

**ASPECTS OF ROMANIAN EARLY JURASSIC PALAEOBOTANY  
AND PALYNOLOGY.  
PART IV. A NEW SPECIES OF WELTRICHIA FROM ANINA**

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**ABSTRACT.** A new species of bennettite genus *Weltrichia* BRAUN, *Weltrichia givulescui* n.sp., is defined, described and discussed. Its age is Sinemurian and it was recorded associated with *Zamites aninaensis* foliage from Anina, South Carpathians, Resita Basin, where these species are confined to the upper sandstone sequences of the Valea Tereziei Member, Steierdorf Formation, between the Coal seams no. 6 and 8.

**Keywords:** *Weltrichia givulescui*, Cycadeoidales, male reproductive structure, Sinemurian, Anina, South Carpathians, Reșița Basin, Romania.

**INTRODUCTION**

Lower Jurassic deposits of Romania yield a rich land flora, well preserved and diverse (Popa, 1998, 2000a). One of the most important Liassic plant locality (LPL) of Romania, a fossile-Lagerstätte locality is Anina (Popa, 1997), formerly known as Steierdorf, which belongs to the Getic Nappe, Reșița Basin respectively. In Anina occurs a palaeobotanical reserve confined to the southern area of the Ponor Quarry, known as the Ponor SSSI (Site of Special Scientific Interest). The Lower Jurassic deposits are included to the Steierdorf Formation (Bucur, 1991), with three members, the Dealul Budinic Member (Hettangian), a basal, coarse sequence, the Valea Mereziei Member, an unit including fine sandstones, clays, coal seams, very rich in plant fossils (Hettangian-Sinemurian) and the Uteris Member (Pliensbachian-Toarcian), represented by black bituminous shales. Details of the litho- and phytostratigraphy of the Steierdorf Formation are discussed in detail in Popa (2000a, b).

The Valea Tereziei Member includes eight coal seams and a refractory clay bed, where the Hettangian-Sinemurian boundary is recorded (Popa, 2000a, b). Also, at the Hettangian-Sinemurian boundary is recorded a floral change, where two separate assemblages are now known to follow one after another. The first, Hettangian assemblage is marked by the Dipteridaceous fern *Thaumatopteris brauniana* and the second, Sinemurian assemblage, is marked by the boom of the Cycadalean species *Nilssonia* cf. *orientalis*. Details of the assemblages and their definitions are given in Popa (2000a, b). The new species of *Weltrichia* described in this paper is recorded from the Sinemurian deposits of the Valea Tereziei Member, from sequences overlying the 6<sup>th</sup> Coal seam from Anina.

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### SYSTEMATICS

Bennettite male reproductive structures were previously described in Romania from Lower Jurassic deposits of the South Carpathians and from Middle Jurassic deposits of Central Dobrogea, south-eastern Romania, together with a wide variety of foliage types. From the South Carpathians, these reproductive structures were described mainly from the Reșița Basin, the first author to approach this kind of cycadeoid organs being Krasser (1915, 1922). Krasser (1915) described "male *Williamsonias*" from Anina, as *Williamsonia banatica* and *W. alfredi*, but these species belong to the genus *Weltrichia* BRAUN, *Williamsonia* being a denomination for female reproductive structures. Langer (1947) described and figured a "neue *Weltrichia*-Blute" which is actually a *Weltrichia banatica* (Popa, 2000a). Givulescu (1990) also described two new bennettite reproductive structures from Anina, including this new taxon. Popa (1998) as well cited *Weltrichia* species collected from Anina, and described them in detail, together with a *Williamsonia* species (Popa, 2000a).

Genus *Weltrichia* was defined by Braun (1849) for bennettite male reproductive structures but this combination was not used widely by later authors who preferred to use the term "male *Williamsonia*". Nathorst (1909) and Harris (1969) showed that the denomination of *Weltrichia* should be used instead of that of "male *Williamsonia*".

**Class CYCADOPSIDA**  
**Order CYCADEOIDALES**  
**Genus *Weltrichia* BRAUN emend. HARRIS 1969**  
***Weltrichia givulescui* POPA n.sp.**  
Text-figs. 1-4, Pl. I, Figs. 1-3

1969 *Williamsonia* sp. HUMML, p. 349, Pl. VII, Fig. 15.

