

SYMPLOCACEAE AND CYRILLACEAE IN THE LOWER RHENISH BROWN COAL: IMPORTANT COMPONENTS OF A PEAT-GENERATING VEGETATION

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ABSTRACT. During the past decades several attempts to reconstruct the original vegetation of the Miocene brown coal in N.W. Europe have been made. They resulted in a differentiation into woody and non-woody types of vegetation. Within the former component the Symplocaceae were represented by several species, forming an important part of the vegetation cover. Symplocaceae are recovered from the brown coal as pollen (*Porocolpopollenites*), wood-remains (*Symplocoxylon* spp.), fruits (*Symplocos* spp.) and recently also from leaf-assemblages (*Symplocos* sp.) within the brown coal. The cuticle of this leaf species shows a great resemblance to that of Recent *Symplocos arisaensis*, *S. ernestii* and *S. paniculata* from East Asia.

Next to Symplocaceae the Cyrillaceae were an important component. Their pollen and wood (*Cyrilloxylon*) has also been recognized. The genus *Cyrilla* has already been known for some time, but now also *Cliftonia* is recognized.

KEY WORDS: leaves, cuticle, Miocene, palaeoecology, Germany

INTRODUCTION

In the past several attempts to reconstruct the vegetation of the brown coal swamps have been made (Schönfeld 1924, Teichmüller 1991, Van der Burgh 1973, Schneider 1986, 1992, 1992a). Using different types of plant fossils and with the help of comparison to recent vegetation these attempts resulted in a differentiation into woody and non-woody vegetation. Several plant-families have been observed with help of different disciplines. However, for a more detailed understanding of the interrelationship of various plant communities an extensive knowledge concerning the taxa is necessary. In this respect the picture is still far from complete and more research is necessary to obtain sufficient data for the interpretation of various vegetation types and their interrelations.

Leaf compressions are not found very regularly in the Rhenish brown coal. So studying and comparing the various plant associations starting from this type of fossils is rather difficult. In 1996 I was given some samples of brown coal containing numerous leaf compressions with a good preservation. This enabled me to do such a study. The cuticles could be identified and in some cases a leaf-shape could be added. This led to some more detailed identifications, of which two are presented here: Symplocaceae and Cyrillaceae.

MATERIAL AND METHODS

The material originated from a local coal developed as a channel deposit in the Upper Miocene Inden Formation of the open-cast-mine Hambach and is therefore comparable with coal from the upper seam within this region. Small pieces of the leaf compressions were bleached with a solution of NaClO and mounted with glycerin jelly. No colouring was applied. The preparations were studied under the light microscope. The leaf compressions themselves were studied under a binocular preparation microscope.

RESULTS

Symplocaceae from the Tertiary of the Lower Rhenish Basin are known from various types of plant-fossils. Several types of pollen, belonging to the genus *Porocolpopollenites* (Mohr 1984) have morphologically been identified as belonging to this family. The taphonomy of pollen, however, is not clearly known. Although the insect-pollinated plants show a narrow distribution of their pollen, little is known about the distributors and their behaviour.

The distribution of wood is better known. Generally wood in allochthonous deposits is displaced over a long distance and therefore extremely allochthonous, more so than leaves and fruits. On the other hand, wood in autochthonous deposits, such as forest peat, is not transported at all, and therefore autochthonous. One of the source vegetations of the rhenish brown coal is thought to have

been a woody vegetation of shrubs and small trees, in which several angiospermous genera and conifers together formed a locally rather dense population of small, slow growing, woody plants. Wood of such a vegetation is autochthonous in the brown coal and in these wood assemblages at least three species of *Symplocoxylon* have been observed (*S. latiporosum*, *S. kraeuselii*, *S. eschweilense*) (important characters are: single vessels, heterogeneous rays, resinous contents, scalariform perforations) (Van der Burgh 1964, 1973).

