

HORSETAILS
FROM THE EARLY-MIDDLE TRIASSIC (ANISIAN)
PIZ DA PERES (DOLOMITES - NORTHERN ITALY)

by
MICHAEL WACHTLER



Dolomythos

Published online by the Dolomythos Museum, Innichen, South Tyrol, Italy.

Dolomythos includes results of original research on systematic, evolutionary, morphological and ecological biology, including paleontology. Syntheses and other theoretical papers, based on research, are also welcome. *Dolomythos* is intended primarily for papers by the staff of the Dolomythos Museum or on research using material in this Museum.

Editors: Edith Campeï, Michael Wachtler

Dolomythos is published at frequent but irregular intervals. Manuscripts, orders for publications, and all correspondence concerning publications should be sent to:

Museum Dolomythos
Rainerstraße 11
39038 Innichen
Italy
mail: info@dolomythos.com

Please cite this articles as:

Wachtler, M., (12/2011): Equisetaceae from the Early-Middle Triassic (Anisian) Piz da Peres (Dolomites - Northern Italy), *Dolomythos*, 51-62, Innichen.

¹ Michael Wachtler, P. P. Rainerstrasse 11, 39038 Innichen, Italy, e-mail michael@wachtler.com.

HORSETAILS

FROM THE EARLY-MIDDLE TRIASSIC (ANISIAN) PIZ DA PERES (DOLOMITES - NORTHERN ITALY)

by

Michael Wachtler

P. P. Rainerstrasse 11, 39038 Innichen, Italy; E-mail: michael@wachtler.com

Abstract

The variegated plant assemblages of Piz da Peres in the Dolomites, including the Kühwiesenkopf area, hold rich horsetail vegetation that gives a good insight into their growing conditions, reproduction and paleoecology. The sphenophytes were dominated by the giant horsetail *Equisetites mougeotii*, found in some places as monophyletic flora reaching several metres in height and about ten centimetres in diameter. Strobili at different stages of maturity were recovered and described as morphogenus *Equisetostachys richthofeni* nov. sp. and thought to belong to *E. mougeotii*.

Online: December 2011.

Key words: Equisetales, Dolomites, Italy, Early-Middle Triassic, Anisian.

Introduction

The horsetail *Equisetites* appeared first at the Late Carboniferous-Early Permian boundary and was probably similar in their overall morphology to extant *Equisetum* (POTT et al. 2008), although nowadays no species reach the 10 to 15 cm thickness (extant *Equisetum giganteum* about 4 cm) of the Mesozoic Equisetales.

The richest Early-Middle Triassic (Anisian) discovery points for Equisetales in the Dolomites lie on the extended mountain range from Kühwiesenkopf to Hochalpenkopf to Piz da Peres. Especially on the western side of Piz da Peres, sphenophyta is one of the most common plant components, although they are represented only by one single genus: *Equisetites mougeotii*, known since 1828 from the Middle European Buntsandstein. In the "Giant horsetail point" (Fig. 3), the stems reach extraordinary diameters of about 10 cm and a height of 3 to 5 metres. In this mainly monophyletic horsetail vegetation only sometimes interrupted by isolated *Voltzia agordica* conifers, all the growing stages - from small-sized underbrush

horsetails to giant *Equisetites* stems - can be studied well. Other lenses on Piz da Peres bear extraordinarily preserved stem diaphragms, branch scars and fructifications. Isolated remains from Archosaurs (teethes) and *Rhyncosaurus* skeletons also give the same fragmentary insight into the animal kingdom.

Another point of some isolated sphenophyta lies on the northern slopes of Kühwiesenkopf - Hochalpenkopf. There, the plant horizon crops out for several hundred metres and divides into two main strata that have a slightly different age: the lower strata classified as belonging to the Early-Middle Pelsonian and the higher ones to the Middle-Late Pelsonian-Illyrian. For detailed studies, see BECHSTÄDT T.H. AND BRANDNER R. (1970), SENOWBARI-DARYAN, B. et al. (1993), BROGLIO LORIGA et al. (2002) and especially KUSTATSCHER, E. et al. (2007). Equisetaceae remains were observed in both the lower and higher layers, with no obvious changes in their morphological aspects. It should be noted that the difference between the Anisian *Equisetites mougeotii* and



Fig. 1: Map showing the Kühwiesenkopf - Piz da Peres mountain range in the Northern Dolomites (courtesy of Tourismusverein Olang).

the Ladinian-Carnian *Equisetites arenaceus*, the characteristic horsetail from German Keuper, is marginal. Therefore, they could be accepted as closely related in a common developing line.

