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BRACTS AND OTHER VEGETATIVE REMAINS OF SALIX RETICULATA L. IN A LATEGLACIAL DEPOSIT FROM USSELO, THE NETHERLANDS

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SUMMARY

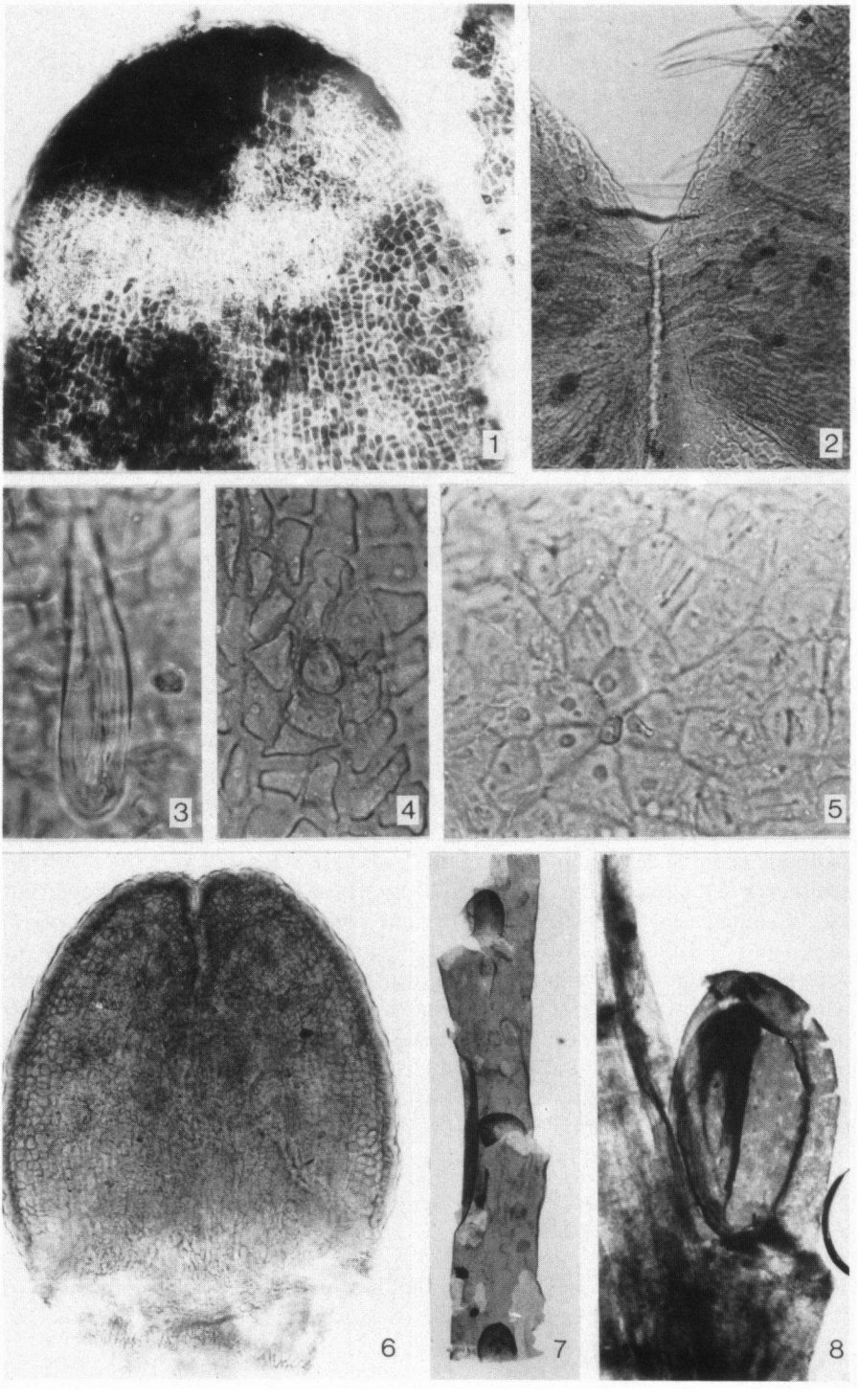
Leathery bracts of *Salix reticulata*, which have never been recognized as such, occurred regularly in a Lateglacial deposit from The Netherlands. Morphological characteristics and illustrations of fossil and recent bracts are presented and the stratigraphical position of the *Salix* macrofossils (bracts, twigs and some leaf fragments) within the Lateglacial deposit indicated along with a selection of pollen curves. *S. reticulata* was restricted in its occurrence to periods of open vegetation.

