The Early Permian (Artinskian) Floras of the Dolomites

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Abstract

One of the classic Early Permian (Artinskian) fossil sites is located on the Mount Dasdana in the Trompia-Valley (Brescia, Northern Italy). Due to the richness in fossilised plants and tracks, international scientists frequented the locality from the mid-19th century. Interesting is the variety of Paleozoic conifers, especially the ancestors of the Abietaceae (*Majonica*), Araucariaceae (*Ortiseia*) or the Voltziaceae, but the highlights are the oldest Pinoidea worldwide, classified as *Férovalentinia wachtleri*. Scarce is the presence of ferns or horsetails, which suggests that the Gondwana Ice Age, prevailing in the Southern Hemisphere at that time influenced the climate also in areas being located close to the equator. Nevertheless, it can be assumed that many conifer families were already fully developed at the Carbon-Perm boundary and they evolved only marginally over the next 300 million years.

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Key words: Permian floras, Artinskian, Dolomites, Coniferophyta, Araucarias, Abietaceae, Pinoidea, *Férovalentinia, Majonica, Ortiseia,* gymnosperm-evolution

Early Permian (Artinskian, about 287 mio years) Collio, Northern Italy

A restricted flora dominates. Probably also winter-storms affected the landscape. Left below Araucariaceae ***Ortiseia dasdanai*** with female cones shed seed scales and a male cone. On the upper side is a branchlet of the Abietaceae ***Majonica suessi*** with a female cone, shed seed scales and winged seeds and small-sized pollen cones. In the middle, grow the oldest Pinoidea ***Férovalentinia wachtleri*** recorded, with its male and female cones, right is a branchlet of ***Voltzia triumpilina*** with its female cone and shed scales. In the middle below, grow some tufts of the lichen ***Ragazzonia schirollii.***

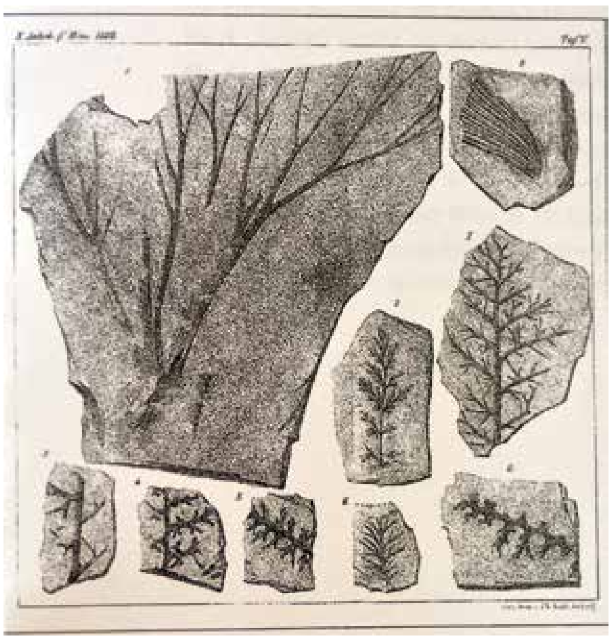
The Italian Southern Alps is one of the major structural units of the Alps because it holds a complete succession from the Variscan crystalline basement up to Cenozoic deposits. It consists of a south-verging thrust-belt located to the south of an important Alpine fault system, known as the "Insubric" or "Periadriatic" line, dividing the Southern Alps from the north-verging Austroalpine, Pennidic and Helvetic units of the large Alpine edifice (Cassinis & Perotti, 2007).

One of the best-observed Early Permian (Artinskian) European continental basins is located in the Val Trompia, (Brescia, Lombardy) between the hamlets Collio and Bagolino: the Collio-Formation. Near the Monte Dasdana and the Monte Colombine over 1200 m of terrigenous and volcanic deposits as complex multiphase tectonic faulting are well exposed. They hold a rich fossilised plant-symbiosis and interesting tracks of Early Permian animals. Typical Carboniferous biocenosis cannot be observed in the Collio Basin. The first sedimentation traces can therefore be dated to the Carboniferous-Permian border (Cassinis et. al., 2011).

Historical overview

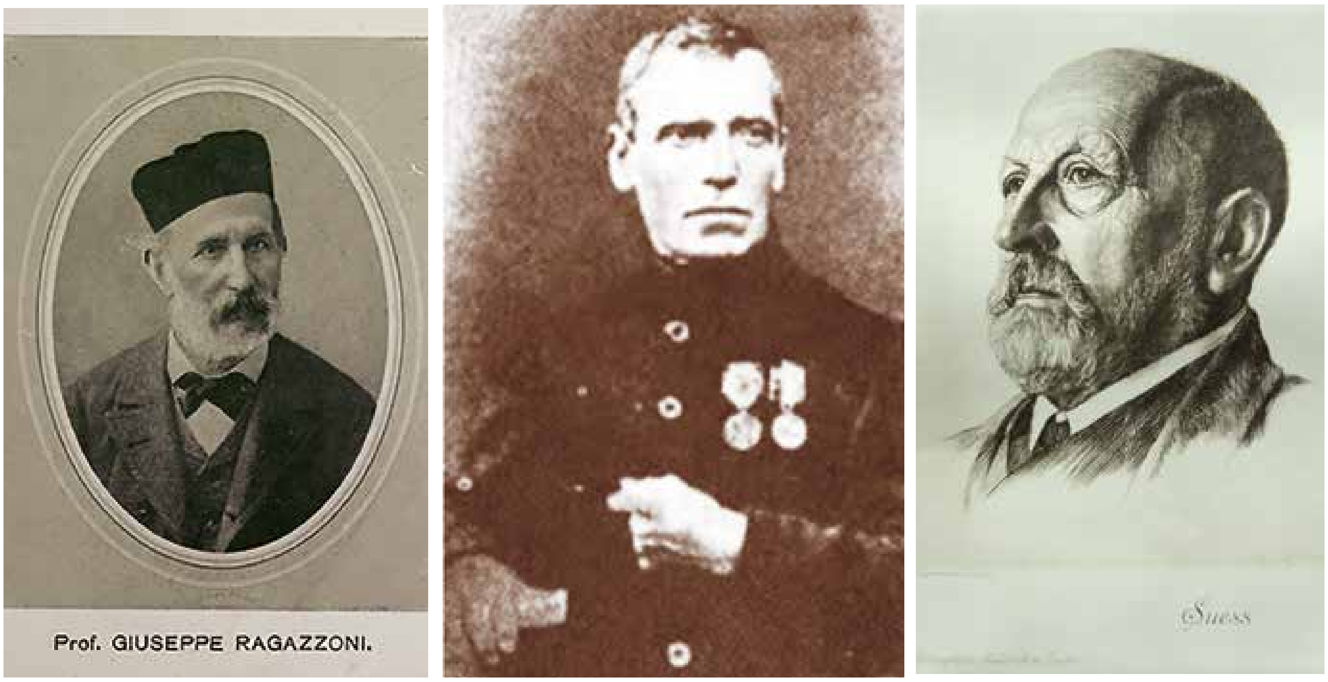
International researchers in earth sciences frequented the Trompia Valley from mid-19th century on. This was largely due to one outstanding personality, the pharmacist and teacher **Giuseppe Ragazzoni** (1824–1898). From 1852 onward he guided Italian and foreign scientists, such as the Austrian geologist **Eduard Suess** (1831–1914), the "inventor" of three major former geographical features, the supercontinent Gondwana, the Angara landmass and the Tethys Ocean—but also other international experts, such as **Franz von Hauer** (1822–1899) and **Victor Leopold von Zepharovich** (1830–1890), without disregarding the who's who of Italian naturalists like **Antonio Stoppani** (1824–1891), **Giulio Curioni** (1796–1878) or **Ferdinando Sordelli** (1837–1916), treading the long-lasting and difficult path from the Trompia Valley to the Monte Colombine, often accompanied by the priest **Don Giovanni Bruni** (1816–1880).