The fruits and seeds of the Rhenish brown coal are rather poorly known, due to the fact that this brown coal is very much homogenized and dense, which is a drawback for a carpological study. Nevertheless, some clayey-coaly deposits could be analyzed and in these the Symplocaceae formed part of the assemblage. Within the brown coal a total of 5 species of *Symplocos* has been identified: *S. gothanii*, *S. lignitarum*, *S. germanica*, *S. salzhausenensis* and *S. schereri* (Van der Burgh 1987). Of the latter species only one endocarp has been found, of the other species several, up to 79 (ca 20%) of one species (*S. lignitarum*) in one association. So it is clear, that *Symplocos* formed part of the local vegetation of the Miocene brown coal bog. Up till now no *Symplocos* had been recorded with certainty from cuticle studies.

However, among the leaf remains of the study sample a rare, extremely thin cuticle (Pl. 1 fig. 3) could be identified as probably belonging to *Symplocos*. It can be compared to the cuticle of *Symplocos arisaensis*, *S. ernestii* and *S. paniculata* (Pl. 1 fig. 2). All three Recent species show a thin cuticle with anomocytic stomata with a plain aperture. The fossil material shows anomocytic stomata with a plain aperture and plain, unicellular hairs with a round not thickened base (Pl. 1 figs 4,5). The latter two extant species show also various types of hairs and hairs with a comparable implantation are found in abundance on the cuticle of *S. paniculata*, together with a very slightly cutinized basal part (Pl. 1 fig. 6).

The leaf-compression (Pl. 1 fig. 1) is incomplete. The leaf is oblong-acuminate, cuneate at the base, is ca 6 cm long and ca 1 cm wide, the margin is entire. Venation: hypodromous. Part of the species used for comparison have also oblong-acuminate, but apically dentate leaves (Pl. 1 fig. 7a, b).

Cyrillaceae: this family has been known from the Rhenish brown coal for a long time. Kräusel & Weyland (1954) identified the leaf and cuticle of *Cyrilla* and I identified the wood as early as 1964 on the ground of diagnostic characters such as: single vessels, heterogeneous rays, scalariform perforations, no resin-like contents (Van der Burgh 1964).

One of the most often occurring cuticle/leaves in our sample is *Lusaticutis* sp. (type Nfu 37, Litke 1966) (Pl. 2 fig. 3). This cuticle is comparable in nearly all its characters with that of *Cliftonia monophylla* from the USA (Pl.

2 figs 1, 2). It is anomocytic with isodiametric epidermal cells. It shows next to the normal cellular-wall rims, an additional number of rims, which obliterate the pattern of the cellwall rims, with the same result as in the cuticle of *Lusaticutis* sp. This type of cuticle has some ornamentation on the internal ledges of the stomatal apparatus, which is also present in *Cliftonia*. The leaf compressions (Pl. 2 fig. 5) are oblong, 3.5–5 cm long and 10–14 mm wide. Both, the apex and the base are acute; the margin is entire. Very often the leaf is slightly curved into an S-shape. The venation is hypodromous. The leaves of the recent species have the same characters (Pl. 2 fig. 4): venation badly visible, S-shape, margins entire, base and apex acute. So our conclusion is, that *Cliftonia* was present in the Tertiary of the Rhenish basin.

DISCUSSION

Cliftonia is with 17% of all cuticle/leaf remains the most numerous angiospermous leaf fossil in our sample. It is followed closely by that of *Cyrilla* (16%). *Symplocos* constitutes only 1% of the dicotyledonous cuticle remains. Of the conifers *Sciadopitys* is very numerous (30%).

In the M. Miocene coal of the Lausitz *Cyrilla* (Schneider 1992) and possibly also *Symplocos* are characteristic for the *Pinus*-vegetations, *Cliftonia* is typical for the Gramineae vegetation (Schneider 1998, personal communication), while an abundance of *Sciadopitys* needles points to a *Sciadopitys*-raised-bog (Jurasky 1936, Schneider 1990, 1992).

In the Rhenish brown-coal *Sciadopitys*-wood together with wood of Pinaceae and Taxodiaceae was found in growing position in the upper seam. A mix of conifers and angiosperms was found in other wood levels (Van der Burgh 1973). So it is clear that this material is at least partly derived from an open coniferous vegetation containing a number of woody angiosperms. The ecological position of *Cliftonia* within the Inden Formation of the Rhenish brown coal cannot be characterized from this sample only and is still an open question with reference to this region.

