Zitteliana

An International Journal
of Palaeontology and Geobiology

Series A/Reihe A
Mitteilungen der Bayerischen Staatssammlung
für Paläontologie und Geologie

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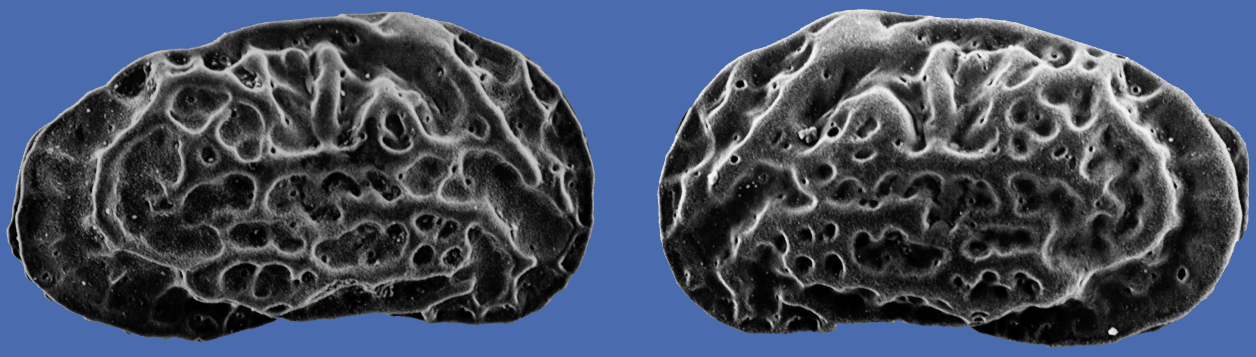

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CONTENTS/INHALT

Zitteliana	A 45	218 Seiten	München, 30.12.2005	ISSN 1612-412X

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Cover illustration: Ostracod *Callistocythere intricatoides* (Ruggieri, 1953) from the Thyrrenian of Altinova (Turkey). Left: Right valve, external view, BSPG 1980 X 1313 (length 0.640 mm). Right: Left valve, external view, BSPG 1980 X 1314 (length 0.646 mm). SEM Photograph: R. Matzke-Karasz (LMU München, Department für Geo- und Umweltwissenschaften, Sektion Paläontologie)

Umschlagbild: Ostrakode *Callistocythere intricatoides* (Ruggieri, 1953) aus dem Thyrrenium von Altinova (Türkei). Links: Rechte Klappe, Außenansicht, BSPG 1980 X 1313 (Länge 0,640 mm). Rechts: Linke Klappe, Außenansicht, BSPG 1980 X 1314 (Länge 0,646 mm). REM-Foto: R. Matzke-Karasz (LMU München, Department für Geo- und Umweltwissenschaften, Sektion Paläontologie)

Zitteliana	A45	199-209	6 Textfigs, 2 Pls, 6 Tabs	München, 30.12.2005	ISSN 1612-412X

Capparidoxylon holleisii nov. spec., a silicified *Capparis* (Capparaceae) wood with insect coprolites from the Neogene of southern Germany

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Abstract

A silicified dicotyledonous wood from Attenfeld, southern Franconian Alb, Germany, is assignable to the form genus *Capparidoxylon* Schenk, 1883 based on anatomical features that are identical to those seen in the wood of extant members in the genus *Capparis*. The new species *Capparidoxylon holleisii* nov. spec. is introduced for the fossil. The genus *Capparis* is today comprised of some 250 species, and widely distributed in dry environments in the Mediterranian, the Palaeotropis, and in South America. A special feature of the fossil is insect feeding channels filled with coprolites. *Capparidoxylon holleisii* nov. spec. represents the first record of a silicified Capparaceae wood from the Neogene of Europe.

Key words: Deciduous tree, Capparaceae, South Germany, Neogene, Wood anatomy, Insect coprolites

Kurzfassung

Ein verkieseltes Laubholz aus Attenfeld, südliche Frankenalb, Süddeutschland, läßt sich der Formgattung *Capparidoxylon* Schenk, 1883 zuordnen. Für dieses Holz wird die neue Art *Capparidoxylon holleisii* nov. spec. eingeführt. Die Anatomie des Holzes wird beschrieben und durch Abbildungen dokumentiert. Die Feinstruktur ist weitgehend ähnlich und vergleichbar mit dem Xylem der artenreichen Gattung *Capparis* (250), derzeit weit verbreitet im Mittelmeerraum, der Paläotropis und in Südamerika. Eine Besonderheit des Fossils sind die erhalten gebliebenen Bohr- und Fraßgänge mit Coprolithen von holzbewohnenden Insekten. Die vorliegende Arbeit beschreibt erstmals einen verkieselten Holzrest der Familie Capparaceae aus neogenen Schichten Europas.

Schlüsselwörter: Holzanatomie, Laubbaum, Capparaceae, Insektenbefall, Süddeutschland, Neogen

1. Introduction

With the Alps emerging, their northern foreland developed into an elongate depression. This depression, the Molasse basin, was subsequently filled with mountain debris. With the onset of the Upper Freshwater Molasse period, continental conditions prevailed in the northern alpine foreland. Giant alluvial fans transported alpine debris into a westward oriented river system (Glaser et al. 2004). Gravel, sands, and fine sediments were deposited and formed the "Tertiärhügelland", which is located south of the river Danube, between the cities Augsburg and Passau. The Early and Middle Miocene sediments of the North Alpine Foreland Molasse Basin continue to yield one of the world's richest regional records of silicified wood (Selmeier 1998b). The number of specimens gathered to date ranges well over 10.000, of which some 1.000 specimens have been scientifically analyzed. These specimens come from 61 stratigraphically well dated localities by using the Coexistence Approach, and demonstrate the potential of fossil silicified wood in palaeobotanical and palaeoenvironmental studies (Böhme et al., in preparation).

Nevertheless, wood of Capparaceae (formerly Capparidaceae) has not been recorded to date. The specimen presented here was collected by P. Holleis from a site west of Attenfeld, southern Franconian Alb. The town of Attenfeld is situated between the rivers Altmühl (north) and Danube (Textfig. 1). The fossils from the Franconian Alb predominantly occur in sandy or loamy sediments, usually close to the surface. They can easly be picked from farmland or at waysites.

