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Stratigraphy, Ammonite Fauna and some Ostracods of the Upper Pliensbachian at the Type Locality (Lias, SW-Germany)

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With 2 plates and 2 figures

Summary

The Upper Pliensbachian at its type locality is figured in a combined section which shows the greatest thickness (27 m) recorded in SW-Germany. The ammonite fauna and some stratigraphically important ostracods found therein are listed. All 5 subzones of the Upper Pliensbachian are identified, base and top are well defined. Therefore the type locality chosen by OPPEL (1856–1858) meets the requirements of the stratigraphic code of today.

1. Introduction

OPPEL (1856, p. 815) renamed D'ORBIGNY's „étage liasien“ Pliensbachian after the little village Pliensbach (district Göppingen, Baden-Württemberg) and a little brook bearing the same name. OPPEL divides this stage into 6 zones and particularly emphasizes the first appearance of *Amaltheus margaritatus*. Therefore the natural division into two parts has already been recorded by OPPEL. Moreover, he noted that in most areas this stage has been divided lithologically into two formations, in SW-Germany into „Numismalmergel“ („Schwarzer Jura γ “) and „Amaltheenton“ („Schwarzer Jura δ “). Later on the upper part was classified by BONARELLI (1894) as Domerian, and the lower part by LANG (1913) as Carixian. (Zonal subdivision of the Pliensbachian see Colloque Jurassique Luxembourg 1962.)

This paper deals with the type locality of the Upper Pliensbachian, its ammonite fauna and some stratigraphically important ostracods. The Lower Pliensbachian will be published separately by SCHLATTER (1977).

1.1 The Upper Pliensbachian in S-Germany

The Pliensbachian has been known for its variety of fossils since v. ZIETEN (1830 to 1833) and QUENSTEDT (1858; 1882–1885). The Amaltheidae have been revised by FRENTZEN (1936; 1937) and also by HOWARTH (1958), and later by JORDAN (1960). Revisions of the rest of the ammonite fauna have also been made: *Cymbi-*

tes by SCHINDEWOLF (1961), *Lytoceras* by WIEDMANN (1970), *Protogrammoceras fucinigeras*, and *Arietoceras* by R. FISCHER (1975).

Only few detailed sections, from which ammonites are collected bed by bed are known from SW-Germany: short sections of the „Schwarzer Jura δ “ have been published by ENGEL (1887), E. FRAAS (1898), ZWIESELE (1898), BESSLER (1933), BECHTER (1937), JORDAN (1960), and complete sections only by FRENTZEN (1934). Even FRENTZEN has investigated only the „Amaltheenton“ („Schwarzer Jura δ “) and not the underlying „Numismalismergel“ („Schwarzer Jura γ “), which also bears Amaltheidae in its uppermost part. FRENTZEN divides the beds investigated by him into *Depressus*-, *Margaritatus*-, *Bechteri*-, and *Spinatus*-Beds. This classification has been revised by HOWARTH (1958, p. XXV). FRENTZEN's beds correspond approximately with the following subzones of HOWARTH:

<i>Spinatus</i> -Schichten	= <i>hawskerense</i> Subzone
<i>Bechteri</i> -Schichten	= <i>apyrenum</i> Subzone
<i>Margaritatus</i> -Schichten	= <i>gibbosus</i> Subzone
<i>Nodifer</i> -Schichten	= <i>subnodosus</i> Subzone

The *stokesi* Subzone has been identified for the first time in the Wutach region by JORDAN (1960, p. 71; 1974, p. 526).

A comprehensive survey of the Amaltheidae from Franconia is still lacking. Some sections, especially of the lower and uppermost part, have been published (*stokesi* Subzone: KRUMBECK 1936, revised by SCHIRMER 1965, furthermore JAHNEL 1970, URLICHS 1975; *hawskerense* Subzone: ZEISS & SCHIRMER 1965, and complete Upper Pliensbachian: D. HOFFMANN 1967).

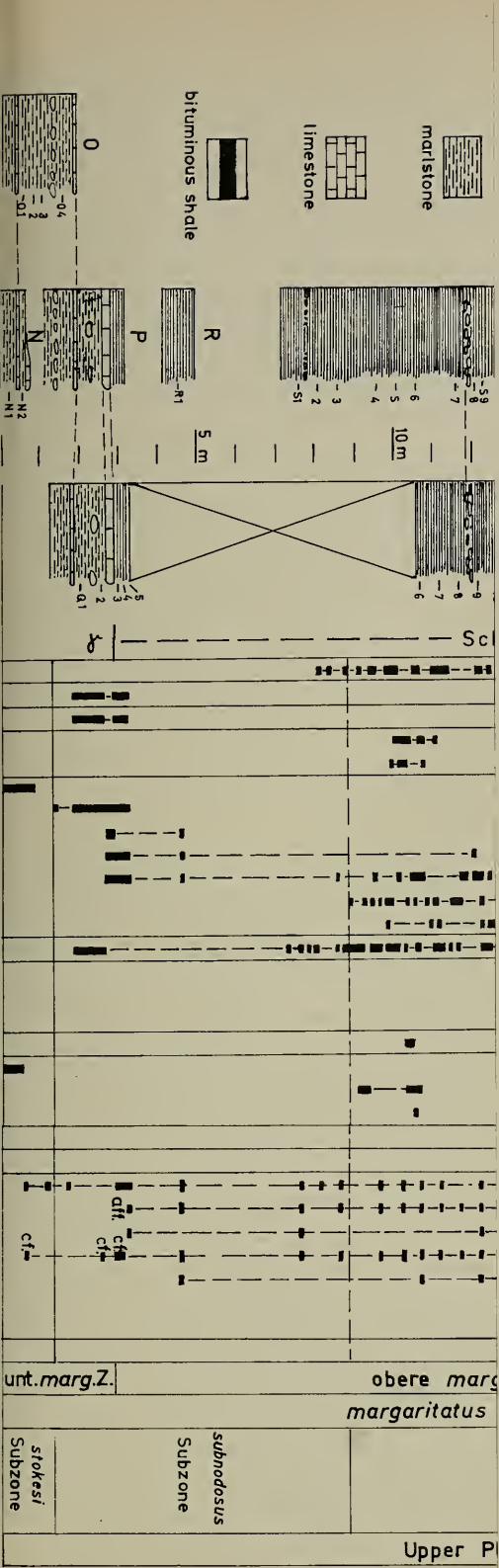
1.2 The Upper Pliensbachian at the type locality