Although horsetail stem fragments, diaphragms and leaf sheaths pertain to the most frequent assemblages of many Mesozoic floras, well-preserved strobili and sporangiophores are very rare (KELBER, K. -P. & VAN KONIJNENBURG-VAN CITTERT, J. H. A., 1998). Therefore, the fructifications and cones recovered from Piz da Peres help to expand the knowledge about the evolutionary stages of Equisetaceae.

Materials and Methods

The study is based on approximately 200 miscellaneous parts of sphenophyta, mostly belonging to *Equisetites mougeotii*. The fossils - preserved mainly as compressions,



Fig. 2: Piz da Peres "Giant horsetail point". Over a strata of conglomerates, lies a layer of exclusively large-sized *Equisetites* remains.

but impressions and pith cast also occurred - were recovered from the typical silty yellow-greyish mudstone known as Pragser Schichten (PIA, 1937), the geological remain of a marine coastal area containing variegated vegetation. It consisted of conifers, ferns, seed ferns, lycopods and cycads. The specimens were rescued from diverse lenses and enabled the observation of the different growing stages, including complete fructifications, sometimes aggregated and with more than one immature and mature horsetail cones. For more detailed information about Piz da Peres plant assemblages, see other works of MICHAEL WACHTLER (2010, 2011).

Further analyses, especially of the spores, could not be performed because all the material was confiscated and removed by the authorities under police force.

Repository

Most of the macrofossil plant collection, including all figured specimens, is stored at the Naturmuseum Südtirol in Bozen (Italy). Their numbers are prefixed by either 'KÜH' for Kühwiesenkopf or PIZ for Piz da Peres. The remainder of the collection is in the Museum DoloMythos at Innichen (Italy).



Fig. 3: The "Giant horsetail point" on the western side of Piz da Peres. Below: Reconstruction of the Anisian landscape with *Equisetites mougeotii*, fertile *Equisetostachys richthofeni* and *Voltzia agordica*.

Systematic description

Division SPHENOPHYTA

Order EQUISETALES Dumortier, 1829

Family EQUISETACEAE Michaux, ex DC 1804

Genus EQUISETITES Sternberg, 1833

Equisetites mougeotii (Brongniart, 1828)

1827 *Calamites arenaceus minor* Jaeger, p. 37, pl. 3, figs 1–7; pl. 5, figs 1–3; pl. 6, fig. 1

1828a *Calamites mougeotii* Brongniart, p. 137, pl. 25, figs 4–5.

1844 *Calamites mougeotii* Brongniart; Schimper and Mougeot, p. 58, pl. 29, figs 1–3.

1844 *Equisetum brongniartii* Schimper and Mougeot, p. 53, pl. 27.

1869 *Equisetium mougeotii* Brongniart; Schimper, p. 278, pls 12, 13, figs 1–4.

1886 *Equisetium mougeotii* Brongniart; Blanckenhorn, p. 141, pl. 20, figs 13–16a.

1894 *Equisetites singularis* Compter, p. 215, pl. 3, figs 3–7.

1910 *Equisetites mougeotii* Brongniart; Wills, p. 282, text-fig. 20, pl. 15, fig. 3.

1915 *Equisetites mougeotii* Brongniart; Frentzen, pp. 14–21, pls 10–11; pl. 12, figs 1–5.

1922 *Equisetites singularis* Compter; Frentzen, pp. 3, 10.

1928 *Equisetites mougeotii* Brongniart; Schmidt, p. 74, fig. 90.

1937 *Equisetites mougeotii* Brongniart; Gothan, p. 254, pl. 31, figs 1–2.

1978 *Equisetites mougeotii* Brongniart; Grauvogel-Stamm, p. 23, pl. 1, fig. 3.

2007 *Equisetites mougeotii* Kustatscher, Wachtler, Van Konijnenburg-Van Cittert, p. 1281, pl. 1, fig. 1–7.