There exist only 2 silicified woods today that have been assigned to the family Capparaceae, i.e. *Capparidoxylon Geinitzi* Schenk (1883) from Egypt (Kairo) and *Forchhammerioxylon scleroticum* Kruse (1954) from Wyoming (U.S.A.). Even the extensive list of silicified woods recorded for the Middle Eocene Clarno Nut Beds flora (145 genera) does not contain the family Capparaceae (cf. Wheeler & Manchester 2002). The specimen of Attenfeld is thus the third fossil record worldwide

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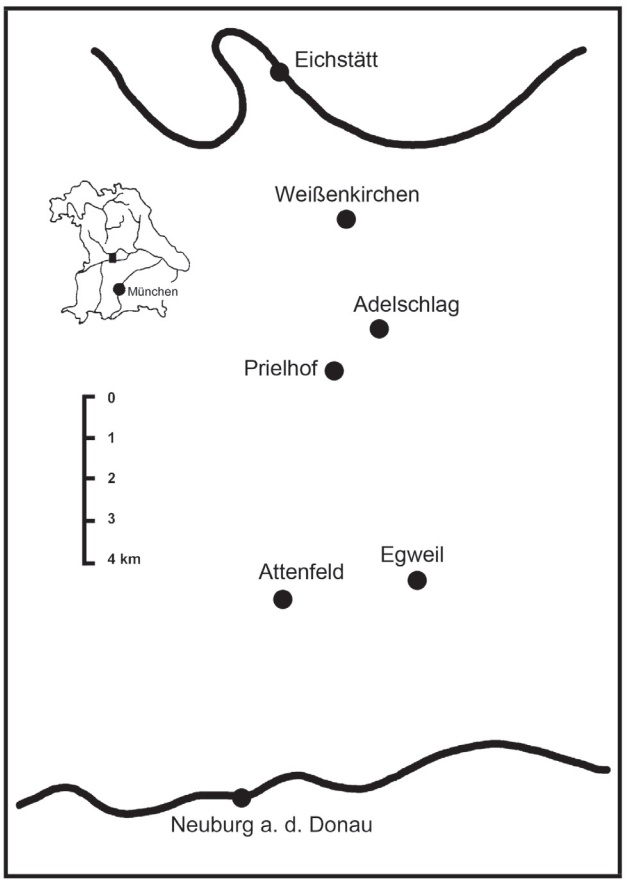


Textfigure 1: Geographic position of Attenfeld and other Miocene localities of the southern Franconian Alb that have yielded diverse silicified wood assemblages.

for the Capparaceae, and the first record for this family from the Neogen of Europe. The specimen from Attenfeld displays insect boreholes and channels filled with coprolites.

In this paper, the microscopic anatomy of *Capparidoxylon holleisii* nov. sp. is described and compared with that seen in the wood of extant representatives of the Capparaceae. The diagnostic value of various anatomical features is discussed.

2. Material and Methods

The specimen is preserved as silicified cellular permineralization. All slides were prepared using standard thin-section techniques. A diamond saw was used to cut thick sections (wafers) of transverse, longitudinal tangential, and radial surfaces. These sections were ground down with a Logitech Lapp & Polish LP 50 (Edinburgh, Scottland) grinding machine until they were thin enough to permit analysis of the anatomical details by transmitted light microscopy (cf. Hass & Rowe 1999).

The description of the wood anatomical details generally follows the list of microscopic features for hardwood identification compiled by the IAWA Committee (1989), counting each vessel separately (Wheeler 1986), and the recommendations of Wheeler & Baas (1998). Photo documentation was accomplished with a Zeiß Ultraphot analog camera and a digital Leica Q 550 IW. Images were processed, and plates and textfigures constructed using Adobe Photoshop 7.0.

For authors of plant names and taxonomy of plant families, genera, and species, four publications were available, i.e. Brummit & Powell (1992), Kubitzki & Bayer (2003), Mabberley (1997), and Schubert & Wagner (1984).

3. Systematic Palaeontology

Order Capparales (formerly Rhoeades)

Family Capparaceae (formerly Capparidaceae)

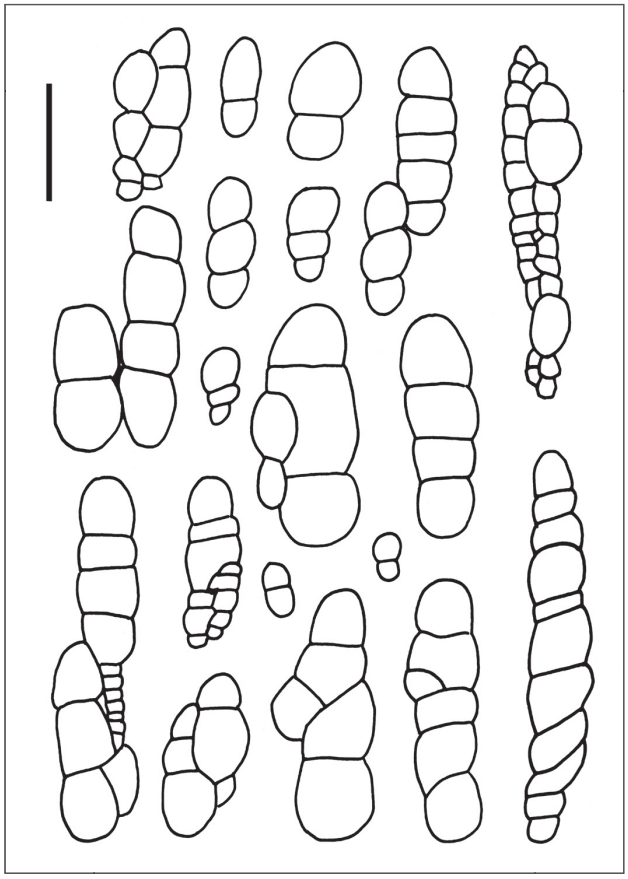
Organ genus *Capparidoxylon* Schenk, 1883 (without diagnosis)

Type species: *Capparidoxylon Geinitzi* Schenk, 1883 (without diagnosis)

Capparidoxylon holleisii nov. sp.

Pl. 1, Figs 1-4; Pl. 2, Figs 1-4; Textfigs 2-6.

Material: Silicified wood, specimen measures 13.3 x 6,8 x 4,6 cm, weight 456 g, surface somewhat smooth, light brown, inside darker.



Textfigure 2: *Capparidoxylon holleisii* nov. sp. Cross section [holotype]. Selection of typical vessel forms, radial multiples of 2-10, occasionally forming small clusters, and vessels intergrading with tracheids; BSPG 2004 XV 1 and Holleis IX 309; scale bar = 200 µm.

