced to a single bed or even a layer with nodules (OHMERT et al. 1995, fig. 2), which makes a further biostratigraphic subdivision impossible. Which parts of the beds 5 and 6 of the Humphriesi-Oolith of Auerbach in Franconia (SCHMIDTILL & KRUMBECK 1938; OHMERT 1994) represent either the *mutabile* or the *umbilicum* horizons is still unclear and a re-study of the samples collected bed-by-bed by SCHMIDTILL & KRUMBECK (1938) would be necessary. We therefore tried to trace their mate-

	Zone	Subzone	Faunal horizons
Lower Bajocian	Humphriesianum	Blagdeni	*coronatum* *acuticostatum* unnamed
		Humphriesianum	*crassicosta* *umbilicum* *mutabile* *gervillii/cycloides*
		Romani	*romani* cf. *complanata*
		Pinguis	

Fig. 25. Ammonite faunal horizons recorded from the Humphriesianum Zone of Gosheim (marked in grey colour). The beds of the Pinguis Subzone (see Ohmert 1990) could not be studied in the "Sturmbühl" section. Probably at least part of the "Blagdeni-schichten" can be assigned to the *coronatum* horizon; however, this interval was not well exposed in the "Sturmbühl" section.

rial, but unfortunately, it appeared that this collection does not exist anymore (pers. comm. C. Schulbert, Erlangen).

In bed HO-13a the genus *Stephanoceras* reaches its acme and the ammonoid diversity increases significantly; the stephanoceratids are now accompanied by oppeliids, sphaeroceratids and even phylloceratids. Either favourable environmental conditions or the development of new seaways resulted in an immigration of these taxa of Tethyan origin into the Swabian Jurassic. Among stephanoceratids forms with a broad whorl section such as *Stephanoceras mutabile*, *Stephanoceras umbilicum* and *Stephanoceras rectecostatum* predominate, which is why we included this bed in the *umbilicum* horizon (sensu Dietze 2010). Specimens from the type locality of this horizon (Essingen near Aalen) differ from those of Gosheim in their preservation. They are slightly compressed and mostly preserved as internal molds. These differences hamper an objective comparison. In the material from Essingen the stephanoceratids more often exhibit an oblique or slightly overhanging umbilical wall. The kinking of the rib direction especially in the diverging points of *Stephanoceras mutabile* is rarer in the specimens from Essingen. These differences, however, do not allow the separation of another faunal horizon. Moreover, some condensation and reworking processes within bed HO-13a are obvious: Ammonites mostly consist only of their phragmocones, and the chambers of the phragmocones are occasionally filled with differently coloured ferruginous sediment. The shells of these ammonites are often overgrown with serpulids or bryozoans. This indicates a slow sedimentation rate. The bed HO-13a itself was strongly bioturbated prior to lithification.

The *umbilicus/scalare* horizon (sensu Ohmert et al. 1995) at Lörrach is partly coeval with the *umbilicum* horizon (sensu Dietze 2010), but it surely ranges up to the *mutabile* horizon.

The *crassicosta* horizon (Ohmert 1990; Dietze et al. 2013) was not recorded in the "Sturmbühl" section.

Bed HO-13b. The finds of *Teloceras (Paviceras)* n. sp. [aff. *arietis* (Maubeuge)] and *Teloceras latiumbilicatum* Schmidtill & Krumbeck from this bed are age-diagnostic for the Blagdeni Subzone. However, we could not find any hints if this bed is present in the entire area or if it is only locally developed. *Teloceras* specimens from the *acuticostatum* horizon of Ringsheim (Dietze et al. 2013) exhibit a significantly broader whorl section than the two sole specimens from Gosheim. Therefore, bed HO-13b is most likely somewhat older than the interval with beds 9–14 of the Blagdenischichten at Ringsheim. Since we were not able to find any *Teloceras (Paviceras) hoffmanni* (Schmidtill & Krumbeck) or *Teloceras (Paviceras) dubium* (Schmidtill & Krumbeck), which are both typical taxa of the *dubium* horizon of the Teufelsgraben locality near Auerbach in Franconia (SCHMIDTILL & KRUMBECK 1938, bed 7) we refrain from assigning bed HO-13b to the *dubium* horizon (OHMERT 1994, fig. 4). We let this horizon unnamed until its exact biostratigraphic position is clarified. Morphologically identical specimens of *Teloceras* were collected from the meanwhile abandoned clay-pit Osterfeld near Goslar (coll. BANIKE). There, a thin condensed bed yielded plenty of ammonites ranging in age from the Sauzei to the Parkinsoni zones; the bulk of that material comes from the transition of the Humphriesianum/Blagdeni subzones.