All of them shared the same interest: collecting fossils (Schirolli, 2010). In addition, new ichnospecies were also collected and recognised as such: "*The 23 of September*



Hanns Bruno GEINITZ, (1869). Ueber Fossile Pflanzenreste aus der Dyas von Val Trompia. The only table figuring plants from the Early Permian Collio Formation: 1. *Schizopteris fasciculata, 2. Sphenopteris tridactylites, 3-7. Sphenopteris suessi, 8. Sphenopteris oxydata, 9. Noeggerathia expansa.*

The catalogue-entry from pieces (*Sphenopteris suessi, Walchia piniformis*) of the Val Trompia made by Hanns Bruno Geinitz in 1869. In the main publication Geinitz noted that Eduard Suess sent several specimens to him. Because they were not yet in the collection from the Senckenberg Naturhistorische Sammlung Dresden, they must have been destroyed probably during the Second World War (Dresden was one of the most damaged German cities) or were lost under other circumstances (Source of information Dr. Lutz Kunzmann, Head of Palaeobotany; Section Senckenberg Naturhistorische Sammlungen, Dresden).



Three pioneers in the research of fossil plants on the Monte Dasdana and the Monte Colombine: The Italian **Giuseppe Ragazzoni,** the local priest **Don Giovanni Bruni** and the Austrian geologist **Eduard Suess.**

1873 Giovanni Bruni found in the locality Cuta physiological traces of amphibians". (*Il 23 settembre 1873 Giovanni Bruni trovò alla Cuta impronte fisiologiche di battraci*). They were further described as *Amphisauropus latus* (Haubold, 1970).

Eduard Suess spent several days in the Val Trompia together with the indefatigable local botanist Giuseppe Ragazzoni. In 1868, they took a field trip to the Monte Colombine (Suess, 1869). Suess expressed his great gratitude to Don Giovanni Bruni and his personal mountain-guide **Ronchini**, as well as other collectors of fossil specimens (Cassinis & Santi, 2001). After his return, Suess sent his plants—collected after more day trips on the Monte Colombine and Monte Dasdana—and probably some pieces granted to him by Giuseppe Ragazzoni—to the best coryphe in palaeobotany at that time, **Hanns Bruno Geinitz** (1814–1900), operating in Dresden. In 1869, Geinitz described and figured on one plate several floral elements from the Collio-Formation in the Lombardian Prealps. They were stored in the Natural History Museum of Dresden, but were lost in the troubles of the Second World War.

In the mid—19th century, it was discovered that the Collio-layers were deposited mainly at the same time as the German or Middle European Rotliegend sediments, belonging to the Lower Permian. New plant-species were named after findings from Collio like the fern *Sphenopteris suessi* (Geinitz, 1869) and the conifer *Curionia triumpilina*

The German palaeobotanist Hanns Bruno GEINITZ

(Sordelli, 1896). Over the years new taxa were tentatively assigned, mostly ferns from the group of sphenopterids, such as *Sphenopteris kukuniana, Sphenopteris patens* and *Sphenopteris interrupte-pinnata,* or conifers from the *Walchia* group like *Walchia geinitzii, Walchia germanica, Walchia hypnoides, Hermitia gallica, Lebachia laxifolia,* and *Otovicia,* but also the mostly Upper Permian *Culmitzschia* (Remy & Remy, 1978, Visscher et al., 2001). Some plants were also inserted in enigmatic groups like *Noeggerathia*.

In the 20th century, other researchers, among them the married couple Winfried and Renate Remy (Remy & Remy, 1978), Hans Kerp (both University Münster), and Henk Visscher (University Utrecht) (Visscher et al., 2001) tried to classify the collections, but they had to admit that due to the small number of species, the lack of cuticles and sometimes also the varnishing of specimens prepared by older collectors, only tentative taxonomic assignments could be done.

In 2014, Michael Wachtler began with intensive research on the Monte Dasdana. Due to the rich material collected, it was possible to bring order in the classifications (Wachtler, 2015; Perner & Wachtler, 2015). The major focus was on the sometimes small-sized fer-

The fascinating discovery-story of an old forgotten specimen

Ferdinando Sordelli, 1896. *Flora fossilis Insubrica, Studi sulla vegetazione di Lombardia durante i tempi geologici.* Tip. Cogliati, Milano. Plate 1 figures *Sphenopteris suessi*, (Museo Civico, Milan)

It is the same specimen, but in a mirror-inverted drawing with the inventory number 12 (ex 1772) in the Brescia Museum, classified as *Palmatopteris*. It was collected in 1868. On page 14 Sordelli wrote: *"Geinitz figures only fragmented specimen. But now in the material sent by Prof. G. Ragazzoni to Prof. Stoppani and examined by me, I've detected a much better specimen, which gave a complete idea about the furcations of the leaves and therefore I've found it opportune to give a good drawing." (Geinitz ne figura vari sassi assai frammentari; ora nel materiale inviato dal prof. G. Ragazzoni al prof. Stoppani e da me esaminato, ne ho trovato un esemplare assai migliore e che da un' idea più completa del modo con cui si divide e si suddivide il lembo fogliare ed ho perciò stimato opportuno il darne una buona figura."*

The road from Collio reaching Passo Crocedominis with Monte Dasdana on the right side. The plant bearing layers are in the foreground till the first elevation.

tile parts. Interesting details came to light: although the area was located in the early Permian close to the equator, the vegetation was very reduced. Probably the impact of the late Paleozoic Icehouse covering much of the Southern continent Gondwana was still noticeable. Conifers dominate the landscape largely, whereas all other flora-elements were not or only marginally present.