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PLATES

Plate 1

1. *Symplocos* sp., leaf compression U9670. 'Hambach', Upper Miocene, Scale bar: 1 cm
2. *Symplocos paniculata* Miquel, cuticle preparation 262, stomata, cultivated, Doorn, The Netherlands, stomata, × 400
3. *Symplocos* sp., cuticle preparation no. C3285, stomata, 'Hambach', Upper Miocene, × 400
- 4, 5. *Symplocos* sp., cuticle preparation C3285, hairs, 'Hambach' Upper Miocene, × 400
6. *Symplocos paniculata* Miquel, cuticle preparation 262, hairs and stomata, × 100
- 7a. *Symplocos arisanensis* Hayata, leaf, Japan, scale bar: 1 cm
- 7b. *Symplocos glauca* (Thunberg) Koidzumi, leaf, Japan, scale bar: 1 cm

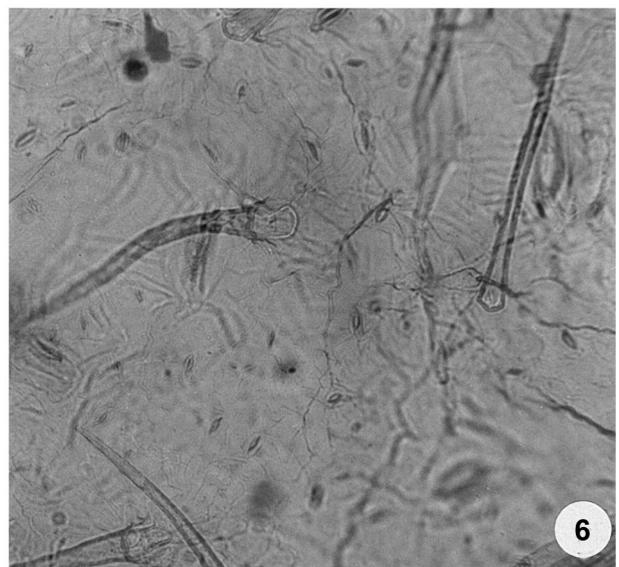
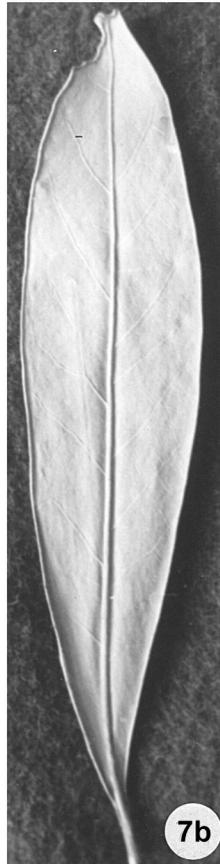
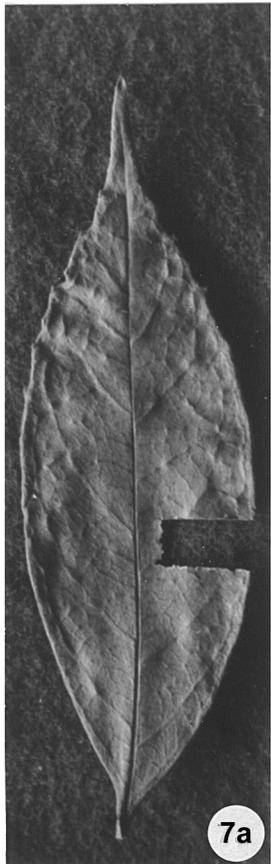
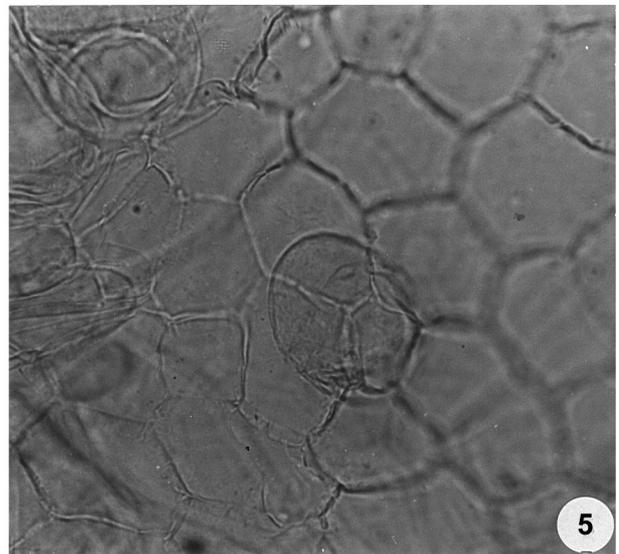
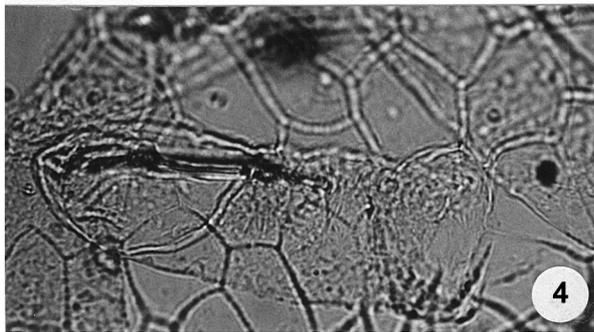
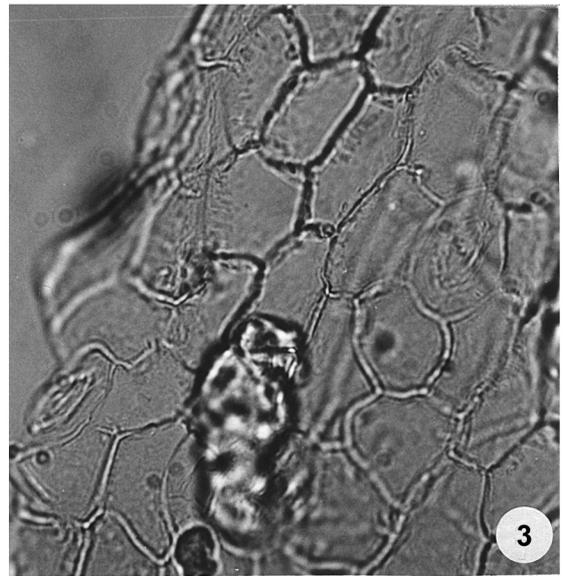
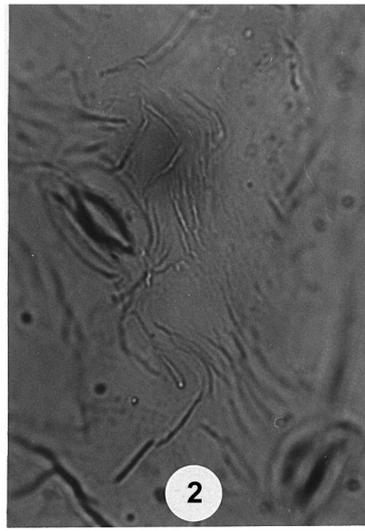
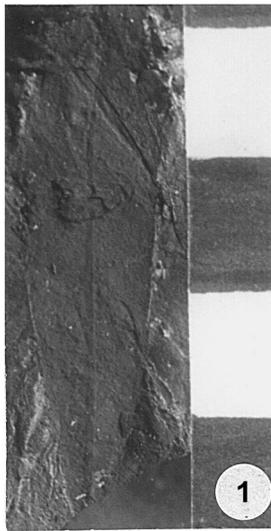


Plate 2

- 1, 2. *Cliftonia monophylla* (Lam.) Sargent cuticle preparation 1088, stomata, epidermal rims, Florida, USA, × 400
3. *Cliftonia* sp., cuticle preparation C3234, stomata, epidermal rims, 'Hambach', Upper Miocene, × 400
4. *Cliftonia monophylla* (Lam.) Sargent, leaves, Florida, USA, scale bar: 1 cm
5. *Cliftonia* sp., leafcompression U9578, 'Hambach', Upper Miocene