1990 *Weltrichia* sp. (?n.sp.) GIVULESCU, p. 2. Pl. 1, Fig. 1, Pl. 2, Fig. 1, 2.

**Holotype:** fragment 1 from sample P113/C1/30A.

**Paratypes:** fragment 1 from sample P113/C1/30B and fragment 1 from sample UEB1.

**Repository:** University of Bucharest, Faculty of Geology and Geophysics, Laboratory of Palaeontology, in the Popa Palaeobotanical collection.

**Type locality:** Anina, Caraș-Severin County, Romania.

**Stratigraphic horizon:** Steierdorf Formation, within the upper, Sinemurian sequence of the Valea Tereziei Member, mainly within the roofs of the Coal seams nos. 6 and 7.

**Etymology:** *Weltrichia givulescui*, in honor of Professor Dr. Razvan Givulescu, Corresponding member of the Romanian Academy, as a homage of his brilliant contributions in the fields of Palaeobotany and Geology, celebrating his 80<sup>th</sup> anniversary.

**Diagnosis**

Bennettitalean male reproductive structure with 16 radial microsporophylls (rays) and a central cup, deeply depressed. The sporophylls have a longitudinal rib on abaxial and adaxial sides, entire margins, acute apices, they are fibrous and thick, and each of them is continued centripetally with an appendage that overlaps the adaxial, inner surface of the central cup. The central cup is covered adaxially by small pustules, possibly attractant bodies.

**Description**

Male, reproductive, cup shaped structures with radially disposed, flattened and fibrous microsporophylls (rays) having a longitudinal, an adaxial and an abaxial rib. This is why the sporophylls appear to be rhombic in cross section. Substance of sporophyll lamina very thick. Sporophylls are usually 16 per whorl and they are adnate in the center of the cup, where the structure is strongly depressed (Pl. I, Figs. 1, 3). They are inserted radially to the cup, sometimes slightly overlapping to their bases, although they are always attached in the same plane. Apices of sporophylls are acute. The external diameter is 80-90 mm, the central, adnate area's diameter is 30-40 mm, the length of the free part of sporophylls is 40-50 mm and their width is 7-10 mm. The external surface of the cup and sporophylls is smooth, while the internal surface of the cup is slightly granulated, indicating the occurrence of possible attractant bodies (Text-figs. 2, 4, Pl. I, Fig. 3). Each sporophyll is continued towards the centre of the cup by a short, free, centripetal appendage (sterile inner scales), overlapping the inner surface (Text-figs. 1, 3, 4, Pl. I, Fig. 1). Each appendage is 2-3 mm wide and 7-10 mm long. The adaxial surface of the sporophylls is rather smooth, without preserving polliniferous sacs or even their clear insertion. No cuticles or in situ pollen were extracted.

**Discussion**

In the depressed area of the structure, no indication of any ovulate cone exists, so no evidence for a possible *Williamsonia* exists at all. The recently collected material (in 1994, 1995, 1997) from Anina, shows undoubtedly the same species, a clear *Weltrichia* taxon. Harris (1969) showed the validity of *Weltrichia*, instead of "male *Williamsonia*", after a long period of time when the last denomination was largely used.

*W. givulescui* was described by Humml (1969) from Anina as *Williamsonia* sp., on material collected from the roof of the Coal seam no. 7, with the same phytostratigraphic position as the material described here, his data matching again with the data presented here. His description is accurate but incomplete, his material being not so well preserved.

This species was previously described also by Răzvan Givulescu (1990) as *Weltrichia* sp. (?n.sp.), also from Anina locality. He intuited that this is probably a new species but he did not name it consequently. Actually, his material stored within the Laboratory of Palaeontology, Babeş-Bolyai University of Cluj-Napoca, lacks any of the centripetal appendages or pollen sacs, making difficult to assess the material to a new taxon.