It was the time when some of today's most dominating conifer-families evolved and spread largely. Interestingly the Araucarias *(Ortiseia*), the Abietaceae (*Majonica*) and the Pinoidea (*Férovalentinia*) were fully developed and changed only marginally in the following 300 million years (Perner 2015). Whereas, the Araucarias and Voltziaceae stood out by their fan-shaped symmetrical branches, the Pinoidea progenitors evolved short spur shoots, and the ancestors of the firs generate plagiotropic spreading twigs the same that we encounter today.

Geology and time-dating

The Collio Basin of Val Trompia, with its ignimbritic rocks at the base and on top encasing a sedimentary succession are suitable candidates for isotopic age analysis, providing constraints on the timing of continental basin formation. The sections from Collio Basin include, from base to top, the following stratigraphic units: basal conglomerate, "lower quartz porphyries" Auctt., Collio Formation, Dosso dei Galli Conglomerate and Auccia volcanics (Cassinis & Neri, 1992).

The most interesting plant fossils of Collio Formation can be subdivided into two sedimentary units: The lower one is composed of grey-green and black sand and siltstones, while the upper unit is defined by mainly reddish sandstones and peltites of volcanic elements with quartz, plagioclase and muscovite. It is well stratified and locally contains some conglomeratic beds. The typical arenaceous zones are formed by shallow alluvial to lacustrine fine-grained sediments with several episodes of emersion and desiccation, as indicated by tetrapod footprints, ripple marks, mud-cracks and raindrop impressions (Santi, 2005; Cassinis & Perotti, 2007).

A mean 206Pb/238U age of 283±1 has been calculated from concordant U–Pb zircon analyses of a sample from the lowermost volcanics (basal ignimbrites). An age of 280.5±2Ma was determined from other concordant zircon analyses of a sample from the uppermost volcanic succession (Auccia ignimbrites). The age values imply a time span of about 3.5 Ma, ranging predominantly throughout the Early Permian (Artinskian, maybe some of the oldest parts could pertain even to the Sakmarian (Schaltegger & Brack, 2007). This age determination helps more than anything else to resolve the time of deposition of the floras and the life in the environment. As such they are slightly older than the nearby Tregiovo-Formation, determined by U-Pb Zircon data to have an age of 276.5 (+-1.2) and 274.1 (+-1.6 Ma), classifying them mostly in the Kungurian period (Cassinis & Perotti, 2007).

Palaeoecology and Palaeoclimatology

Influences of the late Paleozoic Icehouse: Till the Early Permian areas of the world especially on the Gondwana continent, including Antarctica, parts of South America, southern Africa, India, reaching till the Arabian Peninsula, Australia, and parts of South Asia were covered by huge ice-shields. The extensive glacio-marine deposits of the latest Carboniferous till the early Permian age indicate that there was also a widespread cooling till the Northern hemisphere. The mountain glaciations reached the vicinity of the tropics, possibly even at low altitudes (500 to 1,000 m). Moreover, the flora of the Collio-Formation, although located near the Equator, was strongly influenced. This is the reason that only a conifer-dominated vegetation could expand.

An extremely reduced vegetation: Ferns, lycopods, cycads, horsetails were mostly not present in the Artinskian Collio-Formation. But in place of them, strangely new conifer-families like Araucarias (*Ortiseia)*, Abietaceae (*Majonica*), Pinoidea (*Férovalentinia*) and Voltziaceae (probably early representatives of the *Cryptomeria*-conifer) spread largely. Some were characterized by their dwarfish leaves (*Voltzia triumpilina*), others by the shedding of the *needles in wintertime (*Majonica suessii), or their crippled and dwarfish appearance (*Férovalentinia wachtleri)*. Nevertheless, most of them survived till the present.

Animals at that time: Several authors described the rich ichnofauna (Santi, 2005; Marchetti et al., 2013; Marchetti, 2014). The Collio Basin is characterized by a huge presence of *Dromopus* ispp. (69.3%). In most cases it is not possible to distinguish between *Dromopus lacertoides* and *Dromopus didactylus*, but both were present. It is thought that they belong to diapsid animal, the earliest ancestors of modern reptiles. All other ichnospecies are rare. The Seymouriamorpha tracks *Amphisauropus imminutus* (7.8%) and *Amphisauropus latus* (6.8%) belonged to some reptiliomorphous amphibians. *Batrachichnus* isp. (5.1%) was left by primitive little quadrupedal temnospondyl. Whereas *Camunipes cassinisi* (4.7%), *Varanopus curvidactylus* (3.4%), and *Ichniotherium* isp. (2.4%), so common in the German Rotliegend, but rare in the Collio-Formation were left by some tetrapods like *Diadectes.* An association of mostly amphibians and archoreptiles was therefore well adapted in this fluvial, deltaic or lacustrine environment (Avanzini et al., 2001).

Comparisons with other Northern hemisphere biocenosis: The Collio-Formation is not unique to the European context. The German Rotliegend Tambach-Formation from the Bromacker Quarry in Thuringia can be declared as mainly coeval, pertaining to the Artinskian. A large

In 2014, **Michael Wachtler,** sometimes accompanied by the old and faithful herdsman and herbalist **Fèro Valentini** began to collect fossil plants on the Monte Dasdana. In the background is visible a large military base.

number of basal tetrapods were recovered there, some of which were previously found in North America, such as *Seymouria, Diadectes* or Dimetrodon—supporting Wegener's theory of continental drift. Other autochthonous animals, such as *Tambachia* and the oldest bipedal tetrapod *Eudibamus* (an animal that could propel itself forward using only two legs) were typical of the Tambach-Formation. It can be stated that only some of these ichnospecies have similarities with the Collio-Formation.

The plant-rich Lochbrunnen (Oberhof-Formation) in Thuringia is slightly older, belonging to the Sakmarian. There we have a *Melanerpeton arnhardti–Apateon flagrifera oberhofensis*-zone, all branchiosaurians (Werneburg, 1996), which in the Collio-Formation are not present. The Oberhof-Formation is richer in cycads and other water-loving plants. The Collio-flora therefore can be regarded as authochtonous-flora for its richness in Pinus-like *Férovalentinia.* Moreover, *Ortiseia* can be regarded as character-conifer, whereas they were replaced by the Voltziaceae in the German Early Permian. *Majonica* in the Alps and *Gomphostrobus* and *Wachtlerina* in the Rotliegend can both be classified as winged seed-conifers.