1. INTRODUCTION

The site Usselo (52°12′ N, 6°49′ E) is situated in a cover-sand area in the eastern part of The Netherlands. A palynological study of the Lateglacial deposits from the Usselo site was carried out for the first time by VAN DER HAMMEN (1951). A detailed study of a section collected in 1975 has been undertaken by the first author (VAN GEEL et al. 1984). Among the macrofossils were small, leathery tongue-shaped bracts (*plate I, fig. 6*; *plate II, figs. 9–11*), which occur regularly in that part of the deposit underlying the Allerød peat, as well as in the overlying sediments belonging to the Younger Dryas. These bracts were often detached, but in some cases they were still in organic connection to thin twigs (*plate 1, figs. 7* and *8*). Bracts and twigs showed a characteristic epidermis with *c.* 8 μm wide pits, surrounded by relatively thick-walled epidermal cells. In one case some hairs (trichomes) were observed, their bases being implanted in the above-mentioned pits. These observations and the occurrence of the same epidermal type on rare fragments of small willow leaves lead to the identification of the tongue-shaped bracts. The present paper deals with the specific identification and comparison with recent material.

2. RELEVANT PALYNOLOGICAL AND STRATIGRAPHICAL INFORMATION

The schematic summary diagram on the left hand side of *fig. 1* shows the relative frequencies of pollen of *Betula, Juniperus, Hippophae, Pinus* and the total of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upland herbs. The boundaries of zones Ia, Ib, Ic, II and III (according to FIRBAS 1949) are indicated alongside the lithological column. A relevant selection of pollen curves is given to the right of the summary diagram. Next the pollen curve of *Salix* the representation of *Salix* macrofossils (mainly bracts, with some shoots and leaf fragments) is indicated.

During the deposition of the sediments a depression was present at the sampling site. A reconstruction and interpretation of the local vegetational succession was given by VAN GEEL et al. (1984). Initially a pool was present which started as oligotrophic, with a very low organic production, in a barren sandy landscape. The sequence of aquatics and helophytes points to a gradual eutrophication of the site. From the start of the Allerød period (zone II) on, peat was formed. This peat was covered again by a sandy limnic deposit as a consequence of a rise in the water table at the transition between the Allerød and the Younger Dryas (zone III).

Some characteristics of the vegetational succession in the area around the depression can be deduced from the pollen curves of "dry" herbs, shrubs and trees. Zones Ia and Ic both represent a period of open vegetation, whereas zone Ib shows relatively high pollen percentages of shrub-forming *Juniperus* and *Betula*. During the Allerød the area was invaded by *Betula* which gave way to a *Pinus-Betula* forest later on in the period. Zone III reflects a return to open vegetation.

3. THE IDENTIFICATION OF THE SALIX MACROFOSSILS IN THE USSELO SECTION

3.1. Leaves (*plate II, figs. 16, 18* and *19*)

Several fragments of apparently small willow leaves were observed and these were compared with cuticle preparations from herbarium material of several possible species. They appeared to be comparable with the species of the subgenus *Chamaetia* Dumont. Within this subgenus the fossil material was similar to that of *S. reticulata* L. (*Plate I, fig. 5*) and, to a lesser degree, with that of *S. herbacea* L. The cuticles of both species differ principally in the number of hair bases within the areoles (the smallest areas of leaf tissue surrounded by veins). This number is always low (0–5(–8)) in *S. herbacea* and extremely variable in *S. reticulata*, i.e. (0–)3–13(–17) per areole. The cuticle of *S. reticulata* has stomata of the polycytic type, varying from anomocytic to brachyparacytic and hemiparacytic (DILCHER 1974). The trichome basal cells are radially arranged, somewhat modified cells (thicker wall), although those overlying major branches of the

Plate I. *Salix reticulata* L. Figs. 1–5: recent material; Figs. 6–8: fossil remains. Fig. 1: bract with very shallow notch, × 50; 2: detail of a bract, displaying hairs and apical cleft, × 125; 3: detail of bract with hair, × 500; 4: detail of bract with trichome basal cells, × 500; 5: detail of leaf, revealing trichome basal cells and stomata, × 500; 6: bract, × 100; 7: twig with three bracts, × 10; 8: twig-fragment with a bract, in proximity to a leaf-scar, × 25.