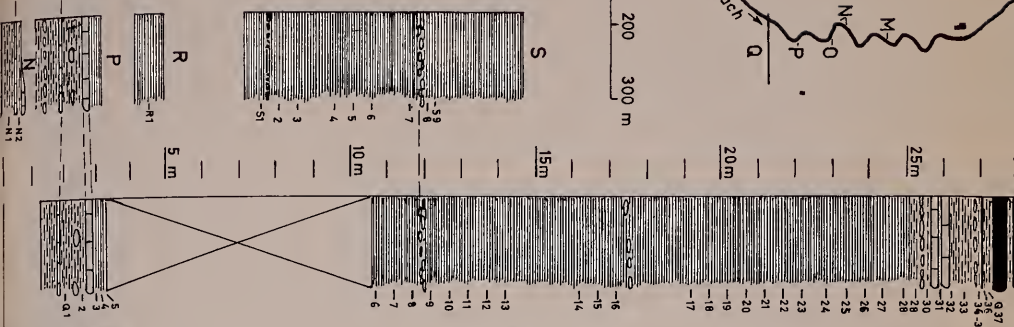
The type locality of the Upper Pliensbachian has been recorded only by ENGEL (1908, p. 252) as a collection locality for Amaltheidae and *Pleurotomaria amalthei*. GEYER (1964) is the first author after OPPEL, who worked in the surroundings of Pliensbach. He lists some more fossils from the Upper Pliensbachian, and he remarks that complete sections can only be made accessible by digging. GEYER (1964, p. 164) estimates the complete thickness to be 15–16 m. Section and biostratigraphy of the type locality are therefore unknown.

2. Lithostratigraphy at the type locality

Only the lower part of the Upper Pliensbachian is exposed in the Pliensbach brook. There are three short, overlapping sections (*stokesi* and lower part of the *subnodosus* Subzone; sections N, O, P on fig. 1), as well as a part of the *margaritatus* Zone (section S). A nearly complete section (section Q) and a very short section (section R) were accessible for a short time by the diggings of a water-supply line. From this it has been possible to combine the complete section. It is subdivided into three lithologic units: A lower, 2.9 m thick, marly to calcareous sequence (Upper „Numismalismergel“ = Upper „Schwarzer Jura γ “), a middle, 22 m thick sequence consisting of claystones and marly claystones („Amaltheenton“ = Lower „Schwarzer Jura δ “), and an upper 2.0 m thick, marly

Fig. 1. Schematic columnar section of the Upper Pliensbachian at its type locality, with the stratigraphic range of the ammonites and some ostracods found therein. Zonal subdivision according to HOWARTH (1958). The ammonites listed here are figured on plate 1–2.





Sowerbyceras tortilisulcoides (QUENSTEDT)
Lytoceras fimbriatum (SOWERBY)
Derolytoceras tortum (QUENSTEDT)
Cymbites centriglobus centriglobus (OPPEL)
centriglobus nanus SCHINDEWOLF
Amaltheus stokesi (SOWERBY)
subnodosus (YOUNG & BIRD)
gloriosus HYATT
striatus HOWARTH
margaritatus (MONTFORT)
gibbosus (SCHLOTHEIM)
laevigatus HOWARTH
Amauroceras ferrugineum (SIMPSON)
Pleuroceras transiens (FRENTZEN)
cf. hawkerense (YOUNG & B.)
cf. spinatum (BRUGIERE)
Fuciniceras compressum (MONESTIER)
Protogrammoceras monestieri FISCHER
depressum (QUENSTEDT)
cf. incertum (MONESTIER)
Trachycythere tubulosa seratina TR. & KL.
Pracytheridea champeauae BIZON
Ogmoconcha intercedens DREYER
circumvallata DREYER
klingleri MALZ
comes MALZ
cista MALZ
cincta MALZ
ambo LORD & MOORLEY
Ogmocanchella impressa MALZ

[illegible]

to calcareous sequence („Costatenkalk“ = Upper „Schwarzer Jura δ “). Within the latter at Pliensbach there are 4 limestone beds. The number of beds is not constant. For example at Notzingen (3 km north of Kirchheim) 5 beds are present (see fig. 2). ETZOLD, HAHN & KOERNER (1975, p. 127) refer even 6 beds. Above these beds bituminous shales and marlstones („Posidonienschiefer“ = „Schwarzer Jura ε “) follow.