No ammonites were recorded from beds HO-14, HO-15 and BS-1.

A poorly preserved fragment of *Teloceras* sp. with a relatively broad whorl section (SMNS 70282/67) was found in bed BS-2. *Teloceras* specimens become much more abundant in the higher part of the ca. 3.5 m thick Blagdenischichten (DIETL & RIEBER 1980) and in the Subfurcaten-Oolith, which overlies the Blagdenischichten. DIETL (1995, fig. 8) illustrated a nice example of a completely preserved *Teloceras coronatum* (ZIETEN) from the Blagdenischichten of Gosheim. The Blagdeni Subzone ranges up to the lower third of the ferruginous Subfurcaten-Oolith (DIETL & RIEBER 1980). This younger part of the Blagdeni Subzone is recorded from many other places in Southwestern Germany, ranging from the Ipf in Eastern Swabia to Ringsheim in the Upper Rhine Valley (DIETZE et al. 2011b, 2013).

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Plate 1

Ammonites from the Gosheim Formation, Humphriesioolith Member of Gosheim; Lower Bajocian, Humphriesianum Zone.
(1–2) *Dorsetensia tecta* Buckman, “Sturmbühl” section, bed HO-4, Pinguis or Romani Subzone, SMNS 70282/21.
(3–6) *Dorsetensia romani* (Oppel), “Sturmbühl” section, bed HO-6, Romani Subzone, *romani* horizon; Figs. 3–4: SMNS 70282/22, Figs. 5–6: SMNS 70282/23.
(7–8) *Dorsetensia romani* (Oppel), “Hirnwiesen” locality, Romani Subzone, *romani* horizon, SMNS 70282/24 [leg. E. Bernt].
Ammonites in natural size. Beginning of bodychamber is indicated by an asterisk.