Description

Vegetative shoots: *Equisetites mougeotii* could be considered a giant horsetail with its 5 to 10-cm (PIZ 277, 278, 279) wide stems that reach a height of 3 to 5 metres. The erect axes arise from a creeping rhizome and are characterised by fine internodes that have longer distances (10 to 15 cm) in the middle and ends in a telescope-like nested head. There, the internodes are closely spaced (PIZ 582, PIZ 600, KÜH 674) and bear hair-like leaves, covering the apex (PIZ 279). Whorls of shoots are given off from the stem nodes. Each diaphragm is usually surrounded by a leaf sheath, which consists of 2-cm long, 0.5-cm wide spine-

like teeth. Lateral branches arise from a central axis (PIZ 634, PIZ 189), which hold the fertile organs, sometimes more than one aggregated together (KÜH 676).

Strobili: These are of the type *Equisetostachys richthofeni*. The main stems and the lateral branches hold from one (KÜH 714, PIZ 633) to two (KÜH 676) strobili. They consist of an arrangement of peltate shields with several elongated fertile appendices on the lower surface directed towards the main axis.

Echinostachys richthofeni, sp. nov. WACHTLER, 2011

1828 *Equisetostachys*, Brongniart; pl. 20, fig. 2

1844 *Equisetostachys cylindrica*, Schimper and Mougeot, pl. XXX fig. 2

2007 *Equisetites mougeotii* Kustatscher et al. Pl. 1 fig. 4–7

Holotype

PIZ 633

Paratypes

PIZ 173

Material

KÜH 676, KÜH 714

Etymology

Honouring Ferdinand von Richthofen (1833 – 1905), one of the pioneers of geology in the Dolomites

Type localities

Piz da Peres, Kühwiesenkopf

Type horizon and age

Early Middle Triassic, Anisian, Pelson

Diagnosis

Morphogenus for those from the Early-Middle Triassic, especially Anisian *Equisetites* cones consisting of aggregated whorls of



- 1) PIZ 279. *Equisetites mougeotii*. Stem fragment with one internodium.
- 2) PIZ 582. *Equisetites mougeotii*. Stem apex with telescope-like nested internodes.
- 3) PIZ 318. *Equisetites mougeotii*. Stem fragment with lateral branching stems.
- 4) PIZ 174. *Equisetites mougeotii*. Stem fragment with one internodium.
- 5) PIZ 635. *Equisetites mougeotii*. Isolated diaphragm.

peltate shields. Several sporangiophores sprout on their abaxial surface towards the main axis. The strobili are globose and densely packed when immature, and cylindrical when mature with open shields to release the spores.

Description

Several fertile specimens belonging to *Equisetites* were found in Piz da Peres and Kühwiesenkopf, showing the structure of immature and mature strobili. KÜH 676 shows two immature strobili attached on the same branch. The spherical slightly elongated strobili, sitting on a 2-cm long, slender peduncle are 4 cm long, 2.5 to 2.8 cm wide and consist of up to 5 to 6 whorls of hexagonal sporangiophores. The peltate shields measure 7.5 to 8.5 mm in diameter. Another juvenile and closed strobilus (KÜH 714) explains the arrangement of sporangiophores well, which are 9 mm in diameter (KUS-TATSCHER, E. et al. 2007) and end with a slightly elevated umbo in the centre of the head.

There are two fertile specimens from Piz da Peres displaying the structure of mature expanded strobili (PIZ 633, PIZ 173). They also have the typical table-like shields, but show about 8 to 12 elongated sporangia on the lower surface. Sporangia are at most 2 mm long and 0.5 mm wide. PIZ 633 in particular demonstrates an elongated 5-cm long and 2.5-cm wide open strobilus, where 8 mature whorls are ready to release their spores. The heads are 5 to 8 mm in diameter and hold a circle of sporangia on the lower surface. The same is true for PIZ 173, which is much smaller, measuring only 2 cm by 2 cm. Also in that specimen, some of the sporangiophores are open to give an insight into the sporangia.

Since the same layers usually showed the vegetative shoots of *Equisetites mougeotii*, the cones of *Equisetostachys richthofeni* were considered morphogenus and belonging to this horsetail.

Remarks

The horsetail group of *Equisetites* is considered highly heterogeneous, including typical casts, diaphragms, leaves, impressions

and compressions thought to be the ancestor line of extant *Equisetum* (TAYLOR T. N. ET AL. 2009). The genus has been reported in numerous localities worldwide, including Europe, America, Antarctica, China and New Zealand, especially from the Triassic to Jurassic, but sometimes also dating back to the Carboniferous. Considering the large number of horsetail remains known from the Triassic, only isolated fertile organs have been found. The majority of described species belong to well-known *Equisetites arenaceus* from the German Keuper (KELBER, K. -P. & HANSCH, W., 1995; KELBER, K. -P. & VAN KONIJNENBURG-VAN CITTERT, J. H. A., 1998).