Until recently most authors have included the marls at the base of the Upper Pliensbachian in the „Schwarzer Jura δ “ (compilation see SCHIRMER 1965). As SCHIRMER (1965, p. 196) already stated, the boundary „Schwarzer Jura γ/δ “ has been fixed unmistakably by QUENSTEDT (1858, p. 163): „So lange die Felder noch grau bleiben, harte Mergelkalke aus dem Boden hervorkommen . . . wähne man sich noch im Gamma, mag auch hin und wieder ganz oben ein verkalkter Amaltheus dabei sein.“ [= „As long as the fields still remain grey, and solid marly limestones appear from the subsoil, one may be shure to be still in the Gamma, even if sometimes a calcareous preserved specimen of *Amaltheus* may be found in the uppermost part.“] Hence it clearly follows that QUENSTEDT has drawn his boundary „Schwarzer Jura γ/δ “ at the facies change from marl to clay.

The boundary „Schwarzer Jura δ/ε “ has been defined by QUENSTEDT (1858, p. 165, and 1885, p. 303) in the same clear way. According to him, the „Schwarzer Jura ε “ begins at the base of the „Tafelfleins“, which is the first thick bed of bituminous dark shale. QUENSTEDT still enclosed thin bituminous beds with fucoids below the „Tafelfleins“ in the „Schwarzer Jura δ “.

3. Biostratigraphy at the type locality

3.1 Ammonites

Amaltheus stokesi has been found close above the highest occurrence of *Oistoceras* and *Androgynoceras* in section M (SCHLATTER 1977, p. 16, fig. 5). This species and *Protogrammoceras monestieri* have been identified up to 0,8 m above the boundary Lower/Upper Pliensbachian. (The measurements in the following text and on fig. 1 are specified in meters above the boundary Lower/Upper Pliensbachian.) From 1,4 m to 3,3 m *Amaltheus subnodosus* occurs. *Amaltheus gloriosus* has been recorded from 2,7 m to about 5,0 m and *A. striatus* from 2,7 m to 11,0 m. The lower part of the „Amaltheenton“ (Lower „Schwarzer Jura δ “) was covered with talus and gravel in section Q. Only at 10,5 m *Amaltheus laevigatus* and *Cymbites centriflobus nanus* have been found one meter below a 0,15 m thick layer of limestone nodules. In the same stratigraphic position in the section S a rich fauna has been investigated: *Amaltheus gibbosus*, *A. laevigatus*, *A. striatus*, *A. margaritatus*, *Sowerbyceras tortisulcoides*, *Cymbites centriflobus centriflobus*, *C. centriflobus nanus*, *Fuciniceras compressum*, *Protogrammoceras depressum*, and *P. cf. incertum*. Since *Cymbites* is frequent only in a horizon of about 2 m in the lower part of the „Amaltheenton“, as ENGEL (1887, p. 65) and FRENTZEN (1934, p. 4) have already found, it seems to be possible to correlate the section S with Q.

The missing parts within the section Q have been partly found in the section R, which was exposed by the diggings for the water-supply, as well as in section S, which is a natural outcrop in the Pliensbach brook. Section R cannot be correlated exactly with the other sections. However, according to its stratigraphic position, it belongs to the lowermost part of the „Amaltheenton“. It contains *Amaltheus gloriosus*, *A. margaritatus*, and *A. striatus*. In section S at 7,5 m *Amaltheus gibbosus*

was found for the first time. In section Q this species extends up to 23,0 m. At 23,2 m *Pleuroceras transiens*¹ was also found. *P. apyrenum* and *P. solare* were not found, because this level is deeply weathered at Pliensbach, and solid rock was not reached by the diggings for the water-supply (section Q). From 25,7 m to 27,0 m *Pleuroceras* cf. *hawskerense* was found. Above this a thin bed of dark bituminous shale with fucoids follows. At Pliensbach no ammonites could be traced in this bed. But PANNKOKE (1965, p. 54) describes *Dactylioceras* sp. from it in the surroundings of Ohmden (4 km west of Pliensbach).

Based on these findings the Pliensbach section can be subdivided in the following way: the *stokesi* Subzone has been identified in the marls of the „Schwarzer Jura γ “ 1,4 m thick. The *subnodosus* Subzone is at least 3 m and at most 7 m thick. In its lower part it contains *Amaltheus subnodosus* and in its upper part *A. striatus*, which still extends into the *gibbosus* Subzone, and *A. gloriosus*. The lower 1,5 m of the *subnodosus* Subzone are enclosed in the upper part of the „Numismalismergel“ („Schwarzer Jura γ “). The lower part of the *margaritatus* Zone, developed in the marly facies of the „Schwarzer Jura γ “, was named by OPPEL (1856, p. 249, 253) lower *margaritatus* Zone. The „Amaltheenton“ (= Lower „Schwarzer Jura δ “), which includes the upper *subnodosus* and the *gibbosus* Subzones, was named upper *margaritatus* Zone by him.

The boundary „Schwarzer Jura γ/δ “ is to be found in the Pliensbach section within the *subnodosus* Subzone. According to JORDAN (1960), this facies change coincides in the Wutach area with the boundary *stokesi/subnodosus* Subzone. The same facts have been stated by KRUMBECK (1936), SCHIRMER (1965), D. HOFFMANN (1967), and JAHNEL (1970) in Franconia (northern Bavaria). Only at Weißenburg (southern Franconia) the calcareous facies of the „Numismalismergel“ („Schwarzer Jura γ “) extends up to the boundary *margaritatus/spinatum* Zone (URLICH 1975).