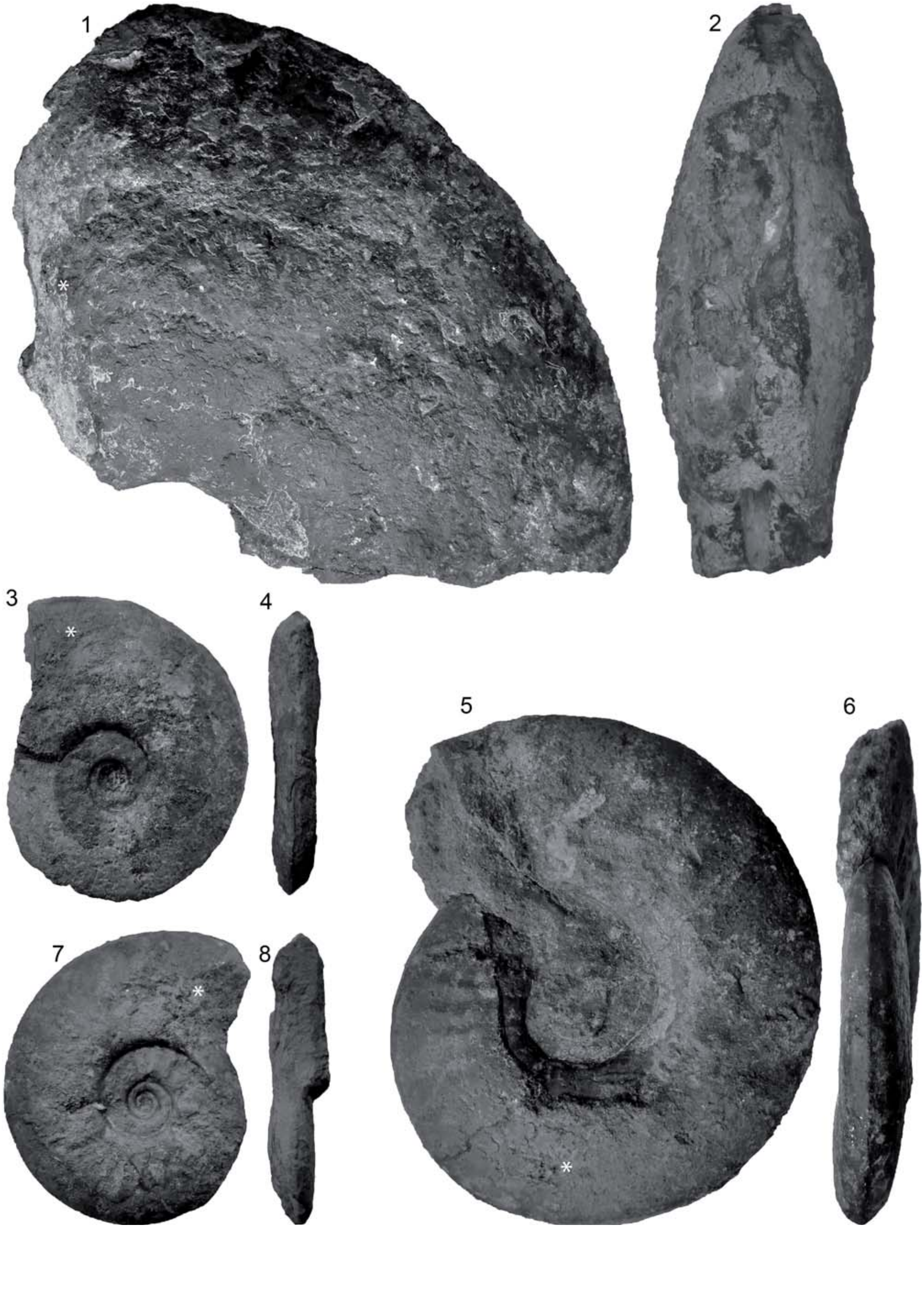
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Plate 2

Ammonites from the Gosheim Formation, Humphriesioolith Member, Gosheim, "Sturmbühl" section, bed HO-9; Lower Bajocian, Humphriesianum Zone and Subzone, *gervillii/cycloides* horizon.
(1, 5) *Stephanoceras mutabile* (Quenstedt), SMNS 70282/25.
(2–3) *Itinsaites vulgaricostatus* (Westermann), SMNS 70282/26.
(4, 6) *Stephanoceras subzieteni* Schmidtill & Krumbeck, SMNS 70282/27.
(7) *Itinsaites latansatus* (Buckman), SMNS 70282/28.
Ammonites in natural size. Beginning of bodychamber is indicated by an asterisk.


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Plate 3

Ammonites from the Gosheim Formation, Humphriesioolith Member of Gosheim; Lower Bajocian, Humphriesianum Zone and Subzone, *gervillii/cycloides* horizon.
(1–2, 8–9) *Poecilomorphus cycloides* (Orbigny), **“**Sturmbühl” section, bed HO-9, Figs. 1–2: SMNS 70282/29, Figs. 8–9: SMNS 79282/30.
(3–4) *Poecilomorphus cycloides* (Orbigny), “Wassersteige” section, SMNS 70282/31.
(5–6) *Stephanoceras subzieteni* Schmidtill & Krumbeck, “Sturmbühl” section, bed HO-9, SMNS 70282/32.
(10–11) *Strigoceras bessinum* Brasil, “Sturmbühl” section, bed HO-9, SMNS 70282/33.
Ammonites in natural size. Beginning of odychamber is indicated by an asterisk.