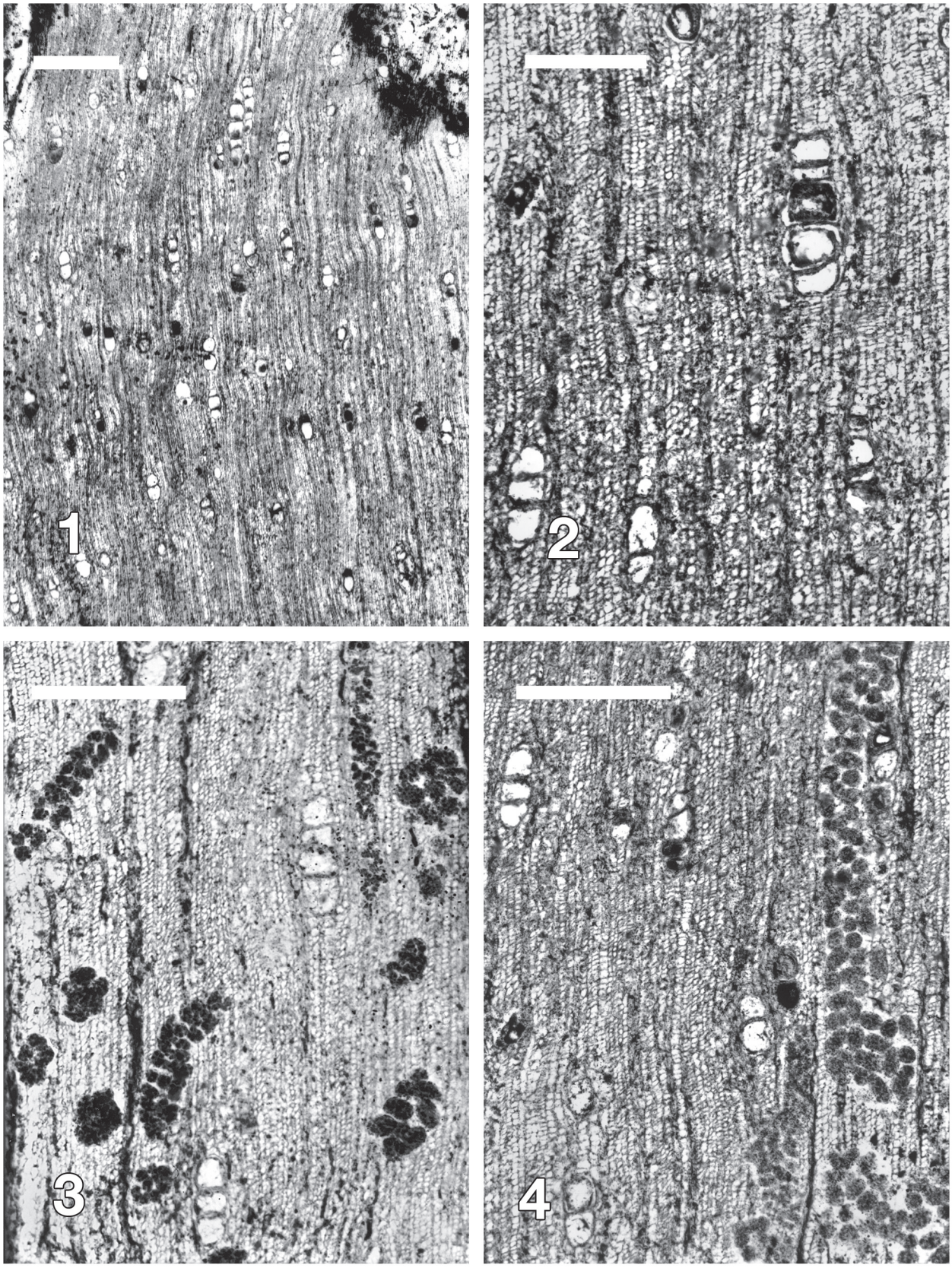


Plate 1: *Capparidoxylon holleisii* nov. sp. from the Neogene of the southern Franconian Alb, Bavaria (Germany); BSPG 2004 XV 1 (Fig. 1) und Holleis IX 309 (Figs 2-4).

Fig. 1: Cross section. Indistinct growth ring boundary, vessels diffuse-porous; scale bar = 1000 µm, x 15.

Fig. 2: Cross section. Vessels in radial multiples of up to five. Ground tissue and dark rays visible; scale bar = 300 µm, x 70.

Fig. 3: Cross section. Ground tissue, vessels, and ten boreholes filled with coprolites recognizable; scale bar = 500 µm, x 55.

Fig. 4: Cross section. Ground tissue, vessels, and a long radially-orientated borehole filled with coprolites; scale bar = 500 µm, x 55.

Holotype: BSPG 2004 XV 1, hand specimens and seven thin sections, reposited in the Bayerische Staatssammlung für Paläontologie und Geologie, Munich, Germany. An additional cross section (IX 309) and a few cutting fragments of the holotype specimen are kept in the Fossil Wood Collection of the "Historischer Verein und Museum Neuburg" (cf. Selmeier 2001).

Diagnosis: Growth rings indistinct. Vessels diffuse-porous, medium-sized (50-100 µm), solitary (not more than 10%), radial multiples up to 10, some in clusters, vessels sometimes intergrading with vascular tracheids, perforation simple, vessel element members relatively short, many vessel lumina filled with yellow or dark deposits. Fibres non-septate, medium thick-walled. Axial parenchyma scanty, paratracheal, and/or sparsely vasicentric. Rays 1-2-(3)-seriate, faintly heterocellular (Kribs 1935; type III), sheat cells occasionally occur, 4-26 cells high, 6-12 rays per mm tangential.

Etymology: The specific epithet refers to P. Holleis who collected the fossil presented here and hundreds of other valuable silicified woods from the southern Franconian Alb.

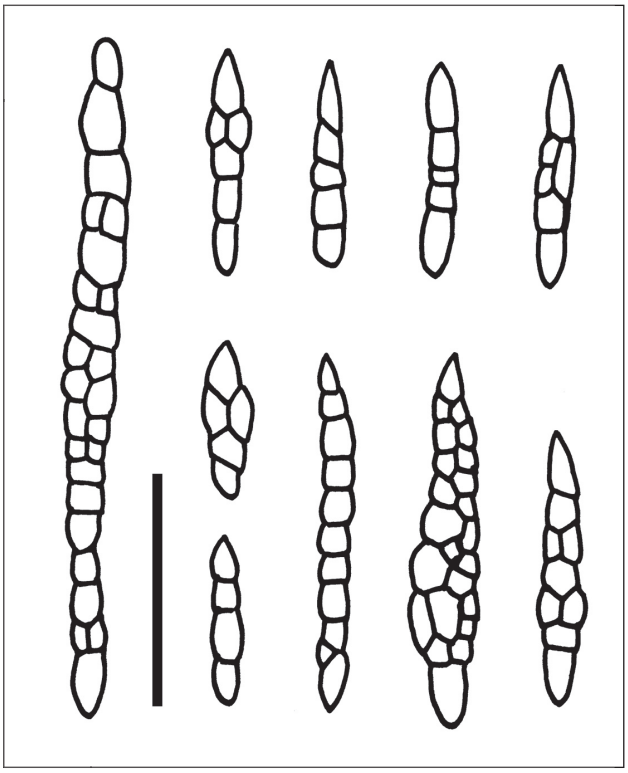
Locality: Attenfeld, Bavaria, map TK 1:25.000, No. 7233, Neuburg a. d. Donau, southern Franconian Alb, Germany (Textfig. 1).