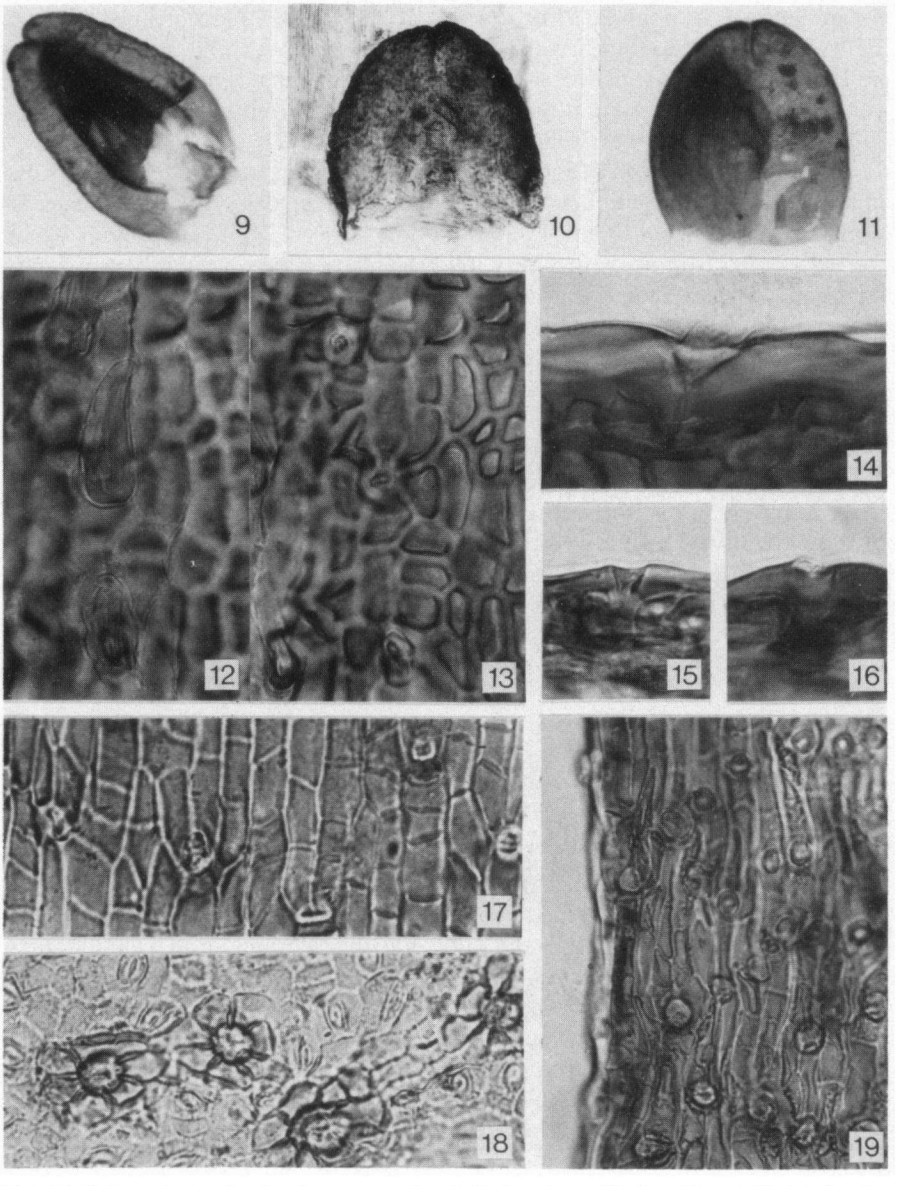

Plate II. *Salix reticulata* L., fossil remains. Figs. 9–11: bracts, × 25; figs. 12 and 13: details of a bract, showing hairs at high and low focus, × 670; figs. 14–16: lateral views of pits formed by hairs in cuticule and epidermis of, respectively, a bract (× 650), a stem (× 500) and a leaf (× 650); figs. 17–19: details of epidermis of a twig, a leaf and a petiole, respectively, × 500.

venation and the petiole are less modified. The trichome bases themselves are thickened.

3.2. Bracts (*plate I, figs. 6–8; plate II, figs. 9–14*)
Tongue-shaped bracts were of regular occurrence in macrofossil samples. These bracts are 0.7–1.6 mm long and detached or still in organic connection to a shoot, in which case they may be in close proximity to a leaf scar (*plate I, fig. 8*) or far apart (*plate I, fig. 7*). The fossil bracts display similarities to those of the subgenus *Chamaetia* which are persistent, becoming leathery with age. Only the bracts of *S. reticulata* (*plate I, figs. 1–4*) bear some hairs, mostly at the tip, but also some short hairs on the adaxial side of the bud. The bracts have an outer layer of thickened epidermal cells, overlain by a thick cuticle. The inner layers of the bracts do not have a characteristic morphology and in any case these layers do not fossilize. The hairs have a thickened base, which however, is not conspicuous between the thick-walled epidermal cells. The radially arranged trichome basal cells have a relatively thick wall. At the top of the bracts a shallow notch can be observed (*plate I, fig. 1*). Under pressure the bract may split, forming a cleft (*plate I, fig. 2*). The fossil bracts differ from the recent material in the shape of the cleft (*plate I, fig. 6; plate II, fig. 9*). However, considering the fossil material would be unable to expand during compression of the enclosing sediments, such a difference could be expected.

3.3. Twigs (*plate I, figs. 7* and *8; plate II, figs. 15* and *17*)
Twigs, 0.9–1.6 mm in diameter, in some cases with bracts and/or leaf scars, were observed in several samples. These twigs display an epidermal pattern similar to the above-mentioned leaves and bracts, in particular with regard to the trichome bases in the epidermis. Specific identification based on isolated willow twigs proved impossible.