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Plate 4

Ammonites from the Gosheim Formation, Humphriesioolith Member, Gosheim, “Sturmbühl” section, bed HO-9 [except Figs. 3–4]; Lower Bajocian, Humphriesianum Zone and Subzone, *gervillii/cycloides* horizon.
(1–2) *Stephanoceras zogenreuthense* Schmidtill & Krumbeck, SMNS 70282/34.
(3–4) *Phaulostephanus paululus* Buckman, bed HO-10, SMNS 70282/35.
(5–6) *Itinsaites prorectus* Westermann, SMNS 70282/36.
(7) *Stephanoceras* cf. *subzieteni* Schmidtill & Krumbeck, SMNS 70282/37.
(8, 11) *Itinsaites prorectus* Westermann, SMNS 70282/38.
(9, 12) *Itinsaites variecostatus* Westermann, SMNS 70282/39.
(10) *Stephanoceras mutabile* (Quenstedt), SMNS 70282/40.
Ammonites in natural size. Beginning of bodychamber is indicated by an asterisk.


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Plate 5

Ammonites from the Gosheim Formation, Humphriesioolith Member, Gosheim, "Sturmbühl" section, bed HO-9; Lower Bajocian, Humphriesianum Zone and Subzone, *gervillii/cycloides* horizon.
(1–2, 4) ?*Teloceras* sp., SMNS 70282/41.
(3) *Stephanoceras subzieteni* Schmidtill & Krumbeck, collected in the village of Gosheim, probably from bed HO-9, as reconstructed from the rock matrix. SMNS 70282/42 [leg. K. Biller].
(5–7) *Stephanoceras subzieteni* Schmidtill & Krumbeck. SMNS 70282/43. The venter is more rounded than in the specimen illustrated on Pl. 5, Figs. 1–2, 4; compare also innermost whorls of the specimen on Pl. 5, Fig. 3.
Ammonites in natural size. Beginning of bodychamber is indicated by an asterisk.


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Plate 6

Ammonites from the Gosheim Formation, Humphriesioolith Member, Gosheim, bed HO-12; Lower Bajocian, Humphriesianum Zone and Subzone, *mutabile* horizon.
(1–2) *Stephanoceras scalare* WEISERT, “Sturmbühl” section, SMNS 70282/44.
(3–4) *Stephanoceras brodiae* (SOWERBY), a phragmocone lacking the bodychamber, “Wassersteige” section, SMNS 70282/45.
Ammonites in natural size. Beginning of bodychamber is indicated by an asterisk.


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Plate 7

Ammonites from the Gosheim Formation, Humphriesioolith Member, Gosheim, “Sturmbühl” section, bed HO-12; Lower Bajocian, Humphriesianum Zone and Subzone, *mutabile* horizon.
(1–2) *Stephanoceras* cf. *zieteni* (QUENSTEDT), a phragmocone lacking the bodychamber, SMNS 70282/46.
(3–4) *Itinsaites* sp., SMNS 70282/47.
Ammonites in natural size. Beginning of bodychamber is indicated by an asterisk.


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Plate 8

Ammonites from the Gosheim Formation, Humphriesioolith Member Gosheim, “Sturmbühl” section, bed HO-13a; Lower Bajocian, Humphriesianum Zone and Subzone, *umbilicum* horizon.
(1–2) *Stephanoceras rectecostatum* WEISERT [slightly pathogenic]; SMNS 70262/68.
(3–4, 7, 13–14) ?*Teloceras subcoronatum* (OPPEL) sensu WEISERT; 3–4: SMNS 70262/69, 7: SMNS 70262/70 [part of the phragmocone of a larger-sized specimen], 13–14: SMNS 70262/71.
(5–6) *Stephanoceras umbilicum* (QUENSTEDT); SMNS 70262/77.
(8) *Itinsaites multicostatus* (WESTERMANN); SMNS 70262/72.
(9) *Itinsaites latansatus* BUCKMAN; SMNS 70262/73.
(10–11) *Stephanoceras* cf. *lohndorfense* SCHMIDTILL & KRUMBECK; SMNS 70262/74.
(12) *Itinsaites crassicostatus* (WESTERMANN); SMNS 70262/75.
Ammonites in natural size. Beginning of bodychamber is indicated by an asterisk.


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Plate 9

Ammonites from the Gosheim Formation, Humphriesioolith Member, Gosheim; Lower Bajocian, Humphriesianum Zone and Subzone, *umbilicum* horizon.

(1, 6) *Stephanoceras* aff. *zieteni* (Quenstedt), Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/78 [leg. D. Schreiber].