References

Avanzini M., Ceoloni P., Conti M.A., Leonardi G., Manni R., Mariotti N., Mietto P., Muraro C., Nicosia U., Sacchi E., Santi G., Spezzamonte M., 2001. Permian and Triassic tetrapod ichnofaunal units of Northern Italy: Their potential contribution to continental biochronology, Int. Congr. "Natura Bresciana", Ann. Mus. Civ. St. Nat. Brescia, monografie, 25: 89-107

Cassinis G. Neri C., 1992. Sedimentary and palaeotectonic evolution of some Permian continental basins in the central Southern Alps, Italy. Cuad. Geol. Ibérica, vol. 16, pp. 145-176, 11 figs., Madrid

Cassinis, G., Santi G., 2001. Hanns Bruno Geinitz: A pioneer of the Permian stratigraphy of Eastern Lombardy (Southern Alps, Italy). In: "Intern. Hanns Bruno Geinitz Symp.", Proceed. Symp. in Honour of Hanns Bruno Geinitz, Dresden, Saxony, January 28-30, 2000, Abh. des Museums für Mineral. und Geol. Dresden, Geologica Saxonica, n. 46/47, pp. 73-82, 2 pls., 4 figs., Dresden

Cassinis G., Cortesogno L., Gaggero L., Perotti C.R. Buzzi L., 2008. Permian to Triassic geodynamic and magmatic evolution of the Brescian Prealps (eastern Lombardy, Italy). Boll. Soc. Geol. Ital. (Ital.J. Geosci.) vol. 127, n. 3, October 2008, pp. 501-518, 16 figs., 1 tab.

Cassinis G., Perotti C.R., 2007. A stratigraphic and tectonic review of the Italian Southern Alpine Permian. In: QunYang & D.H.Erwin (Eds.): "Contributions to Permian and Carboniferous Stratigraphy, Brachiopod Palaeontology and End-Permian Mass Extinctions, in Memory of Professor Yu-Gan Jin", Palaeoworld, vol. 16, Special Issue, January/September 2007, pp. 140-172, 13 Figs.

Cassinis G., Perotti C.R., Ronchi A., 2011. Permian continental basins in the Southern Alps (Italy) and peri-Mediterranean correlations. Intern. J. Sci. (Geol. Rundsch.), DOI 10.1007/s00531-011-0462-6, Springer-Verlag

Cassinis G., 1966. La Formazione di Collio nell'area-tipo dell'alta Val Trompia (Permiano inferiore bresciano). Riv. It. Paleont. Strat., 72, 507-588

Geinitz, H.B., 1869. Ueber fossile Pflanzenreste aus der Dyas von Val Trompia; N. Jb. Min. Geol. Paleont., p. 456-461, Stuttgart

Haubold, H., Schaumberg, G., 1985. Die Fossilien des Kupferschiefers. Pflanzen- und Tierwelt zu Beginn des Zechsteins – eine Erzlagerstätte und ihre Paläontologie. – Neue Brehm-Bücherei, Bd. 333, 223 S., 139 Abb., 13 Tab., Wittenberg (A. Ziemsen-Verlag). ISSN 0138-1423

Marchetti L., Bernardi M., Avanzini M., 2013. Some insights on well-preserved *Amphisauropus* and *Erpetopus* trackways from the Eastern Collio basin (Trentino-Alto Adige, NE Italy), Bollettino della Società Paleontologica Italiana 52 (1), 55-62

Marchetti L., 2014. Vertebrate footprints of Lower Permian in South Alpine region (Northern Italy): A comparison between Collio, Orobic, Tregiovo and Mt. Luco basins, Phil. Thesis, Padova

Perner, T., Wachtler M., 2015. The Permian - Birth of a New World, Dolomythos, Ininchen and Oregon-Institue, Portland

Remy, W., Remy, R., 1978. Die Flora des Perms im Trompia-Tal und die Grenze Saxon/Thuring in den Alpen. Argumenta Palaeobotanica 5, 57–90

Santi G., 2005. Lower Permian palaeoichnology from the Orobic Basin (Northern Alps). GeoAlp, 2: 77-90

Schaltegger, U., Brack, P., 2007. Crustal-scale magmatic systems during intracontinental strike-slip tectonics. U, Pb and Hf isotopic constraints from Permian magmatic rocks of the Southern Alps. Int. J. Earth Sci.,

Schirolli P., 2010. Giuseppe Ragazzoni, il «maestro» della geologia bresciana. Monografie di «Natura Bresciana», 30, 112 pp. con allegato DVD, DGM Brescia

Sordelli F., 1896. Flora fossilis Insubrica, Studi sulla vegetazione di Lombardia durante i tempi geologici. Tip. Cogliati, Milano

Suess E. 1869. Über das Rothliegende im Val Trompia. 107- 119, Sitzungsberichte vom 21. Jänner 1869, Wien

Wachtler M. 2015. The Lower Permian (Sakmarian/Artinskian) Collio-Flora from Val Trompia (South- ern-Alps, Italy); in Wachtler M., Perner T., 2015. Fossil Permian plants from Europe and their evolution. Rotliegend and Zechstein-Floras from Germany and the Dolomites. Published by Dolomythos Museum, Innichen, South Tyrol, Italy; Oregon Institute of Geological Research, Portland, OR, (USA), ISBN 978-88- 908815-4-1, pp. 45-51

Werneburg R., 1996. Temnospondyle Amphibien aus dem Karbon Mitteldeutschlands.– Veröff. Naturhist. Mus. Schloß Bertholdsburg Schleusingen, 11, 23-64

Visscher, H., Kerp, H., Clement-Westerhof, J.A., Looy, C.V., 2001. Permian floras of the Southern Alps). In: Cassinis, G. (Ed.), Permian Continental Deposits of Europe and Other Areas. Regional Reports and Correlations. Natura Bresciana, Museo Civico di Scienze Naturali, Monografia No. 25, pp. 117–123

Components of the Collio-Flora:

Lichens
Ragazzonia schirollii (WACHTLER, 2015)

Sphenophyta
Calamites sp.

Pteridophyta
Sphenopteris suessi (GEINITZ, 1869)

Coniferophyta
Majonica suessi (WACHTLER, 2015)
Ortiseia dasdanai *(WACHTLER, 2021)*
Voltzia triumpilina (SORDELLI, 1896, WACHTLER, 2021)
Férovalentinia wachtleri (PERNER, 2015)

Lichens

Fossilised lichens are rare and therefore Ragazzonia schirollii from the Lower European Permian (Sakmarian-Artinskian) fills a gap and increases our knowledge about Permian plants. Lichens can be regarded as good climatic indicators, completing the wisdom about the strange palaeo-ecosystem from the Northern Italian Collio-Formation composed of interesting extremely climate-resistant plants.