Age and horizon: Neogene sediments of the Alpine foredeep, southern Franconian Alb. The Lower part of the Upper Freshwater Molasse (OSM, Obere Süßwasser Molasse) is correlated with the lower Karpatien-Badenien based on mammal fossils (uppermost MN4-MN5), Late Karpatian, 17.0-16.3 Ma. (Doppler et al. 1996, 2002).

Length and width, µm	Length and width, µm
221 : 117	559 : 104
273 : 208	676 : 78
274 : 234	819 : 468
312 : 234	1326 : 143
442 : 182	1664 : (156-364)

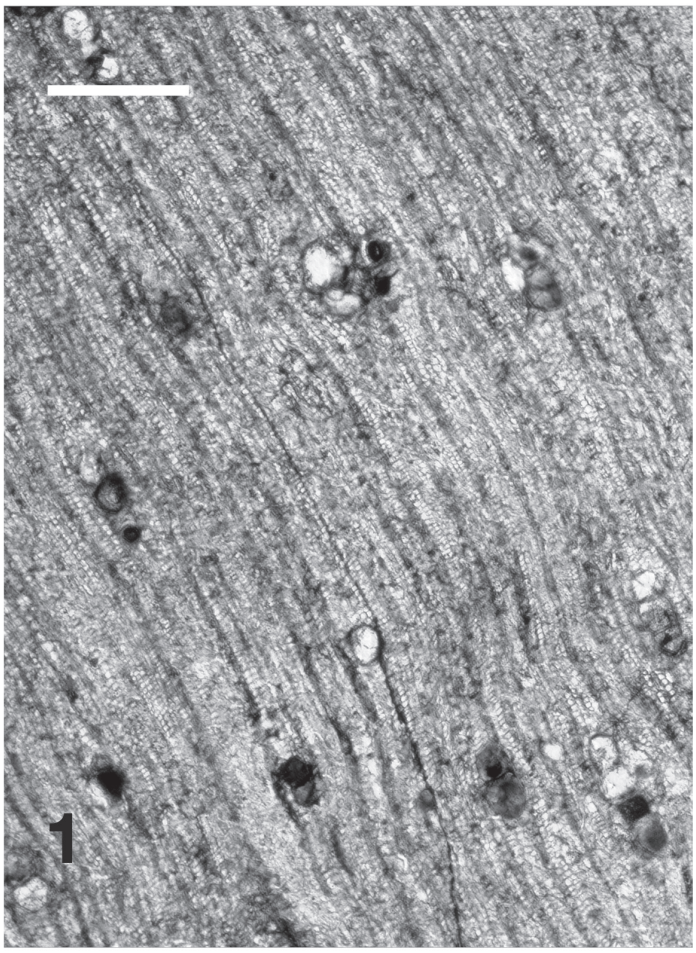
Table 1: Size of 10 insect borings filled with coprolites, measured from cross sections of *Capparidoxylon holleisii*.

Description: Secondary xylem of dicotyledonous wood without bark or pith. Microscopic structure of radial section poorly preserved. Growth rings faint and indistinct (Pl. 1, Fig. 1). Vessels randomly arranged, a specific pattern is not recognizable (Pl. 1, Fig. 1-2), diffuse-porous, and either solitary (not more than 10%), in radial multiples of 2-10 or forming small clusters (rare); vessels partly intergrading with vascular tracheids (Textfig. 2), solitary vessels tangential diameter up to 95 (radial 52-122) µm, tangential diameter of radial multiples of two 55-129 (mean 95) µm, radial 80-259 (mean 185) µm; individual vessels of multiples flattened; multiples radially up to 683 µm; perforations simple with transverse to oblique end walls (Textfig. 4), vessel member length short, 165-427 (mean 283) µm, intervessel pits crowded and alternate; very small to minute, difficult to observe due to meagre preservation; in cross- and longitudinal sections, many vessel lumina filled with yellowish deposits (Pl. 2, Figs 1-2; Textfig. 4), they often appear to accumulate at the end of vessel elements (longitudinal sections). Fibres non-septate (Pl. 2, Fig. 4), medium thick-walled, polygonal in cross section, more or less quadratic or round, tangential diameter 15-22 µm, radial 11-23 µm. 4-(6) rows of fibres between two rays, locally only 1-2 rows. The axial parenchyma is paratracheal and usually sparsely vasicentric. Rays 1-2(3) seriate, somewhat heterocellular (Kribs 1935; type III), 3(96 µm)-26(738 µm) cells high (Pl. 2, Figs 3-4; Textfig. 3); uniserate rays, e.g., with 12 cells (365 µm), uniseriate rays partly 2-seriate, 143-857 µm high; rays composed of procumbent, somtimes square and upright cells, sheat cells occasionally present, vertically up to 62 µm; 6-12 rays per mm tangential.



Textfigure 3: *Capparidoxylon holleisii* nov. sp. Longitudinal tangential section. Rays 1-3-seriate, faintly heterocellular, tendency to sheat cells; BSPG 2004 XV 1; scale bar = 200 µm.