4. DISCUSSION

In palaeobotanical studies of Quaternary deposits the occurrence of leaves of *Salix* species is often mentioned (see e.g. TRALAU & ZAGWIJN 1962; TRALAU 1963; GODWIN 1975), specific identifications being based on the outline and venation of the leaves. During the present study well-preserved leathery bracts of *Salix reticulata* were of regular occurrence in the samples, whereas leaves were rare and badly damaged. The observed difference in preservation is apparently related to the very thick outer cell walls and cuticle of the bracts. Bracts of *Salix* have not been mentioned in the palaeobotanical literature and this justifies the illustrations and the short description given in the present paper.

From their stratigraphical position in the section Usselo one can deduce that *S. reticulata* (as could be expected, see TRALAU 1963) formed part of a rather open vegetation with pioneers like *Artemisia, Hippophae, Plantago* and *Tortella flavovirens* (WIEGERS & VAN GEEL 1983). A conventional interpretation of such a vegetation with dwarf willows implies relatively cold to cool conditions. Palynological studies and an analysis of insects from Lateglacial deposits present somewhat conflicting evidence as far as mean July temperatures are concerned (COOPE 1977). In a separate paper a palaeoclimatological interpretation of the

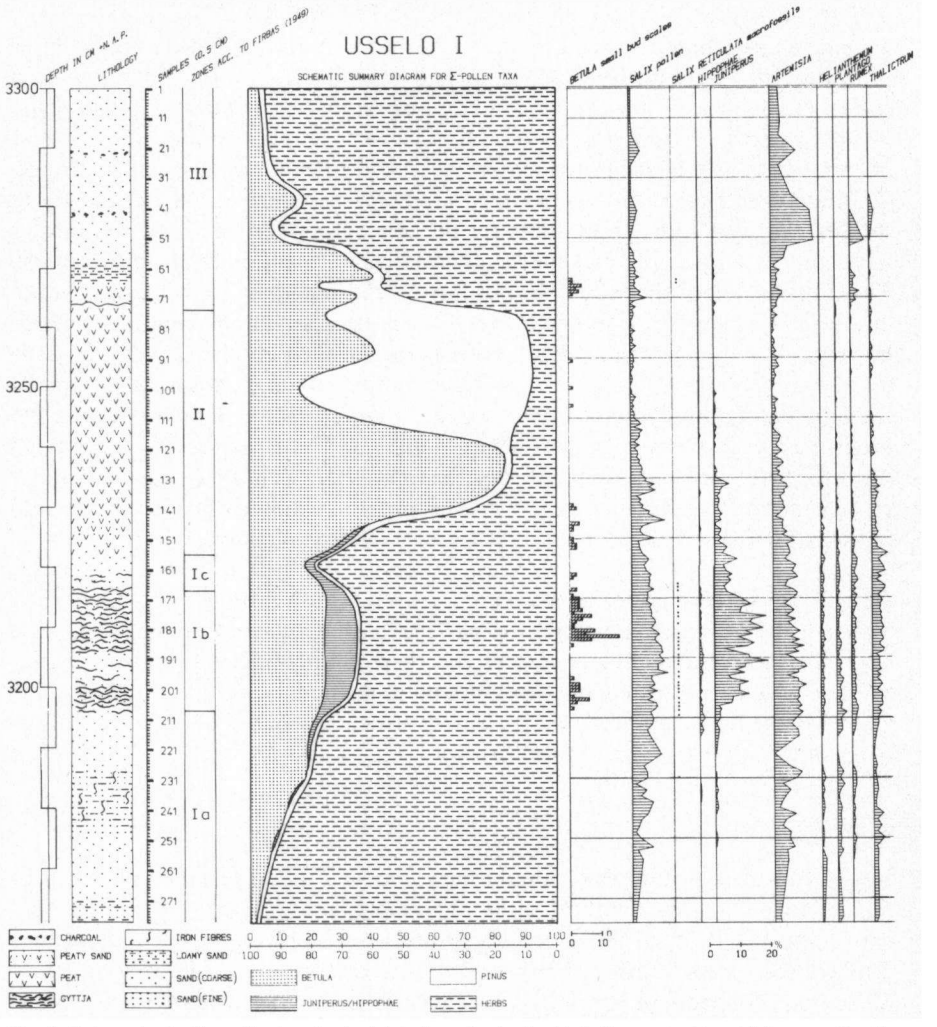

Fig. 1. Relevant selection of palynological data in order to elucidate the context in which macrofossils of *Salix reticulata* are found in the Lateglacial section Usselo I.

integrated studies on the Lateglacial sequence from Usselo will be presented.

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