The great thickness of the *gibbosus* Subzone of at least 14 m and at most 18 m in the Pliensbach section is very remarkable. In the lower part of this subzone *Cymbites*, *Protogrammoceras*, *Fuciniceras*, and *Arietoceras* occur. According to the sections referred to by ENGEL (1887, p. 65) and FRENTZEN (1934, p. 8–23) these genera are found particularly in the middle part of the „Amaltheenton“, i. e. in the lower *gibbosus* Subzone. *Arietoceras retrorsicosta*, however, also occurs in the upper *gibbosus* Subzone. This species has been found at Notzingen (3 km north of Kirchheim) 0,87 m below the lowermost limestone bed of the „Costatenkalk“, 0,40 m below the boundary *margaritatus/spinatum* Zone (fig. 2).

The *apyrenum* Subzone is known at Pliensbach from merely one finding of *Pleuroceras transiens*. According to HOWARTH (1958, p. 36), the index fossil *P. apyrenum* is known in S-Germany only from the Reichenbach near Aalen (see also pl. 2, fig. 7). But these specimens differ from the type of *P. apyrenum* in the following features: They are more strongly ribbed and not so compressed. They have a different whorl section and a larger, coarsely crenulated keel. The specimens from the Reichenbach are renamed *P. reichenbachense* by SCHLEGELMILCH (1976, p. 72).

¹ The lectotype of *Pleuroceras transiens* (FRENTZEN), which was designated by HOWARTH (1956, p. 365), but was destroyed during the last war in 1943, has in contrast to HOWARTH's description a prominent, well developed keel. In the Pliensbach section a specimen was found (pl. 2, fig. 1), which is identical with the figure of the lectotype (FRENTZEN 1937, pl. 4, fig. 26). Its whorl section is rounded quadrilateral with a prominent keel.

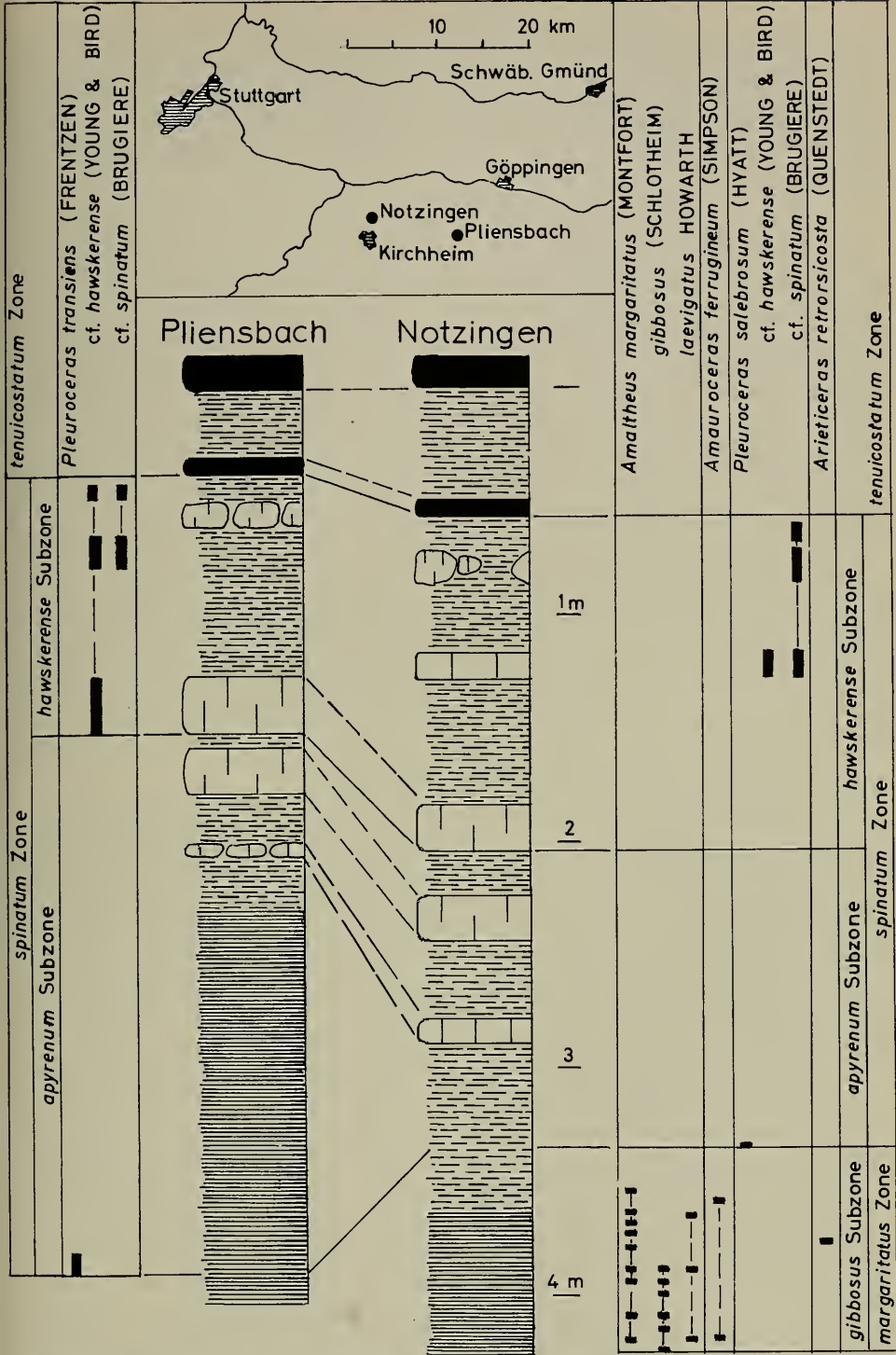


Fig. 2. Schematic columnar sections of the *spinatum* Zone at Pliensbach and of the *spinatum* and upper *margaritatus* Zone of Notzingen with the range of the ammonites found therein (signatures see fig. 1).