(2–3) *Itinsaites* n. sp. b aff. *mackenzii* (McLearn) [sensu Westermann 1954]. Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/48 [leg. D. Schreiber].

(4–5) *Itinsaites gracilis* Westermann. Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/49 [leg. D. Schreiber].

(7–8) *Stephanoceras mutabile* (Quenstedt), a phragmocone lacking the bodychamber, Gosheim, loosely collected from near the "Wassersteige" section, bed HO-13a, as reconstructed from the rock matrix; SMNS 70282/50 [leg. F. Neubauer].

Ammonites in natural size. Beginning of bodychamber is indicated by an asterisk.


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Plate 10

Ammonites from the Gosheim Formation, Humphriesioolith Member, Gosheim, loosely collected in the village (Hermle factory), bed HO-13a reconstructed from the rock matrix; Lower Bajocian, Humphriesianum Zone and Subzone, *umbilicum* horizon.
(1–2) *Stephanoceras rectecostatum* Weisert, SMNS 70282/79 [leg. D. Schreiber].
(3–4) *Itinsaites prorectus* Westermann, SMNS 70282/51.
(5–6) *Stephanoceras lohndorfense* Schmidtill & Krumbeck, a phragmocone lacking the bodychamber, SMNS 70282/52 [leg. D. Schreiber].
(7) *Stephanoceras lohndorfense* Schmidtill & Krumbeck, a phragmocone lacking the bodychamber, SMNS 70282/53 [leg. D. Schreiber].
(8) *Itinsaites* n. sp. b aff. *mackenzii* (McLearn) [sensu Westermann 1954], SMNS 70282/54 [leg. D. Schreiber].
(9–10) *Stephanoceras zogenreuthense* Schmidtill & Krumbeck, a phragmocone lacking the bodychamber; SMNS 70282/55 [leg. D. Schreiber].
(11–12) *Stephanoceras* cf. *lohndorfense* Schmidtill & Krumbeck, a phragmocone lacking the bodychamber, SMNS 70282/56 [leg. D. Schreiber].
Ammonites in natural size. Beginning of bodychamber is indicated by an asterisk.

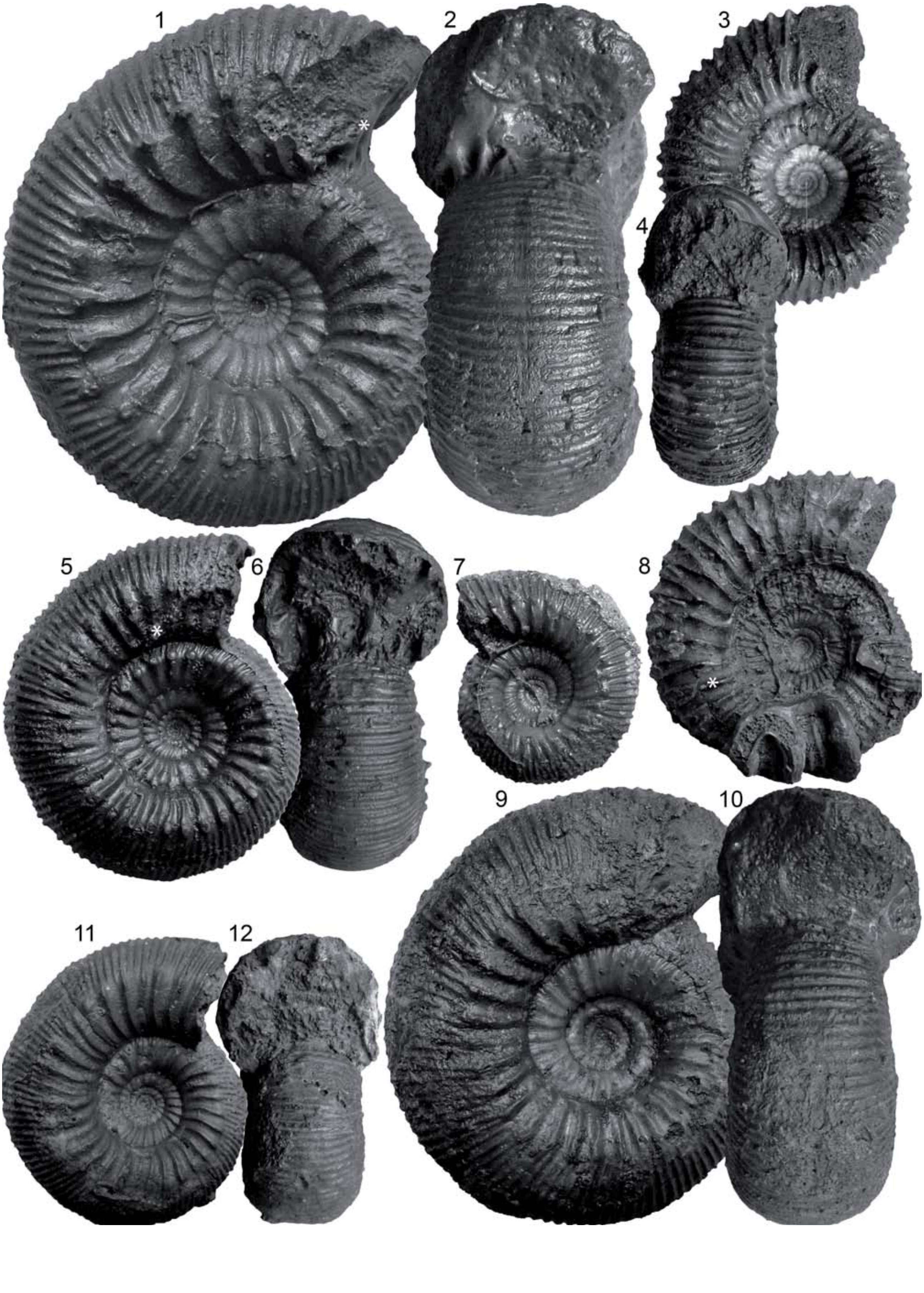
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Plate 11