The closest *Weltrichia* species is *Weltrichia setosa* NATHORST emend. HARRIS 1969. This species resembles *W. givulescui* as it is the only *Weltrichia* species that has centripetal appendages, but these appendages are covered by long hairs, which is not the case of our new species. Also, the number of sporophylls

and of the centripetal appendages is far higher than in *W. givulescui*, in *W. setosa* each sporophyll tending to have two appendages. Moreover, *W. setosa* is associated with *Otozamites beani*, although Harris (1969) did not assign it surely to this foliage.

Similarities are shared with *Weltrichia alfredi* KRASSER emend. HARRIS 1969, especially in sporophylls ornamentation, but *W. alfredi* has less sporophylls per cup and no attractant bodies inside the central area. *W. alfredi* is always associated with *Ptilophyllum maculatum* foliage and probably it is the reproductive structure of the plant bearing these leaves.

Another similar reproductive structure that was also described from Anina and with the same stratigraphic range is *Weltrichia banatica* KRASSER emend. GIVULESCU 1990. But this species has different shape of sporophylls, and their number is much higher (21-22). *W. banatica* is intimately associated with *Zamites schmiedelii* foliage and probably it belongs to this species.

The invariable occurrence of *W. givulescui* especially with *Zamites aninaensis*, but also with *Z. schmiedelii* and *Z. andraeanus* foliage suggests that this structure belongs to one of these plants, most probably to *Z. aninaensis* (Pl. I, Fig. 4).

Interesting to note is the role of the centripetal appendages over the central cup. There is no doubt that *Weltrichia* type structures, as all the other cycadeoid reproductive structures evolved in intimate connection with insect behavior, and that a strong coevolution existed between the bennettites and insects. This coevolution finally had as an effect the emergence of angiosperms (at least part of them as they are a polyphyletic group) during the Late Jurassic times or even earlier. In *Weltrichia givulescui*, the role of the centripetal appendages might have been that of increasing the contact surface with the insects or that of supplementary protection of attractants occurring inside the cup. Trapping insects temporary or definitively inside the cup may have also been an aim for these centripetal appendages but it looks more improbable than the other roles.

### **Preservation**

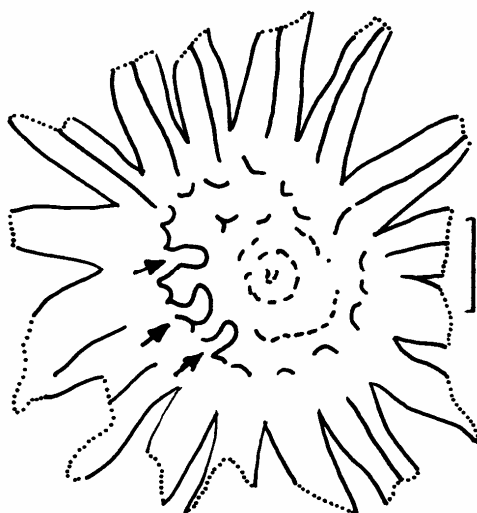
The material is compressed, with the lamina of the microsporophylls often well preserved. The preservation is rather good, with structures preserved transversally (Pl. I, Figs. 1, 3) or longitudinally (Pl. I, Fig. 2), in spite of polliniferous sacs lacking.

### **Occurrence and phytostратigraphy**

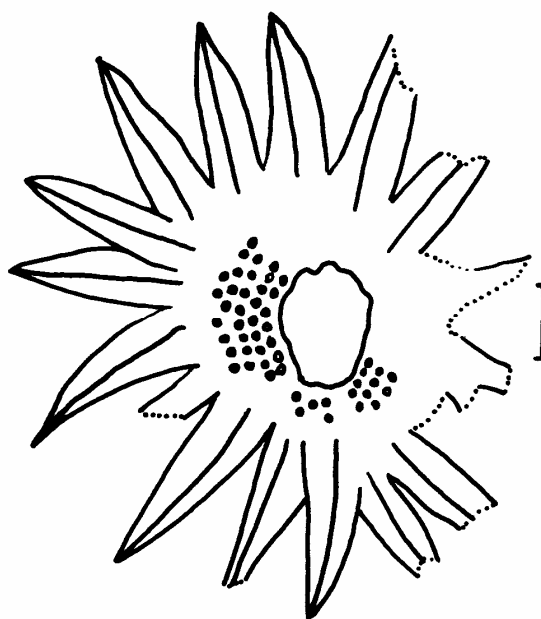
The stratigraphic position of *W. givulescui* is always above the Coal seam No. 5, in all Anina coalfields. Usually, it can be found within the roofs of the 6<sup>th</sup> or 7<sup>th</sup> Coal seams in Anina area, especially for the Northern Coalfields (Anina, Zona Nouă and Brădet Coalfields). It is a typical Sinemurian taxon and the reproductive structure of a Sinemurian coal generator.