Plate 2: *Capparidoxylon holleisii* nov. sp. from the Neogene of the southern Franconian Alb, Bavaria (Germany); BSPG 2004 XV 1.
Fig. 1: Cross section. Vessels diffuse-porous, vessel lumina partly filled with yellow deposits, solitary vessels rare; scale bar = 500 µm, x 40.
Fig. 2: Longitudinal tangential section. Vessel members filled with brown-yellow deposits; scale bar = 300 µm, x 60.
Fig. 3: Longitudinal tangential section. Rays 1-3-seriate, faintly heterocellular; scale bar = 200 µm, x 125.
Fig. 4: Longitudinal tangential section. Fibres non-septate, rays faintly heterocellular, 1-3-seriate; scale bar = 200 µm, x 125.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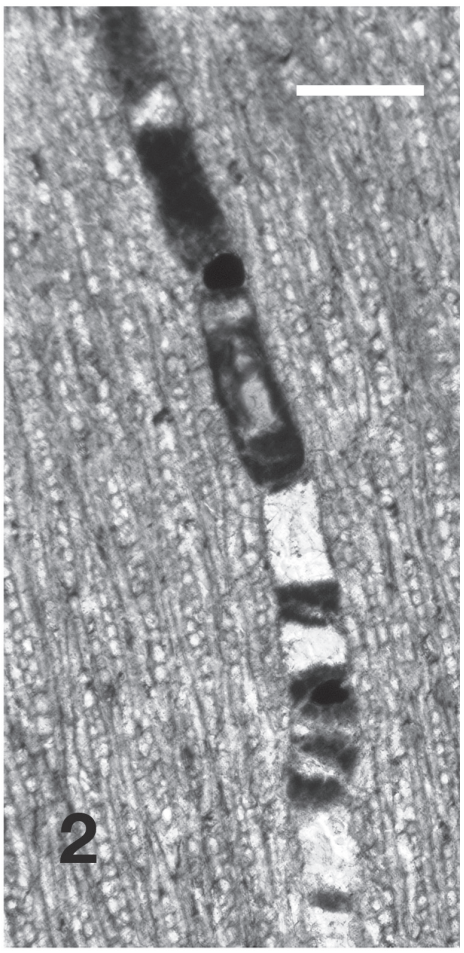
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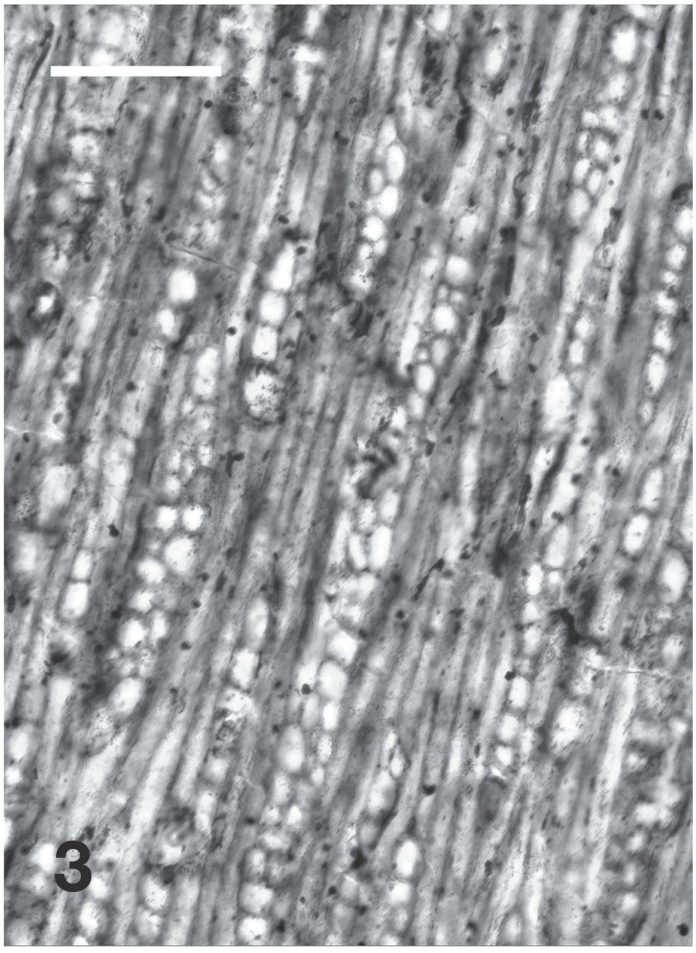
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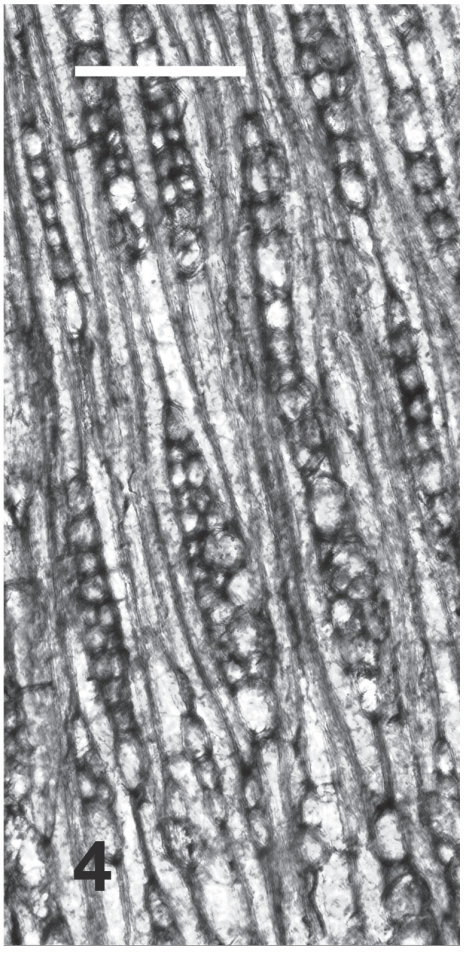
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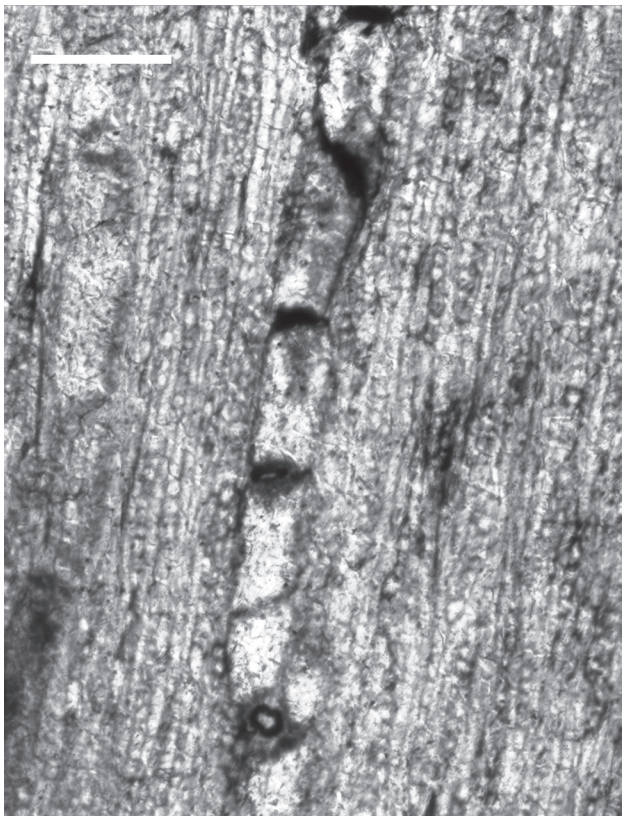
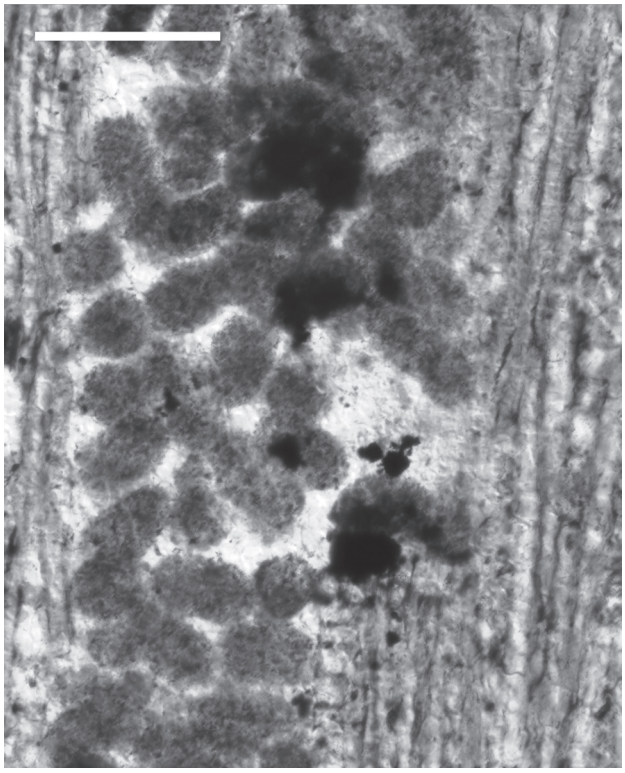