Like *Equisetites arenaceus*, *E. mougeotii* can also be considered a "giant horsetail". For *E. arenaceus*, estimations suggest a diameter from 10 to 20 cm and a length of 3 to 7 metres. Consequently, there are marginal differences between Ladinian - Carnian *E. arenaceus* and Anisian *E. mougeotii*, which seems to be a little smaller.

Several Carnian *Equisetites* species have been described from the Japanese Carnian to Lower Jurassic Hiramatsu Formation (KON'NO, 1962: *E. asaensis*, *E. minensis*, *E. takahashii*, *E. bracteosus*, *E. nagatensis*, *E. takaianus*, *E. naitoi*, *E. koreanicus*, *E. nariwensis* and *E. paotensis*). The stem fragments were usually much smaller, which was also noted for the associated cones found.

Dispersed strobili have been attributed to the organ genus *Equisetostachys*, sometimes also to *Equicalastrobus* (GRAUVOGEL-STAMM, L. & S. R. ASH, 1999; WEBER, R., 2005), but distinctions are generally not made and it has become customary to describe all the plants as *Equisetites*. Therefore, only for morphogenus reasons, isolated fertile organs took the name of *Equisetostachys richthofeni*. The closest relationship of Early-Middle Triassic *Equisetostachys richthofeni* is made with the strobili belonging to *Equisetites arenaceus* from the Upper Triassic (Julian-Tuvalian) Keuper in Germany (KELBER, K. -P. & VAN KONIJNENBURG-VAN CITTERT, J. H. A., 1998). However, in comparison to *E. arenaceus* cones, *Equisetostachys richthofeni* exhibit a small number of whorls and is smaller in size. As suggested by other authors (KELBER, 1999), triplets of strobili were typical of *E. arenaceus*, whereas for *E. richthofeni*, only two fertile organs



- 6) PIZ 600. *Equisetites mougeotii*. Apical stem fragment with several nodes.
 7) PIZ 634. *Equisetites mougeotii*. Stem with two lateral stems. Probably the main axis was destroyed and so, small shoots grow out on the last nodium.
 8) PIZ 204. *Equisetites mougeotii*. Several nodes with the brackish water-loving shells *Neoschizodus laevigatus* elongates.
 9) PIZ 189. *Equisetites mougeotii*. Diaphragm with attached stem.
 10) PIZ 131. *Equisetites mougeotii*. Diaphragm with attached stem.
 11) PIZ 636. *Equisetites mougeotii*. Diaphragm with proximal leaf sheaths.
 12) PIZ 108. *Equisetites mougeotii*. Internodium.

on small branches were recorded. It is possible that the number of strobili varies from one to three.

Another morphogenus - *Equicalastrobus* (ex *Lycostrobus*) *chinleana* (GRAUVOGEL-STAMM & ASH, 1999) - attributed to *Equisetites aequicaliginosus* recovered from the Upper Triassic (Carnian) Santa Clara Formation in Mexico is characterised by its robust 6 to 15-cm thick stems (WEBER, 2005). It holds strobili with deciduous sporangio-phores, which bear a peltate head attached to a four-angled stalk. However, the sporangio-phores bear a lanceolate single-veined, leaf-like appendage directed toward the cone apex extending from a slightly elevated umbo in the centre of the head, which has never been recorded in *Equisetostachys richthofeni*.

General discussion

The horsetail *Equisetites* appeared first at the Late Carboniferous - Early Permian boundary, but Stephanian-Lower Permian *Asterophyllites equisetiformis* has also been found at a certain frequency in the Lower Permian Laas-Formation in Carinthia (FRITZ ET AL. 1990) and displays a lot of characteristics of true Equisetaceae. The Upper Permian Monte Ozol Formation (WACHTLER, 2011) in the Dolomites harbour some horsetail fragments, suggesting that the Permian was not so desert-like and xeric as usually thought.

Another heyday of Equisetaceae was in the Early Triassic (Induan-Olenekian), such as in the German Buntsandstein basin and the Alpine Werfen-Formation. Together with the enigmatic lycophyte *Pleuromeia sternbergii*, they built most of the monoculture-like vegetation.