Ragazzonia schirollii (WACHTLER, 2015)

2015 *Ragazzonia schirollii,* WACHTLER, pp. 52-55

Etymology

Remembering the outstanding Brescian naturalist Giuseppe Ragazzoni (1824–1898), the first researcher of the Collio Flora in the Lombardian Alps. The species-name honours Paolo Schirolli, conservator of the Museum of Natural History Brescia for his studies of the local geology and palaeontology.

Holotype

COL 145, **Paratype:** COL 82. **Repository:** Wachtler collection, Brescia, Museum of Natural Sciences

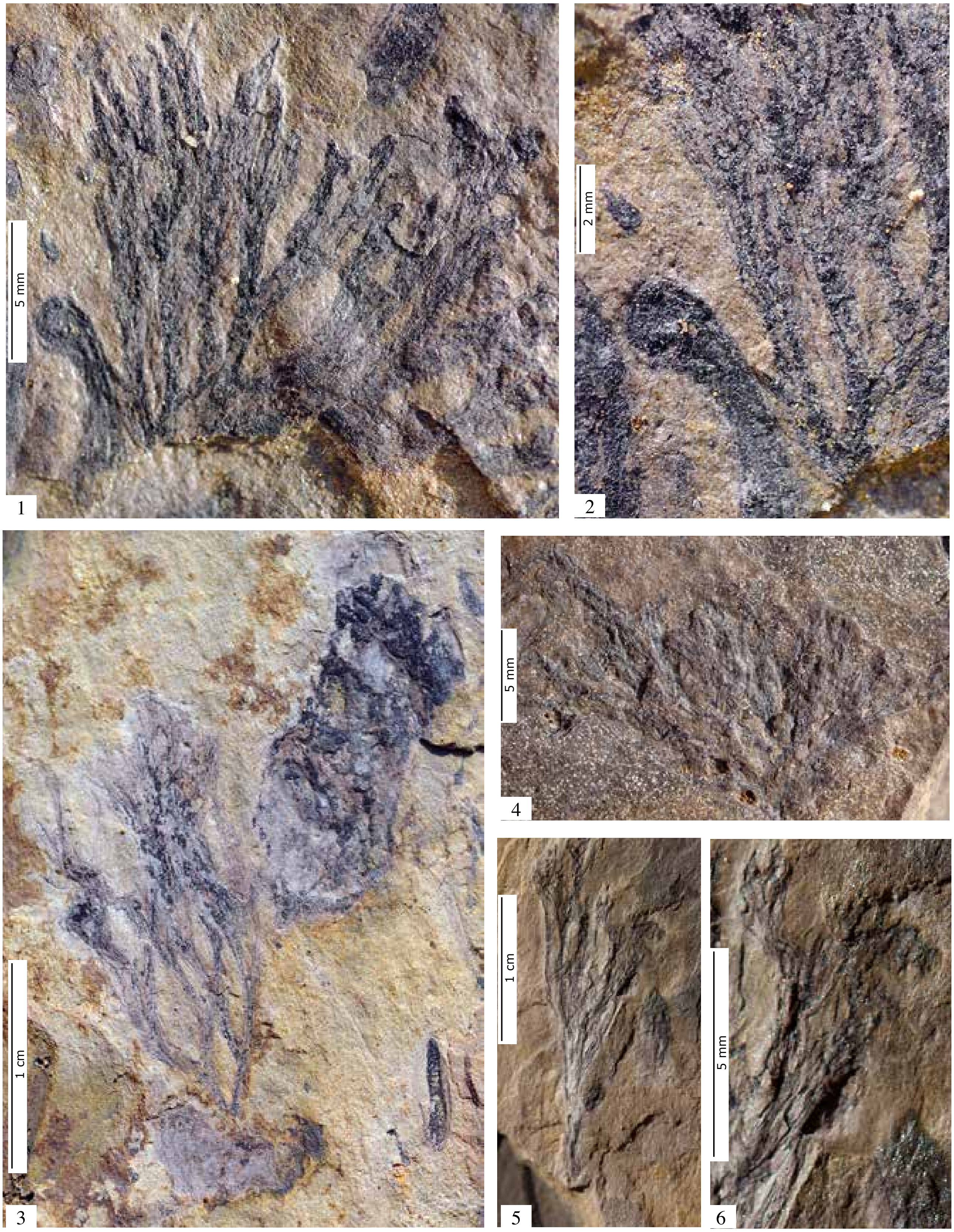
Description

Plant: Lichens growing in tufts, cushionlike, many lobed and irregularly branched. From 1.5 to 2.5 cm high with multiple branches diverging from a single base. Thallus plane, but variously contorted. Thalline margins distinctly crenulate and somewhat inrolled.
Fertile parts: Apothecia bearing thalli being broader than the branch, fertile disks appressed, flat with a thickened border.

Taxonomic notes

Lichens are a group of symbiotic organisms, which also today manifest an important role in our ecosystems. They can be regarded as unique, being composite organisms that consist of two unrelated components, such as algae or cyanobacteria (or both), living among filaments of a fungus in a symbiotic relationship. The whole combined life form has properties that are different from those of its component organisms. They do not have roots to absorb water or bring nutritive substances into the plant. But they produce their own nutrients from sunlight, air, water and minerals. Lichens are better adapted to rough and cold climates than other life forms; they do well even in direct sun, and can grow on shallow, sterile soils. Since lichens are able to draw moisture from the air, the underlying soil is not so important as humidity source like it is for other vascular plants.
Therefore, they can be regarded as pioneer plants persisting even in environments too rough for higher plants, provided the humidity is sufficiently high for growth and the temperature is low enough to block

Extant *Cladonia macroceras* could be a good example about the blueprint of Permian lichen *Ragazzonia.*



***Ragazzonia schirollii*. Plant (Early Permian, Artinskian)**

1-2. Plant with fertile and sterile parts; 2. Noteworthy are the broad, apothecia-bearing thalli (COL 145, holotype); 3. Erect tuft (COL 82 Paratype); 4. Other specimen (COL 279); 5-6. Plate and counterplate (COL 278); All Monte Dasdana, Coll. Michael Wachtler, Dolomythos-Museum other competitors. Today northern boreal forests or even tundras, but also exposed areas at high elevations, naked rocks, and toxic slag heaps offer good conditions for lichen growth because of slow plant succession and little competition from other plant forms. They are also characterised by their longevity. It is estimated that today 6% of Earth's land surface is covered by lichens; therefore, it can be supposed that in the past they played a much larger role as suggested by the poor fossil record.