The *hawskerense* Subzone has been identified at Pliensbach by findings of *Pleuroceras* cf. *hawskerense* and *P.* cf. *spinatum* in the upper part of the „Costatenkalk“. This subzone is at least 1,4 m thick. From the *spinatum* Zone *Protogrammoceras* is hitherto unknown (see FISCHER 1975, fig. 34). Now *Protogrammoceras* cf. *depressum* (pl. 2, fig. 11) has been recently found at Sunthausen near Donaueschingen.

3.2 Ostracods

Since all subzones of the Upper Pliensbachian have been identified in the Pliensbach, the range of some stratigraphically important ostracods, especially the rimmed *Ogmoconchs* („vallate *Ogmoconchen*“, see MALZ 1975), the *Procytheridea champeauae*, and *Trachycythere tubulosa seratina* has been recorded. These species have been described by TRIEBEL & KLINGLER (1959), K. HOFFMANN & MARTIN (1960), MALZ (1971; 1975), and LORD & MOORLEY (1974), and I cannot add further morphological details after investigating the material of the Pliensbach section.

It is important that the developmental series from *Ogmoconcha comes* finally to *O. ambo*, as established by MALZ (1975)², has now also been found at the Pliensbach section with the following modification: *Ogmoconcha cista* has the same range as *O. comes* and both are very closely related. The series is now arranged from *O. comes* to *O. cincta* and finally to *O. ambo*. Since this series has been found in a second section, its validity has been confirmed. A general application, however, seems to be impossible, because the ostracods occur frequently in marls. On the other hand they have seldom been found in clays, or they are totally absent therein. E. g. the rimmed *Ogmoconchs* in the Pliensbach section are seldom found in the clays of the *margaritatus* Zone but frequently in the marls of the *spinatum* Zone. In the clays of the *spinatum* Zone in Franconia only *Ogmoconcha circumvallata* and *O. intercedens* have been rarely found.

The following additions to the stratigraphic range of the investigated species may be made: Only *Ogmoconcha circumvallata* and *O. klingleri* in the Pliensbach section show the known range from the *subnodosus* to the *apyrenum* Subzone. The earliest specimens of *O. circumvallata* are determined by „aff.“, because the characteristic rim is very poorly developed, but the characteristic difference from the other species, the pits on the surface, is present. These specimens are probably transitional forms between *Ogmoconcha intercedens* and *O. circumvallata*. *Ogmoconcha intercedens* and *O. comes* appear in the *stokesi* Subzone, and they extend into the *gibbosus* Subzone. The earliest specimens of *O. comes* are identified by „cf.“, because the rim at the dorsal margin is shorter and the carapaces are not so high as figured and described by MALZ (1975). *Ogmoconcha cista* in the Pliensbach section has also a much larger range than hitherto known: it occurs from the *subnodosus* to the *gibbosus* Subzone. *Ogmoconcha ambo* and *Ogmoconchella impressa* extend into the *tenuicostatum* Zone (Lower Toarcian). *Trachycythere tubulosa seratina* has only been found in the *apyrenum* and not in the *gibbosus* Subzone, as recorded by KLINGLER (1962). *Procytheridea champeauae* appears at the boundary Pliensbachian/Toarcian. According to PLUMHOFF (1967, p. 561), this spe-

² MALZ (1975) took over FRENTZEN's stratigraphic scheme in a modified form. He renamed FRENTZEN's beds zones. For example *margaritatus* Beds have been changed into *margaritatus* Zone. This zone corresponds to the *gibbosus* Subzone of DEAN, DONOVAN & HOWARTH (1961). This must be taken in account when studying the stratigraphic range of the ostracods in the paper of MALZ (1975).

cies occurs already in the uppermost marls of the Pliensbachian. PLUMHOFF correlates the boundary Pliensbachian/Toarcian with the base of the „Schwarzer Jura ε “. Taking to account that the base of the Toarcian in Württemberg lies below the boundary „Schwarzer Jura δ/ε “, then *Procytheridea champeauae* in the Wutach region probably also appears at the base of the Toarcian.

By using ostracods for stratigraphic purposes it is possible to subdivide the Upper Pliensbachian approximately as well as by using ammonites.