Textfigure 4: *Capparidoxylon holleisii* nov. sp. Longitudinal tangential section. Short vessel members with simple perforation plates; BSPG 2004 XV 1; scale bar = 300 µm, x 60.



Textfigure 5: *Capparidoxylon holleisii* nov. sp. Longitudinal tangential section. Vertical insect boring filled with oval to round coprolites, presumably from *Anobium* sp.; BSPG 2004 XV 1; scale bar = 200 µm, x 120.

Crystals and stroried structure not observed.

Coprolites: Numerous feeding channals occur that are particularly conspicuous in cross sections (e.g., Pl. 1, Figs 3-4; Textfig. 5). These are filled with coprolites; small coprolites are round and 27-55 µm in diameter, the larger ones oval and measure 75-112 (mean 89) x 62-70 (mean 65) µm. The radial length of the borings varies from 0.2 to 1.6 mm (Tab. 1). *Capparidoxylon holleisii* represents only the second fossil from the southern Franconian Alb that displays insect damage. The perpetrators of these feeding channels probably were *Anobium* sp. (Mombacher 2003). A first silicified wood with feeding channels filled with coprolites assignable to *Anobium* sp. has been reported from Egweil (Selmeier 1984b), a site located a few kilometers east of Attenfeld (Textfig. 1).

Synopsis of microscopic features:

a) IAWA Committee (1989): 2, 5, 10, (11), 13, 22, (24/25), (41/42), 46, 51, 58, 60, 75, 97, 100, 105.

b) Fossil Wood Datasheet for Species (Wheeler 1991a, b): 42, 45, 50, 51, 54, 58, 62, 65, 71, 83, 86, 87, 95, 106, 110, 113.

4. Discussion

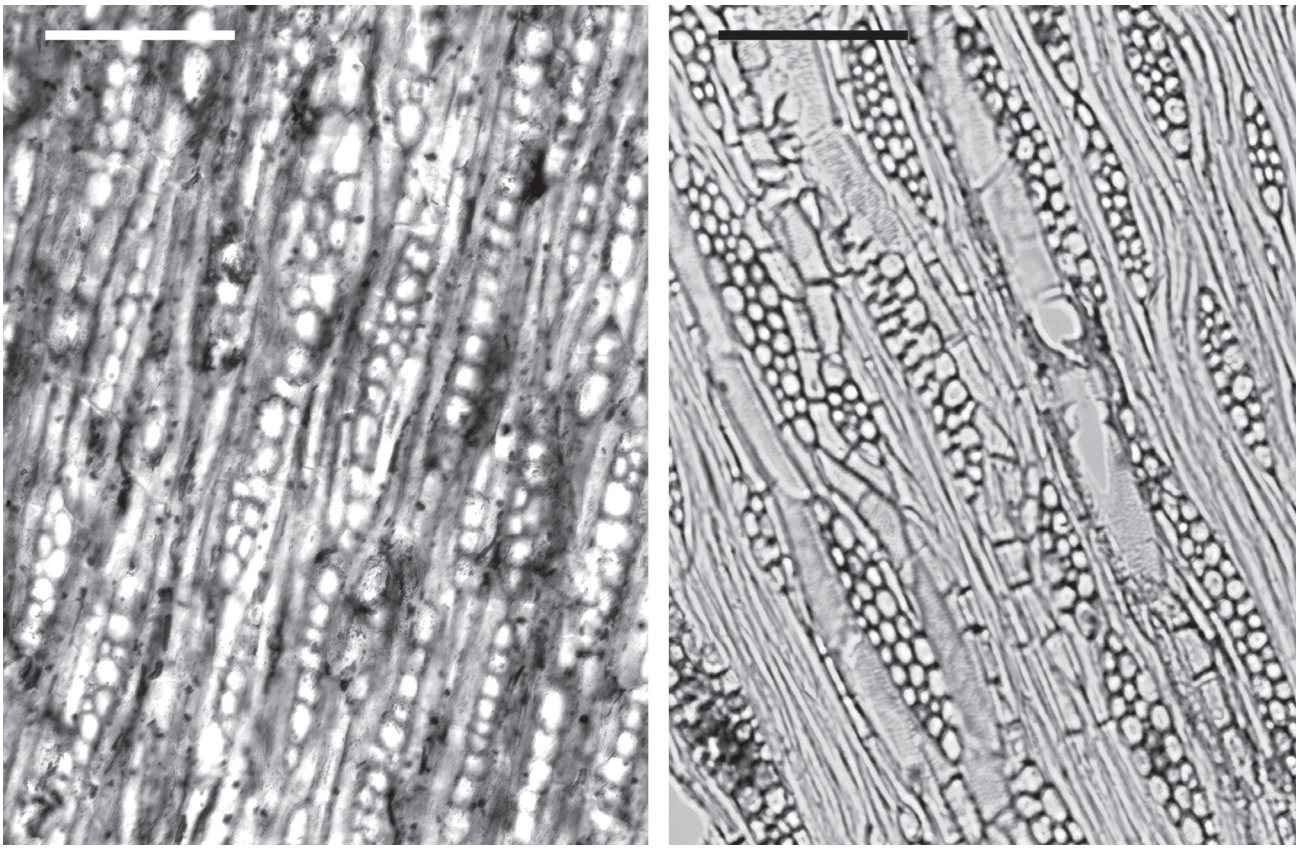
4.1 Comments on Anatomical Features

Vessels – Distinct vessel diameter classes are a typical feature for 12 species of the Saharan and Sahelian Capparaceae (Neumann et al. 2001). This feature is highly diagnostic, but may be difficult to observe since the smaller vessels cannot be separated with confidence from vasicentric tracheids in cross sections (Textfig. 2). Quantitative features such as vessel diameter and number of vessels per mm² are highly variable.