Ammonites from the Gosheim Formation, Humphriesioolith Member, Gosheim; Lower Bajocian, Humphriesianum Zone and Subzone, *umbilicum* horizon.
(1–2) *Stephanoceras umbilicum* (Quenstedt), a phragmocone lacking the bodychamber; Gosheim; loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/80 [leg. D. Schreiber].
(3–4) *Stephanoceras umbilicum* (Quenstedt), a phragmocone lacking the bodychamber; Gosheim; loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/57 [leg. D. Schreiber].
(5–6) *Stephanoceras basilense* (Maubeuge), a phragmocone lacking the bodychamber; Gosheim, "Wassersteige" section, after its preservation probably from bed HO-13a, SMNS 70282/58.
(7, 10) *Stephanoceras rectecostatum* Weisert, slightly restored in the ventral area; Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/59 [leg. D. Schreiber].
(8–9) *Sphaeroceras brongniarti* (Sowerby), Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/60 [leg. D. Schreiber].
(11, 16) *Itinsaites formosus* (Buckman), Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/61 [leg. D. Schreiber].
(12–13) *Stephanoceras basilense* Maubeuge, phragmocone lacking the bodychamber, Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/62 [leg. D. Schreiber].
(14, 19) *Calliphylloceras* aff. *disputabile* (Zittel), Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/63 [leg. R. Botzenhard].
(15) *Oppelia subradiata* (Sowerby), Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/64 [leg. D. Schreiber].
(17–18) ?*Teloceras subcoronatum* (Oppel) sensu Weisert, a phragmocone lacking the bodychamber, Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/65 [leg. D. Schreiber].
(20–21) *Oppelia pleurifera* (Buckman), Gosheim, loosely collected in the village (Hermle factory), bed HO-13a as reconstructed from the rock matrix; SMNS 70282/66 [leg. D. Schreiber].
Ammonites in natural size. Beginning of bodychamber is indicated by an asterisk.


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Plate 12

(1–2) *Teloceras (Paviceras)* n. sp. [aff. *arietis* (MAUBEUGE)], a phragmocone lacking the bodychamber, Gosheim, "Sturmbühl" section, Gosheim Formation, Humphriesioolith Member, bed HO-13b [leg. D. SCHREIBER]; Lower Bajocian, Humphriesianum Zone, Blagdeni Subzone, unnamed horizon. Natural size.


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