The Mesozoic sphenophytes include four major morphogenera: *Equisetites*, *Schizoneura*, *Neocalamites* and *Phyllotheca*. Whereas *Neocalamites* resembles dwarf-calamites of the Paleozoic, the genus *Equisetites*, beginning from the Early Triassic, has only slightly changed from the Late Carboniferous/Early Permian to the present. The major surprise lies in the fact that vegetative branches and cones reached their perfect plan to survive all the changes on earth just 300 million years ago. A direct development line from *Equisetites mougeotii* to *E. arenaceus* and

probably also to the extant horsetails could be suggested.

Early Triassic *Equisetites mougeotii* with its protruding whorled branches and sessile cones might be comparable, apart from their smaller size, to extant *Equisetum palustre*, the marsh horsetail growing in rare cases up to one metre high.

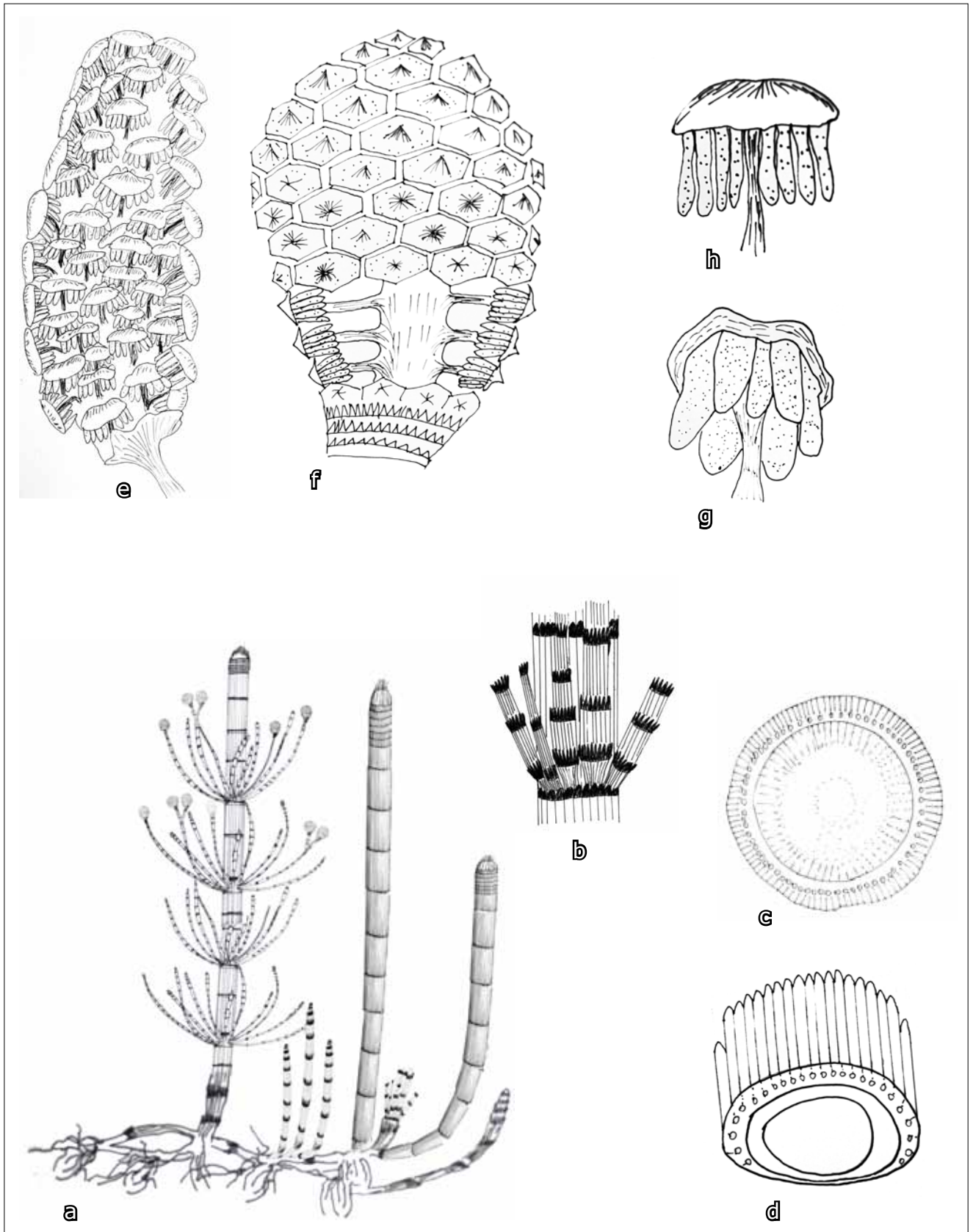
Like the lycopodiales - especially *Lycopia dezanchei* - there is an increasingly diminishing trend up to the present, where extant Equisetaceae normally do not surpass half a metre in height. This dwarfism started surprisingly at the Carboniferous-Permian boundary and crossed mainly undisturbed into the Permian-Triassic, affecting some other plant groups like ferns (*Anomopteris* and *Gordonopteris*) and conifers (*Alpia* and *Schizolepis*). In contrast to them, some groups like the conifers recovered, whereas club mosses and horsetails remained small.