Deposits – In woody plants, various deposits commonly occur and are irregulary distributed. Their formation is often related to processes of heartwood formation. In the fossil presented here, conspicuous yellow deposits, probably consisting of mustard-colored oil glycosides (cf. Roth et al. 1994), are clearly visible in cross- and longitudinal sections (Pl. 2, Figs 1-2; Textfig. 4). Gums and other deposits include a wide variety of chemical compounds (Hillis 1987).

Tracheids – 82% of the Saharan extant woody plants possess vascular/vasicentric tracheids (Neumann et al. 2001). These tracheids are effective as a subsidiary system for water conduction. Within the Sahelian woody plants that display vascular/vasicentric tracheids, the family Capparaceae is well represented with 11 species (Neumann et al. 2001). Unfortunately, this important feature is often difficult to observe without maceration.

Rays – Wood samples of a single plant species often display considerable size differences with regard to the width of the multiseriate rays. The fossil presented here, displaying mixed procumbent, square, and upright cells, is presumably part of a twig or young branch, but not a mature wood. The young tissues usually display a higher amount of square and upright cells. The ray heigth is also a highly variable feature.



Textfigure 6: *Capparidoxylon holleisii* nov. sp. (left, BSPG 2004 XV 1), and *Capparis speciosa* (right, RAKF No.3223). Note the similarities in cellular composition of the rays; scale bars = 200 µm, x 115.

Crystal-containing ray cells – In heterocellular rays with mixed procumbent and square or uprigth cells, crystals are usually present in both cell types. Crystals have not been observed from the fossil. However, Miller (1978) found that sectioning and mounting techniques may remove some of the crystals.

4.2 Affinities

Capparidoxylon holleisii is characterized by indistinct growth rings, solitary vessels with approximately 50 to 100 µm tangential diameter, radial multiples of up to 10, the occasional occurrence of vessel clusters, vessels that sometimes intergrade with vascular tracheids, short vessel members, simple perforations, conspicuous yellow deposits, non-septate fibres, scanty paratracheal axial parenchyma, rays 1-2-(3)seriate, faintly heterocellular rays, and the occasional occurrence of sheath cells. This complement of wood anatomical in nearly all microscopic details clearly resembles that seen in woods members in the extant genus *Capparis*. A detailed summary of the similarities between the fossil *C. holleisii* and selected extant species of *Capparis* is provided in Tabs 2-4.

4.2.1 Comparison to Extant Wood

A detailed microscopic examination of the wood structure of selected extant Capparaceae was carried out to specify the nearest living equivalent of the fossil. The Xylothec of the Wood Research Institute, Technical University Munich, Germany (Stern 1988) holds material of the following genera: *Boscia* sp. (Lam.), *Buchholzia coriaceae* (Engl.) A.Chev., *Capparis cynophallophora* L., *C. speciosa* Griseb., *C. spinosa* L., *C. tomentosa* Lam., *Crataeva adansonii* DC., *C. tapia* L. and *Maerua* sp. Forssk. This material was included in the comparative analysis. *Capparis speciosa* Griseb. (RAKF No.3323) is very similar to the present fossil, especially with regard to the cellular composition of the rays (Textfig. 6). Moreover, descriptions and microphotographs (Gregory 1994) of the wood structure of extant Capparaceae in the literature were considered; these include data on *Capparis maroniensis* R. Ben. (Détienne & Jacquet 1983); *C. cartilaginea* Decne., *C. decidua* (Forssk.) Edgew., *C. ovata* Desf., *C. spinosa* L., *Cleome droserifolia* (Forssk.) Del., *Maerua crassifolia* Forssk. (Fahn et al. 1996); *C. decidua* (Forssk.) Edgew. (Jagiella & Kürschner 1987); *C. acuminata* Willd., *C. micracantha* D.C., *C. subacuta* Miq. (Janssonius 1952); *C. decidua* (Forssk). Edgew., *C. spinosa* L., *C. tomentosa* Lam., *Crataeva religiosa* Forst. (Neumann et al. 2001); *C. decidua* (Forssk.) Edgew. (Niloofari 1961); *C. spinosa* L. (Schweingruber 1991), and other species in the genus *Capparis* (cf. Boureau 1957; Carlquist 2001; Ilic 1991; Metcalfe & Chalk 1950).

Only very few anatomical features distinguish *Capparidoxylon holleisii* from the general characteristics of the wood seen in the extant genus *Capparis*; no extant taxon displays exactly the same complement of wood anatomical features

Microscopic features	Extant *Capparis* spp.	*Capparidoxylon holleisii*
Growth rings	indistinct	indistinct, faint to fairly distinct
Vessels		
Arrangement	diffuse	diffuse
Tangential diameter	53-127 (95) µm	40-135 µm, up to 150 µm
Perforation plates	simple	simple
Radial multiples	2-10	up to 8(10)
Clusters, sometimes intergrading with vascular tracheids	present	present
Intervessel pits	alternate, weakly vestured, 4-6 µm	alternate, apertures slit-like
Vessel element length	160-200 µm	mean 283 µm
Vessels per square mm	4-10	4-8
Solitary vessels per mm	ca. 10%	10% or less, up to 30%
Yellow and/or solid deposits	present in *C.decidua*	present
Fibres		
Septate or non-nseptiate	non-sepetate	non-septate
Pits	simple pits	not observed
Axial parenchyma		
Vasicentric	scanty, paratracheal to vasicentric	scanty, paratracheal
Fusiform or in 2-3-celled strands	present	not observed
Rays		
Width	1-2-4 (6) seriate	1-2 (3) seriate
Cellular composition	homo- and weakly heterocellular	homo- and weakly heterocellular
Sheath cells	ocasionally present	present, rare
Height	up to 29 (50) cells	up to 26 cells
Number per mm tangential	(3)-5-9	6-12
Crystals	not observed, probably water-soluble	not observed

Table 2: Comparison of wood anatomical features of selected extant species of *Capparis* (i.e. *C. cartilaginea, C. decidua, C. ovata, C. spinosa*) and *Capparidoxylon holleisii*.

as that recorded for the fossil. For example, one difference in minute anatomy concerns the absence of two clearly distinct vessel diameter classes in cross section (Tab. 4) in extant *Capparis*. As stated above, the fossil presumably represents part of a twig or branch. It is established knowledge that the wood of branches and twigs may differ in anatomy from the wood of mature trunks. Trunk wood, however, usually forms the base for wood anatomical descriptions of extant plants. Thus, taking the wealth of striking similarities (Tabs 2-4) into account that exist between *Capparidoxylon holleisii* and extant Capparaceae, the fossil can be assigned to the family Capparaceae with confidence.