### **Conclusions**

*Weltrichia givulescui* is a new species of male bennettite reproductive structure from Anina, Sinemurian in age, intimately associated with *Zamites aninaensis* foliage and it is probably the reproductive structure of the plant that was bearing this foliage.

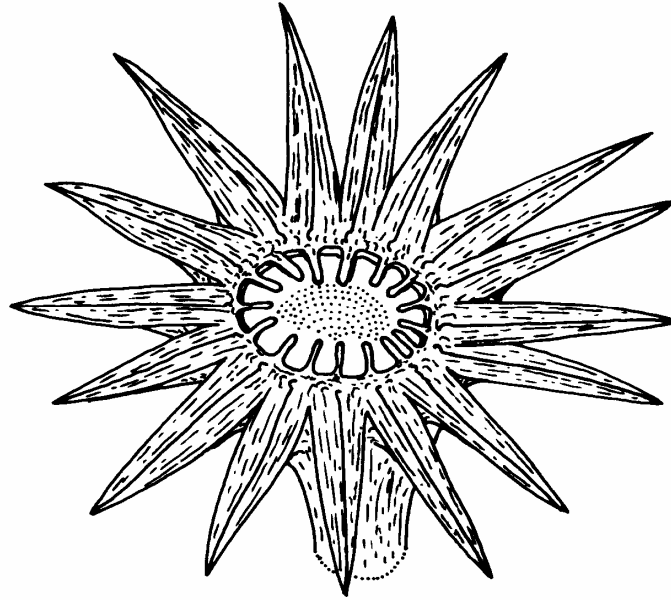


Text-fig. 1. *Weltrichia givulescui* n.sp., holotype, P113/C1/30A/Fr.1, preserved transversally. Arrows indicate the presence of appendages. Scale bar: 1 cm.

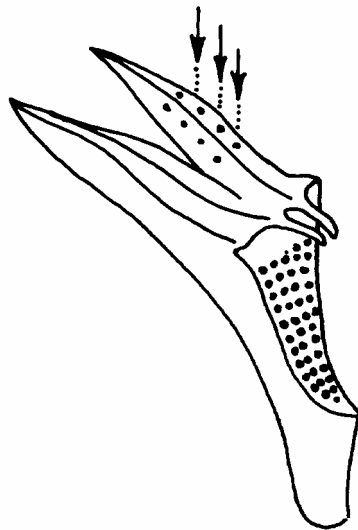


Text-fig. 2. *W. givulescui* n.sp., paratype, UEB1/Fr.1, preserved transversally. Scale bar: 1 cm.

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Text-fig. 3. Reconstruction of a ripen *W. givulescui* n.sp., with the insertion points of the polliniferous sacs not figured as they could not be found due to preservation.



Text-fig. 4. Axial section through the central cup of *W. givulescui* n.sp., showing the internal bodies, appendages and sporophylls. Arrows indicate the possible position of the polliniferous sacs.

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**PLATE CAPTIONS****Plate I**

- Fig. 1. *Weltrichia givulescui* n.sp., holotype, P113/C1/30A/Fr.1, preserved transversally.
- Fig. 2. *W. givulescui* n.sp., paratype, P113/C1/30B/Fr.1, preserved longitudinally.
- Fig. 3. *W. givulescui* n.sp., paratype, UEB1/Fr.1, preserved transversally.
- Fig. 4. *Zamites aninaensis*, P113/C1/48/Fr.1. All scale bars: 1cm.

PLATE I