Equisetites mougeotii and *Pleuromeia sternbergii* from the Early Triassic (Olenekian) Werfen-Formation. Bleiriese-Golsernock, Stockenboi Carinthia.



- 1) PIZ 633. *Equisetostachys richthofeni*. (Holotype). Fertile open strobilus showing open sporangiophores.
- 2) PIZ 173. *Equisetostachys richthofeni*. Fertile strobilus with some open sporangiophores.
- 3) KÜH 676. *Equisetostachys richthofeni*. Two closed strobili on a slender shoot.
- 4) KÜH 714. *Equisetostachys richthofeni*. Mainly closed sporangiophores.



Equisetites mougeotii: (a) Entire plant, (b) branching shoots, (c) stem apex with telescope-like nested internodes, (d) diaphragm with proximal leaf sheaths, (e) *Equisetostachys richthofeni*: fertile strobilus showing open sporangioophores, (d) closed strobilus, (e) lateral view of sporangioophore and (f) basal view of sporangioophore.

It is worth to attempt a reconstruction of the preferred habitat of Early Mesozoic Equisetaceae. Specimen and fragments were found everywhere in the Piz da Peres layers, mixed between the extraordinarily variegated plant lenses composed of ferns, seed ferns, conifers, lycopods and cycads as monophyletic horsetail vegetation with some isolated conifer fragments (WACHTLER, 2011a,b). In this monoculture like the "Giant horsetail-point" on Piz da Peres, the largest *Equisetites mougeotii* stems were encountered, reaching several metres high and with diameters of up to 10 cm. An ancient swampland could have offered the ideal conditions for this pure stand vegetation.