Finds of petrified lichens are rare due to the fact that they are in no sense aesthetic or attractive to collectors. Also, the lack of defining features makes an unambiguous classification difficult. The oldest lichen-like organism can be dated to Precambrian phosphorites of the Doushantuo Formation in southern China. The fossils make it evident that fungi symbiosed with prototrophs and document that they evolved much earlier than vascular plants (Taylor et al., 1995). A well-known lichen comes from the Devonian Rhynie Chert. *Winfrenatia reticulata* comprises a thallus made of layered, aseptate hyphae with a number of depressions on its top surface. Each depression contains a net of hyphae holding a sheathed cyanobacterium. The fungus appears to be related to the Zygomycetes (Taylor et al., 2009). The thallus of *Winfrenatia reticulata* consists of thin bands with irregular margins, up to 10 cm long and about 1–2 mm thick (Karatygin et al., 2009).

Although many lichens have foliose forms that are capable of preservation, we have a long vacuum from the Carboniferous to the Permian and Triassic although they must have existed during that time. From the Eocene we know the epiphytic lichen *Strigula.* A well-preserved lichen included in a 20 Ma-old amber was described as *Chaenothecopsis bitterfeldensis* (Garty et al., 1982). Other well-preserved lichen fossils are recorded from the Paleogene and Neogene. Therefore, *Ragazzonia schirollii* from the Early Permian fills a large gap and can be inserted as important for palaeobotanical research works. Surprisingly, this plant with its inrolled thalli and the apothecia can be classified as modern, having affinities with extant lichens like *Cladonia.*

References

Garty, J., Giele, C., And Krumbein, W. E., 1982. On the occurrence of pyrite in a lichen-like inclusion in Eocene amber (Baltic). Palaeogeography, Palaeoclimatology, Palaeoecology 39: 139-147

Karatygin, I. V., Snigirevskaya, N. S., Vikulin, S. V., 2009. The most ancient terrestrial lichen *Winfrenatia reticulata*: A new find and new interpretation. Paleontological Journal 43: 107. doi:10.1134/S0031030109010110

Taylor, T. N. Hass, H. Remy, W. Kerp, H., 1995. The Oldest Fossil Lichen, Nature 378 (6554), 244

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.

Sphenophyta

The horsetails play only a marginal role in the vegetation of the Early Permian Collio Formation. This is difficult to understand, since the horsetails in the Upper Carboniferous (Kasimovian-Gzhelian) from the nearby Carnic Alps still occupied a dominant position with many different *Calamites*-species.

Neocalamites sp.

2015 *Sphenophyllum,* WACHTLER, pp. 56-57

Sometimes isolated striate branchlets and wedge-shaped leaves were found at the Early Permian Collio-Formation. They were classified as *Noeggarathia expansa* (by Hanns Bruno Geinitz, 1869, or as *Palmatopteris* (Helmut Tyroff, 1962, label in the Museum Brescia), but due to the presence of sporophylls typical for the Calamaticeae an insertion in the horsetails could be more reasonable. Although the name *Calamites*, introduced by the French paleobotanist Adolphe Brongniart in 1828, was used for the stems or pith casts, in this work it will also be used to describe and insert the whole plant composed of secondary whorls, leaves and sporangiophores.

Description

Plant: Stems with characteristic longitudinal ribs and furrows ornament divided by internodal regions. *Calamites*-pith casts, irregularly interrupted by nodes, surface of the stem smooth or furnished with closely spaced transverse furrows and ribs. Nodes producing irregularly lateral branches. They are accompanied by *Sphenophyllum*-leaves and *Calamostachys*-reproductive organs.

***Ragazzonia schirollii*. Lichen. Reconstruction (Early Permian, Artinskian)**
a. Plant with fertile and sterile parts (COL 82); b. Holotype COL 145; c. Apothecia-bearing thalli

The leaves consisted of verticils surrounding the branchlet like a collar. Strobili segmented in whorls of sporangiophores. These formed by sterile minute and clawing bracts holding on the inner side the sporangia. In an adult stage, the bracts open or expand, whereas the sporangia desiccate to release the spores.

Taxonomic notes

Generally the name *Sphenophyllum* refers to creeping Sphenophyta. The most well-known Lower Permian species were *Sphenophyllum oblongifolium, S. longifolium, S. angustifolium* and *S. thonii.* They are distinguished, primarily based on the different appearance of the wedge-shaped leaves. However, most *Sphenophyllum*-species can be classified as *Calamites.* They were even widespread, also in the Carnian Alps with many subspecies like *Calamites multiramis, Calamites equisetiformis* or *Calamites incisum* in the Upper Carboniferous period, only to decline suddenly after that. Beginning from the Later Early Permian the name *Neocalamites* was introduced. In conclusion, it can be stated that we probably have a new *Neo(Calamites)*-species in the Collio-Formation, but till now the specimen recovered are too scanty that no further classification can be given (Wachtler, 2015).

References

Geinitz, H.B., 1869. Ueber fossile Pflanzenreste aus der Dyas von Val Trompia; N. Jb. Min. Geol. Paleont., p. 456-461, Stuttgart

Wachtler M., 2015. The Lower Permian (Sakmarian/Artinskian) Collio-Flora from Val Trompia (Southern-Alps, Italy); in Wachtler M., Perner T., 2015. Fossil Permian plants from Europe and their evolution. Rotliegend and Zechstein-Floras from Germany and the Dolomites. Published by Dolomythos Museum, Innichen, South Tyrol, Italy; Oregon Institute of Geological Research, Portland, OR, (USA), ISBN 978-88-908815-4-1, pp. 45-51

Pteridophyta

The skeletal fern *Sphenopteris* constitutes one of the most common but also most misunderstood Permian ferns. During that time, it was—in contrast to the other lack of ferns—widespread across the Northern hemisphere. The genus name was just introduced in 1825 by Caspar Sternberg. It can be suggested that *Sphenopteris suessi* represents the only Pteridophyta in the Artinskian Collio-Formation.