4.2.2 Fossil Capparaceae Wood

The fossil record of Capparaceae wood is meagre (Andrews 1955). I am aware of only to descriptions of silicified wood specimens that have been assigned to Capparaceae, i.e. *Capparidoxylon Geinitzi* Schenk, 1883 from the Petrified Forest near Cairo in Egypt and *Forchhammerioxylon scleroticum* Kruse,

	Number of vessels per multiples	% of solitary vessels	Vessel member length, mean µm	Ray width, No. of cells	Maximum ray height, No. of cells
C. cartilaginea	2-8(12)	10 or less	160	1-4	30
C. decidua	2-3(5)	35	180	1-3(4)	40
C.ovata	2-5(6)	25	200	(1)3-6	50
C. spinosa	2-6(8)	20	170	1-4(5)	30
Maerua crassifolia	2-8	40	140	1-3	45
Capparidoxylon holleisii	2-7(10)	10 or les	283	1-2(3)	*26*

Table 3: Quantitative comparison of selected wood anatomical features of *Capparidoxylon holleisii* with those seen in selected extant species of *Capparis* and *Maerua* (according to Fahn et al. 1986).

Species	Vessels	Deposits in vessel lumina	Vascular tracheids	Cellular compostion of rays	Perforation plates	Reference
Capparis decidua	two distinct vessel diameter classes	yellow gum-like deposits	commonly present	procumbent, square and upright	simple	Neumann et al. 2001
Crateva religiosa	medium sized	–	commonly present	procumbent, square and uprigth (in branchwood)	simple	Neumann et al 2001
Capparis decidua	tending to be of two classes	gummy contents in many vessels	vessels typically intergrading with vascular tracheids	somewhat heterocellular	simple	Fahn et al 1996
Capparis decidua	diffuse-porous, small, pore groups irregular distributed	mustard-oil glucosides	paratracheal-vasicentric parenchyma	homo- and heterocellular (Kribs Typ III)	simple	Jagiella & Kürschner 1987
Capparis spp.	–	often filled with solid deposits	–	–	simple	Metcalfe & Chalk 1951
Capparidoxylon holleisii nov. sp.	medium sized, two distinct classes not observed	yellow deposits in many vessels	vessels partly intergrading with vascular tracheids	procumbent, square, uprigth, sheat cells	simple	this paper

Table 4: Wood anatomical similarities between *Capparidoxylon holleisii* and selected extant species of *Capparis*

Fossil name	Affinities	Locality and age	Author
Capparidoxylon Geinitzi	*Capparis* (Tourn.) L.	Egypt, Oligocene	Schenk, 1883
Forchhammerioxylon scleroticum	*Forchhammeria*, *Cadaba*, *Maerua*	Wyoming, USA, Eocene	Kruse, 1954
Capparidoxylon holleisii	*Capparis* spp.	Germany, Miocene	this paper

Table 5: Summary of fossil Capparaceae wood described since 1883.

Family	Genus	References
Anacardiaceae	*Pistacia*	Selmeier 2000a, 2000b; Gottwald 2004
Capparaceae	*Capparis*	this paper
Dipterocarpaceae	*Shorea*	Selmeier 1998a
Fagaceae	*Castanopsis*	Selmeier 1970; Gottwald 2002, 2004
Icacinaceae	*Cantleya*	Gottwald 2002, 2004
Juglandaceae	*Carya, Juglans*	Selmeier 1986; Gottwald 2004
Lauraceae	*Laurus, Cinnamomum,*	Selmeier 2003; Gottwald 2004
Leg.-Mimosoideae	*Acacia, Dichrostachys*	Gottwald 2002, 2004
Leg.- Papilionoideae	*Robinia*	Gottwald 2004
Meliaceae	*Cedrela*	Gottwald 2002, 2004; Selmeier 2003a, 2004
Rosaceae	*Crataegus*	Selmeier 1984a; Gottwald 2004
Rosaceae	*Prunus*	Selmeier 1984a
Sapotaceae	*Bumelia*	Selmeier 1991; Gottwald 2004
Ulmaceae	*Celtis*	Selmeier 1989; Gottwald 2004
Cupressaceae	*Cupressus*	Gottwald 2002
Podocarpaceae	*Podocarpus*	Gottwald 2004
Taxodiaceae	*Taxodium*	Selmeier 2003b; Gottwald 2004
Taxodiaceae	*Glyptostrobus*	Gottwald 2004
Tempskyaceae	*Tempskya*	Holleis & Gregor 1986

Table 6: Silicified wood from the locality Attenfeld in the southern Franconian Alb: summary of genera described to date.

1954 from the Eden Valley in Wyoming (U.S.A.). However, the specimen from Egypt is not included in the Fossil Wood Database/Database References (Wheeler 1991a, 1991b). A second *Capparidoxylon* specimen from the Petrified Forest near Cairo is 8 cm long and 5 cm in perimeter, and was collected by Schlieffen. According to Schenk (1883), this second specimen is very similar in anatomy to *C. Geinitzi*.

4.3 Silicified Wood from Attenfeld

Some 1.200 specimens of permineralisized wood have been collected from farmland and waysides by P. Holleis during the mid 1970s (Holleis 1992). Twenty-two genera from this locality have to date been identified by xylem-microscopic methods (Tab. 6).

5. Concluding Remarks

Several localities in the southern Franconian Alb continue to yield well preserved Miocene silicified wood. Of these localities, Attenfeld produced the most diverse assemblage of wood ever recorded from a single locality in the North Alpine Molasse Foreland, and twenty two different plant genera have been identified based on silicified wood. The extant equivalents of these woody plants from the southern Franconian Alb generally thrive in temperate, subtropical, and tropical climates; they occur today in the Mediterranean to Minor Asia and to parts of South Asia. The fossil wood from Attenfeld must have been reworked and transported to southern places of the Franconian Alb by rivers based on the fact that fossilized roots have never been found to date in Miocene sediments in southern Franconian Alb.

Capparidoxylon holleisii represents the first record to date of silicified Capparaceae wood from the Neogene of Europe. The fossil displays indistinct growth rings, which suggests that relatively stable climate conditions existed during this time. Variability of the ecological conditions, including seasonal drought, soil composition, light regimes, and temperature variability, may profoundly affect xylem structure. However, genetic determination of quantitative anatomical features and differences related to the topographic position of the wood fragment must also be taken into consideration. *Capparidoxylon holleisii*, together with the fossil representatives of *Dichrostachys* and *Pistacia* (Tab. 5), has presumably been subjected to prolonged drought periods. *Capparis* is today widely distributed in arid-/semi-arid regions and open habitat in the Mediterranean and adjacent areas (Zohary 1960, 1983).

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