References

- BECHSTÄDT T.H., BRANDNER R. 1970. Das Anis zwischen St. Vigil und dem Höhlensteintal (Pragser und Olang Dolomiten, Südtirol). - Festband D. Geol. Inst., 300-Jahr-Feier Univ. Innsbruck: 9-103.
- BROGLIO LORIGA, C., FUGAGNOLI, A., VAN KONIJNENBURG-VAN CITTERT, J. H. A., KUSTATSCHER, E., POSENATO, R., WACHTLER, M. 2002. The Anisian macroflora from the Northern Dolomites (Monte Prà della Vacca/Kühwiesenkopf, Braies): a first report. *Rivista Italiana di Paleontologia e Stratigrafia*, 108, 381-390.
- DE ZANCHE, V., FRANZIN, A., GIANOLLA, P., MIETTO, P. and SIORPAES, C. 1992. The Piz da Peres Section (Valdaora-Olang, Pusteria Valley, Italy): a reappraisal of the Anisian stratigraphy in the Dolomites. *Eclogae Geologicae Helveticae*, 85, 127-143.
- FRITZ, A. BOERSMA, M., KRÄINER, K. 1990. Steinkohlenzeitliche Pflanzenfossilien aus Kärnten.- *Carinthia II*, Sonderheft
- GRAUVOGEL-STAMM, L. (1978): La flore du grès à Voltzia (Buntsandstein Supérieur) des Vosges du nord (France). Morphologie, anatomie, interprétations phylogénique et paléogéographique. *Univ. L. Pasteur de Strasbourg, Inst. Géol., Mém.*, 50 : 225 S.
- GRAUVOGEL-STAMM, L., ASH S. R. 1999. "Lycostrobus" chinleana, a new equisetalean cone from the Upper Triassic of the southwestern United States and its phylogenetic implications. *American Journal of Botany*, 86 (10) : 1391-1405.
- KANDUTSCH, G., 2011- Other ferns from the Early-Middle Triassic (Anisian) Piz da Peres (Dolomites - Northern Italy), *Dolomythos*, 80-87, Innichen.
- KELBER, K.-P. and HANSCH, W. 1995. Keuperpflanzen. Die Enträtselung einer über 200 Millionen Jahre alten Flora. *Museo*, 11, 1-157.
- KELBER, K.-P. 1999. Neue Befunde über die Schachtelhalme des Keupers.- In: Hauschke, N. & Wilde, V. (eds.): *Trias - Eine ganz andere Welt*, III.14: 355-370; (Verl. Dr. F. Pfeil), München.
- KELBER, K.-P., VAN KONIJNENBURG-VAN CITTERT, J. H. A. 1998. *Equisetites arenaceus* from the Upper Triassic of Germany with evidence for reproductive strategies. *Review of Palaeobotany and Palynology*, 100, 1-6.
- KON'NO, E. 1962. Some species of Neocalamites and Equisetites in Japan and Korea. *Tohoku University Science Report Special Volume 5* : 21-47.
- KUSTATSCHER, E. WACHTLER, M., VAN KONIJNENBURG-VAN CITTERT, J. H. A. 2004. Some additional and revised taxa from the Ladinian flora of the Dolomites, Northern Italy. *GeoAlp*, 1, 57-70.
- KUSTATSCHER, E., WACHTLER M. & VAN KONIJNENBURG-VAN CITTERT J.H.A., 2007. Horsetails and seed ferns from the Middle Triassic (Anisian) locality Kühwiesenkopf (Monte Prà della Vacca) in the Dolomites (Northern Italy). - *Palaeontology* 50/5: 1277-1298.
- PIA, J., 1937. *Stratigraphie und Tektonik der Prager Dolomiten in Südtirol*. Pia, Julius: XV + 248 S. + 14 Tafeln. OBrosch. 5710BB Wien, Selbstverlag.
- POTT, C., KERP, H., KRINGS, M. 2008. Sphenophytes from the Carnian (Upper Triassic) of Lunz am See, Lower Austria. - *Jahrbuch der Geologischen Bundesanstalt*, Wien 148, 183-199.
- SCHIMPER, W. P. 1869. *Traité de Paléontologie végétale ou la flore du monde primitif dans ses rapports avec les formations géologiques et la flore du monde actuel*. I. J. B. Baillière et Fils, Paris, 738 pp.
- SCHIMPER, W. P, MOUGEOT, A. 1844. *Monographie des Plantes fossiles du Grès Bigarre de la Chaîne des Vosges*. G. Engelmann, Leipzig, 83 pp.
- SCHMIDT, M. 1928. *Die Lebewelt unserer Trias*. Hohenloh'sche Buchhandlung, F. Rau, Öhringen, 461 pp., 1220 figs.
- SENOWBARI-DARYAN, B., ZÜHLKE, R., BECHSTÄDT, T., FLÜGEL, E. 1993. Anisian (Middle Triassic) buildups of the Northern Dolomites (Italy): the recovery of reef communities after the Perm/Triassic crisis. *Facies*, 28, 181-256. *Revue de Paléobiologie*, Genève (juin 2005) 24 (1): 331-364
- TAYLOR, T.N., TAYLOR, E.L., KRINGS M. 2009. *Paleobotany. The Biology and Evolution of Fossil Plants*. Burlington MA, London, San Diego CA, New York NY, Elsevier/Academic Press Inc., xxi + 1230 pp.
- WACHTLER, M., 2010. About the origin of Cycads and some enigmatic Angiosperm-like fructifications from the Early-Middle Triassic (Anisian) Braies Dolomites (Northern Italy), *Dolomythos*, 1: 3-55, Innichen.
- WACHTLER, M., 2011. Ferns and seed ferns from the Early-Middle Triassic (Anisian) Piz da Peres (Dolomites - Northern Italy), *Dolomythos*, 57-79, Innichen.
- WACHTLER, M., 2011. Seed ferns from the Early-Middle Triassic (Anisian) Piz da Peres (Dolomites - Northern Italy), *Dolomythos*, 88-104, Innichen.
- WACHTLER, M., 2011. Evolutionary lines of conifers from the Early-Middle Triassic (Anisian) Piz da Peres (Dolomites - Northern Italy), *Dolomythos*, 3-72 Innichen.
- WEBER, R., 2005. *Equisetites aequicaliginosus* sp. nov., ein Riesenschachtelhalm aus der spätriassischen Formation Santa Clara, Sonora, Mexiko. *Revue de Paléobiologie*, Genève 24 (1): 331-364