Sphenopteris suessi (GEINITZ, 1869)

1869. *Sphenopteris suessi, Sphenopteris tridactylites*, *Sphenopteris oxydata*, GEINITZ, fig. 2-8, table V
1999. *Sphenopteris suessi* VISSHER ET. AL. fig. 6,Table 1, *Sphenopteris kukukiana* fig. 12, Table 1
2015. *Sphenopteris suessi*, WACHTLER, pp. 58-62

Neotype

Coll. Ragazzoni N. 1 (Brescia, Museum of Natural Sciences); **Paratype:** COL 34 (Coll. Wachtler) Museum Brescia

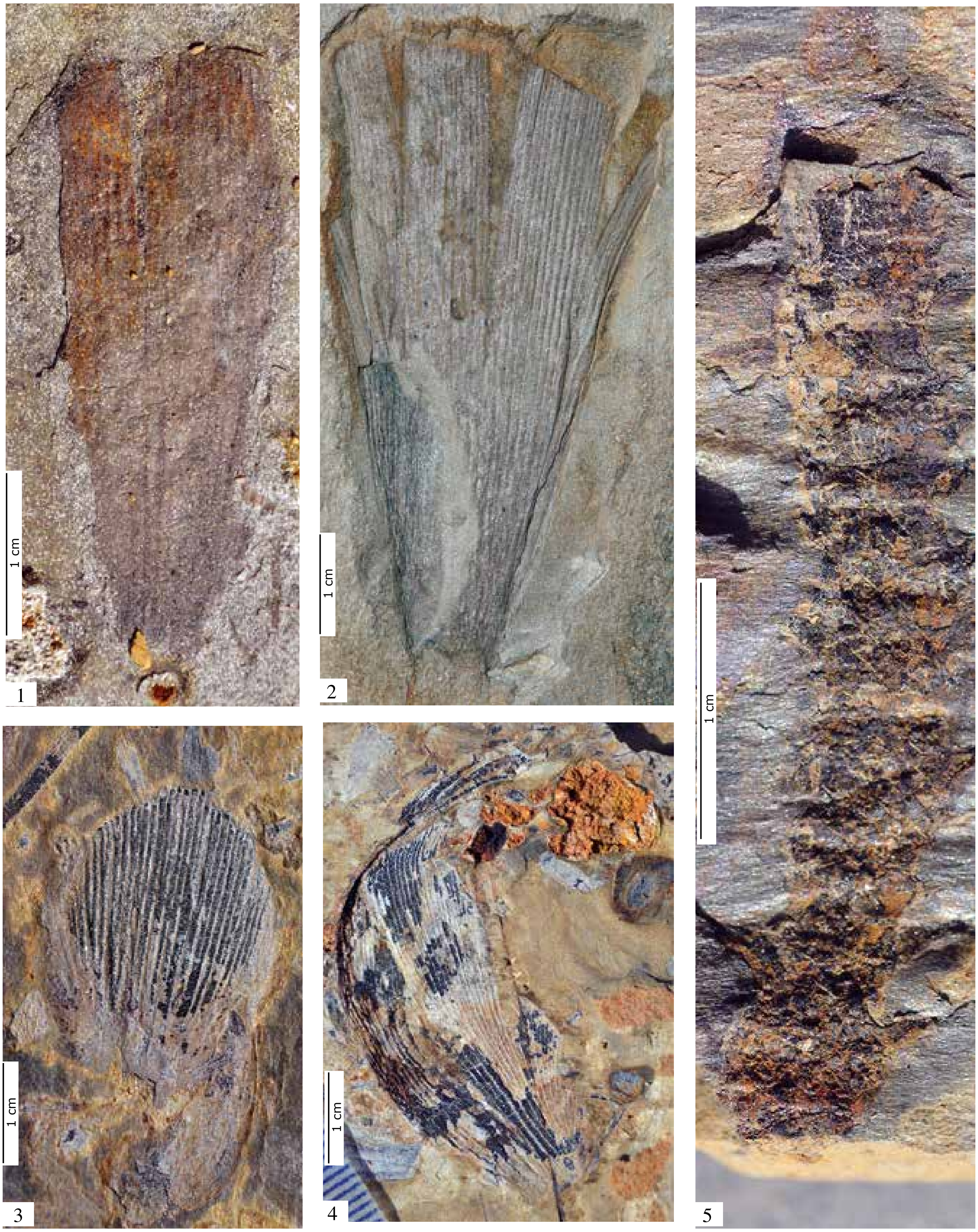
Description

Fronds and pinnules: Wedge-shaped and repeatedly incised low growing fern. Fronds alternate and tripinnate. Secondary pinnae opposite to alternate. Pinnae bifid only allusively evidencing the mid-vein or other internal veins, mirror-like pinnules only on the basal leaves, upper part irregularly incised. The attachment to the rachis is narrow. They are up to 2.0 cm long, 1 cm wide, often looking withered and skeletonised.
Fertile pinnules: Much more skeletonised, exhibiting only a rudimentary leaf structure. Single leaflets 1 cm long. The sporangia clung densely to the lower side of the pinnules.

Taxonomic notes

Beginning from the Carboniferous/Permian border most of the hygrophilous ferns dis-

A specimen classified as *Noeggarathia* expansa from the Ragazzoni Collection nr. 9. It looks more as a horsetail (*Calamites*).