3.3 Base of the Upper Pliensbachian

Already OPPEL (1856, p. 250–251) has clearly defined the base of the Upper Pliensbachian: „Die unterste Zone des Amm. margaritatus wird hiernach charakterisiert, daß Amm. margaritatus hier zum erstenmal erscheint“ and „Amm. margaritatus durchläuft also zwei Zonen, von welchen die untere noch mehr den Charakter der Numismalisschichten besitzt, die obere meist viel mächtigere dagegen den Typus der eigentlichen Margaritatusschichten.“ [= „The lowermost zone of *A. margaritatus* is characterized by the fact, that *A. margaritatus* appears here for the first time“ and „*A. margaritatus* thus passes through two zones, of which the lower one retains more the character of the Numismalis Beds, whereas the upper one, which is in general the much thicker one, shows the type of the true *Margaritatus* Beds.“] In the index table OPPEL (1856, p. 409) equalizes the boundary „Schwarzer Jura γ/δ “ with the boundary *davoei/margaritatus* Zone. At this time QUENSTEDT (1843; 1851) had not yet fixed the limit between „Schwarzer Jura γ “ and „ δ “ exactly. Later on he defined it for the first time (QUENSTEDT 1858, p. 163).

3.4 Base of the Toarcian

OPPEL (1856, p. 317) defined the lower boundary of the Toarcian by the appearance of shales with *Posidonia bronni*. DEAN, DONOVAN & HOWARTH (1961, p. 476) defined the base of the Toarcian by the disappearance of *Pleuroceras* and by the abundance of *Dactylioceras*. This boundary has been precised by HOWARTH (1973, p. 268): „... the base of the Tenuicostatum Zone is drawn ... between the highest *Pleuroceras* and the lowest *Dactylioceras*.“ In SW-Germany the lowermost Toarcian (*tenuicostatum* Zone) has been identified for the first time by K. HOFFMANN & MARTIN (1960) in the borehole Offenburg I (Rhine Graben area) by findings of *Dactylioceras* cf. *semicelatum*. In the Swabian Alb the lowermost *Dactylioceras* (*Eodactylites*) *pseudocommune* from a limestone bed of the „Costatenkalk“ (Upper „Schwarzer Jura δ “) of Hechingen has been described by SCHMIDT-EFFING (1972, p. 91–92). SCHMIDT-EFFING considers this species as belonging to the Upper Domerian. But according to HOWARTH (1973, p. 267–268) and also to FERRETTI (1967, p. 745), *Dactylioceras pseudocommune* characterizes the lowermost Toarcian, the *paltum* Subzone, which was introduced by HOWARTH (1973, p. 267). The exact horizon of the Hechingen specimen is unknown. It is not out of question whether it occurs together with *Pleuroceras*, since at other localities *Pleuroceras* occurs in all limestone beds of the „Costaten-Kalk“. The lowermost horizontized specimens of *Dactylioceras* have been found in a thin bed of dark bituminous shale 0,30–0,40 m below the base of the „Schwarzer Jura ε “ by EINSELE & SEIBOLD (1961, p. 240) and PANNKÖKE (1965, p. 54). Just below this bed I found *Pleuroceras* cf. *hawskerense* at Pliensbach and Notzingen (3 km north of Kirchheim). The defined boundary

Pliensbachian/Toarcian has therefore been identified in the field. It lies 0,30 to 0,40 m below the base of the „Tafelfleins“ (= base of the „Schwarzer Jura ε“).

4. Conclusion

At the type locality the Upper Pliensbachian reaches the greatest thickness (27 m) known in SW-Germany. All 5 subzones have been identified. Since the defined base and also the top are recognizable in the terrain, the type locality chosen by OPPEL (1856—1858) meets the requirements of the stratigraphic code of today.

Für folgende Hilfen bedanke ich mich herzlich: für Präparationsarbeiten bei den Herren W. Diem, M. Kapitzke und cand. geol. G. Gebhardt, für Fotoarbeiten bei Herrn H. Lumpe, für Schreibarbeiten bei Frau J. Buchta, sowie für Hinweise und Diskussionen bei Herrn Dipl.-Geologen R. Schlatter (alle Ludwigsburg), Prof. R. Fischer (Marburg), Dr. M. K. Howarth (London), Dr. R. Schlegelmilch (Aalen) und für Hilfe bei der Übersetzung Frau E. Katzschner (Berlin) und Dr. B. Herting (Ludwigsburg). Die VEDEWA gestattete die Untersuchung eines Rohrleitungsgrabens; hierfür danke ich Herrn Dipl.-Ing. Rieg.

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Plate 1

- Fig. 1. *Amaltheus stokesi* (SOWERBY); Schwarzer Jura γ ; 1a: lateral view, 1b: ventral view; Nürtingen; inv.-no. 23217. — x 1,5.
- Fig. 2. *Amaltheus gloriosus* HYATT; 2a: lateral view, 2b: ventral view; Schwarzer Jura δ ; Pliensbach, section R, 4,6 m; inv.-no. 23218. — x 1.
- Fig. 3. *Amaltheus stokesi* (SOWERBY); Schwarzer Jura γ ; Pliensbach, section M, 0,2 m; inv.-no. 23219. — x 1.
- Fig. 4. *Amaltheus subnodosus* (YOUNG & BIRD); Schwarzer Jura δ ; Pliensbach, section Q, 2,8 m; inv.-no. 23220. — x 1.
- Fig. 5. *Amaltheus striatus* HOWARTH; Schwarzer Jura δ ; Pliensbach, section Q, 2,8 m; inv.-no. 23221. — x 1.
- Fig. 6. *Amaltheus gibbosus* (SCHLOTHEIM); Schwarzer Jura δ ; Pliensbach, section S, 12,2 m; inv.-no. 23222. — x 1.
- Fig. 7. *Amaltheus margaritatus* (MONTFORT); Schwarzer Jura δ ; Pliensbach, section S, 11,8 m; inv.-no. 23223. — x 1.
- Fig. 8. *Amaltheus laevigatus* HOWARTH; Schwarzer Jura δ ; Pliensbach, section S, 12,0 m; inv.-no. 23228. — x 1.

All specimens: Staatliches Museum für Naturkunde. Stuttgart. — Foto: H. Lumpe.

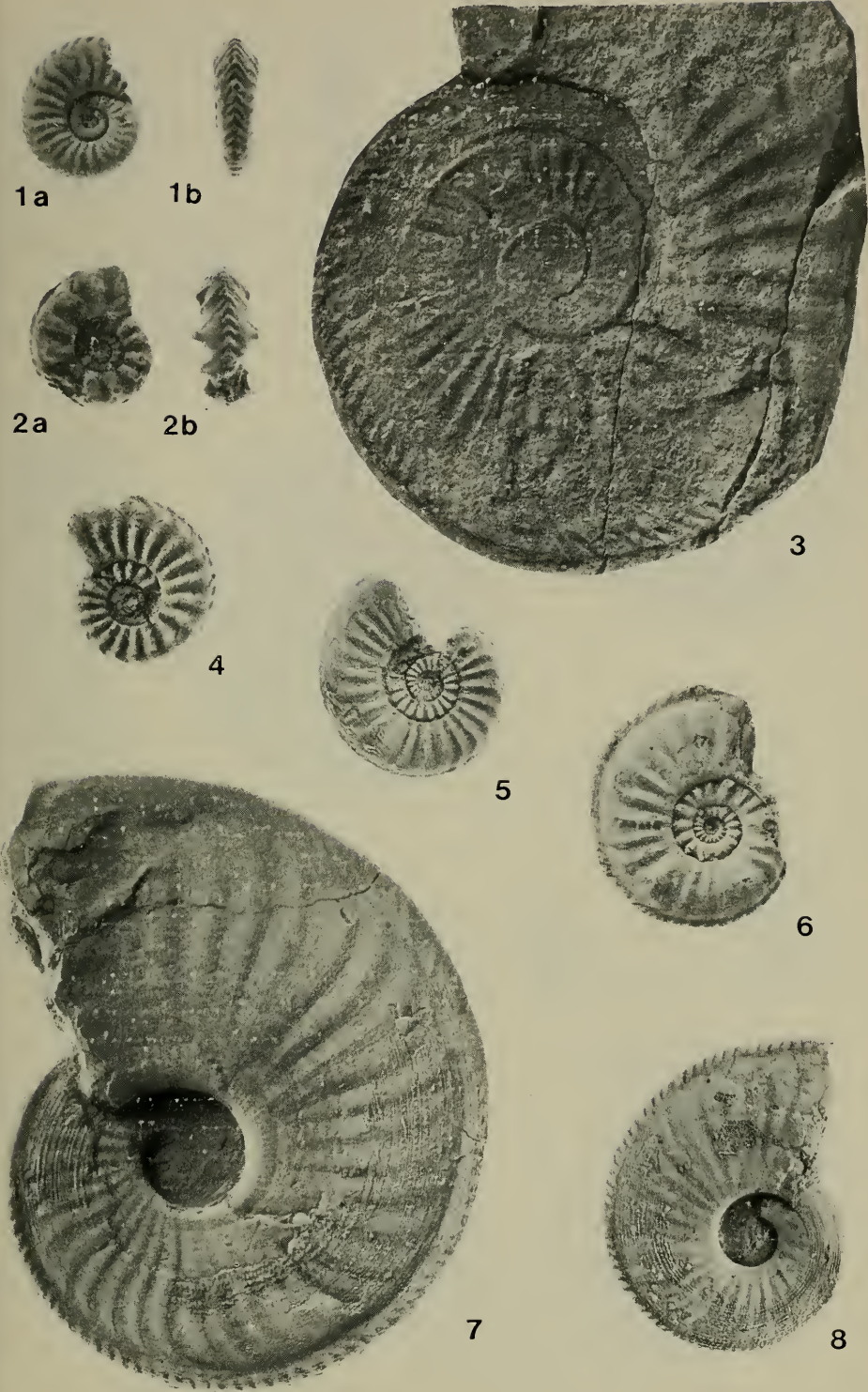
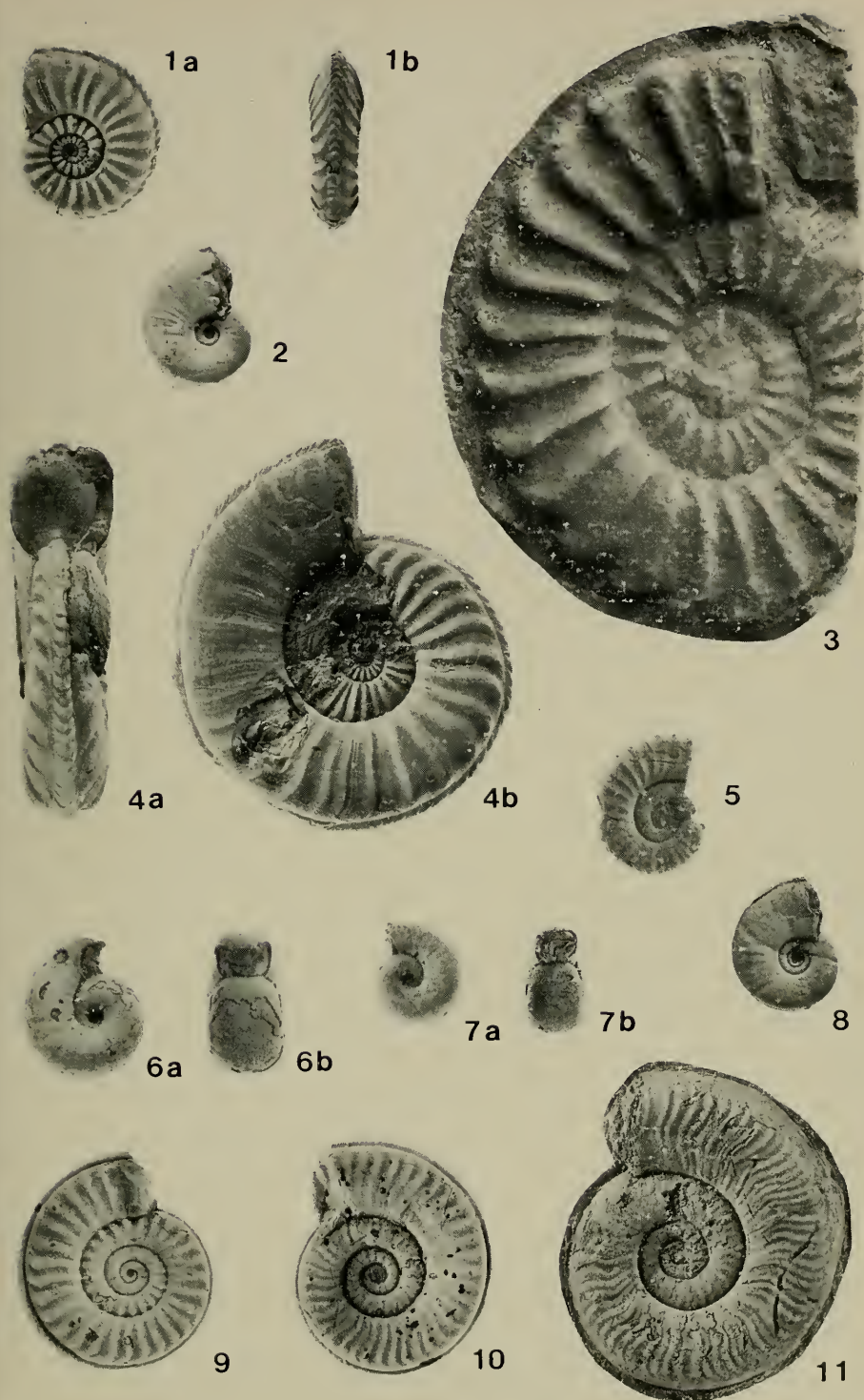


Plate 2

- Fig. 1. *Pleuroceras transiens* (FRENTZEN); 1a: lateral view, 1b: ventral view; Schwarzer Jura δ ; Pliensbach, section Q, 23,2 m; inv.-no. 23229. — x 1.
- Fig. 2. *Amauroceras ferrugineum* (SIMPSON); Schwarzer Jura δ ; Pliensbach, section S, 8,35 m; inv.-no. 23230. — x 1.
- Fig. 3. *Pleuroceras* cf. *haukerense* (YOUNG & BIRD); Schwarzer Jura δ ; Pliensbach, section Q, 25,7 m; inv.-no. 23231. — x 1.
- Fig. 4. *Pleuroceras* aff. *apyrenum* (BUCKMAN) (= *P. reichenbachense* SCHLEGELMILCH); Schwarzer Jura δ ; 4a: frontal view, 4b: lateral view; Reichenbach near Aalen, inv.-no. 23232. — x 1.
- Fig. 5. *Derolytoceras tortum* (QUENSTEDT); Schwarzer Jura δ ; Pliensbach, section Q, 2,8 m; inv.-no. 23233. — x 1.
- Fig. 6. *Cymbites centriglobus centriglobus* (OPPEL); 6a: lateral view, 6b: frontal view; Schwarzer Jura δ ; Pliensbach, section S, 10,70 m; inv.-no. 23234. — x 1,5.
- Fig. 7. *Cymbites centriglobus nanus* SCHINDEWOLF; 7a: lateral view, 7b: frontal view; Schwarzer Jura δ ; Pliensbach, section S, 10,70 m; inv.-no. 23235. — x 1,5.
- Fig. 8. *Sowerbyceras tortisulcoides* (QUENSTEDT); Schwarzer Jura δ ; Pliensbach, section S, 8,10 m; inv.-no. 23237. — x 1.
- Fig. 9. *Fuciniceras compressum* (MONESTIER); Schwarzer Jura δ ; Pliensbach, section S, 10,40 m; inv.-no. 23236. — x 1,5.
- Fig. 10. *Protogrammoceras depressum* (QUENSTEDT); Schwarzer Jura δ ; Pliensbach, section S, 10,60 m; inv.-no. 23238. — x 1.
- Fig. 11. *Protogrammoceras* cf. *depressum* (QUENSTEDT); Schwarzer Jura δ , Costatenkalk; Süntausen, 9 km NE Donaueschingen; inv.-no. 23239. — x 1.

All specimens: Staatliches Museum für Naturkunde. Stuttgart. — Foto: H. Lumpe.



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