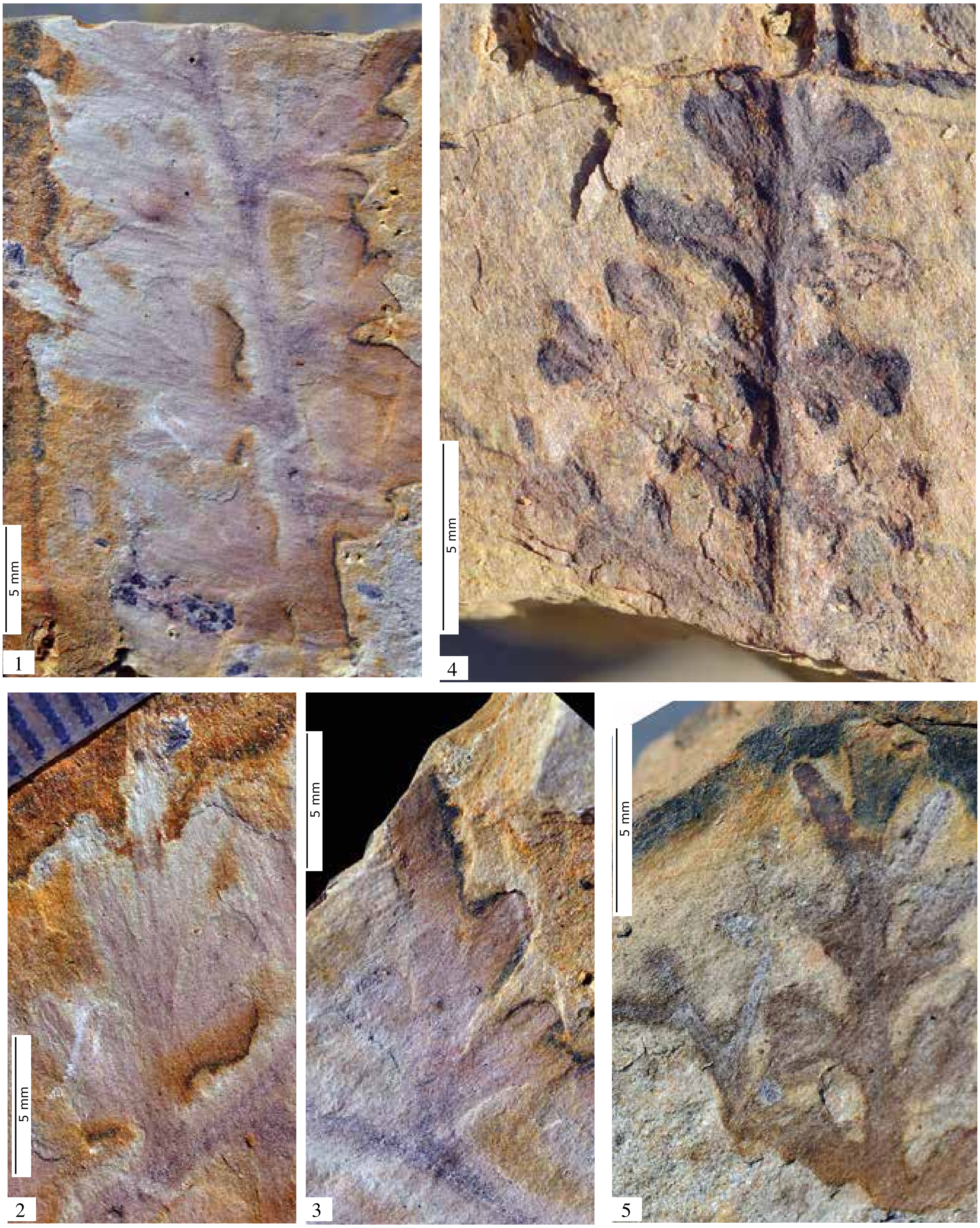


***Neocalamites sp.* horsetail. Stems and sporophylls (Early Permian, Artinskian)**

1-2. Part of a branchlet (COL 14, COL 225); 3-4. Detail of isolated lateral leaves (COL 119, COL 112); 5. Sporangiophore with nodes and bracts (COL 11); All Monte Dasdana, Coll. Michael Wachtler, Dolomythos-Museum.

***Sphenopteris suessi*. Fern (Early Permian, Artinskian)**

1. Designated neotype found by Giuseppe Ragazzoni in 1867. Fertile and sterile fronds (Coll. Ragazzoni Brescia N. 1); 2-3. Strange counterplate of N. 1, but found by Corrado Allegretti (1894-1969), probably around 1950, label on the specimen (Coll. Allegretti Brescia N. 127); 4. Fertile and sterile pinnules (Coll. Ragazzoni Brescia N. 2); 5. Frond (Coll. Brescia N. 76);



***Sphenopteris suessi.* Fern (Early Permian, Artinskian)**

1-3. Detail of frond and isolated pinnules (COL 34, Paratype); 4. Detail of a sterile frond (COL 87); 5. Detail of a sterile frond (COL 114). All Monte Dasdana, Coll. Michael Wachtler, Dolomythos-Museum.

appeared so that only one genus of true ferns became widespread in the Permian: *Sphenopteris*. This Pteridophyta is till now in many localities and is the only certain representative of the ferns (Perner & Wachtler, 2015).

In 1869, Hanns Bruno Geinitz described and figured some plants from the Collio-Formation in the Lombardian Prealps within several *Sphenopteris*-species: *Sphenopteris tridactylites* (Brongniart) (fig. 2) and *Sphenopteris oxydata* (Goeppert) (fig. 8) were just previously known from the European Rotliegend, whereas all other figures (from 3 to 7, Table V) feature *Sphenopteris suessi,* a new species name honouring Eduard Suess activities in the Val Trompia. Albeit the old plant slabs were impregnated with varnish, probably by the original collectors, and therefore sometimes darkened. In the Brescia Natural-Museum, we found sufficient opportunities to identify the story of these ferns.

In the following decades, especially in the 20th century, additional names for *Sphenopteris* ferns from the Collio-Formation, such as S*phenopteris kukukiana, Sphenopteris dichotoma, Sphenopteris hoeninghausi* or S*phenopteris patens* were given, mostly because of distant resemblances to species from German Upper Permian localities. In the end, this culminated in the absurd situation—also including the material in the Natural History Museum in Brescia—that for all suggested *Sphenopteris* specimen an equal number of *Sphenopteris* species names were assigned.

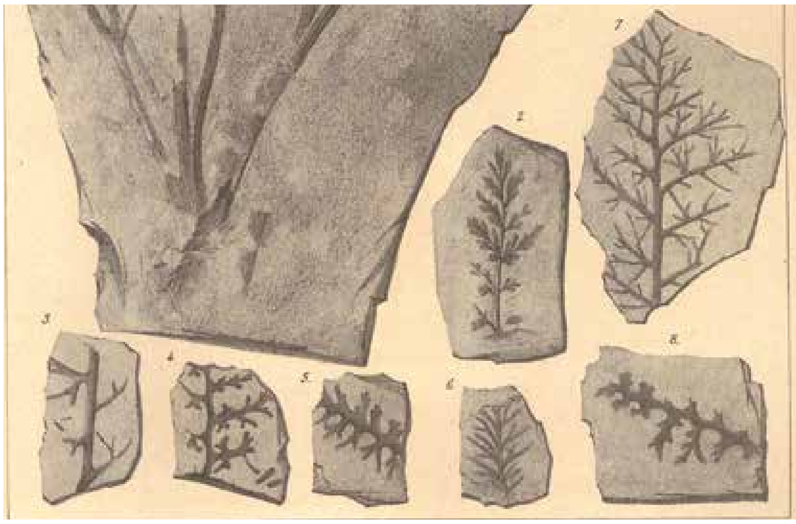
By collecting plant slabs on Monte Dasdana, as well as studying material in the museums it became obvious that we were not dealing with so many species. Due to the consistent differences from other *Sphenopteris* ferns from Germany and France, only *Sphenopteris suessi* can be regarded as corresponding to the endemic terrain.

Therefore—because the original material seemed definitely to have been destroyed in the Second World War—a neotype was selected from the old Ragazzoni-material stored in the Brescia Museum with the suggestive number 1 and collected in 1867; however, it was darkened by lacquer. Amazingly, in examining the rest of the collections, another specimen, N. 127, was identified on its backside by a label that it was collected by Corrado Allegretti—a famous Italian speleologist—it is the perfect counterplate to neotype N. 1. It can therefore be suggested, due to the relatively fresh character of the slab, that Allegretti found this counterplate about hundred years later in the heap of material left by Ragazzoni on Monte Colombine.

References

Geinitz, H.B., 1869. Ueber fossile Pflanzenreste aus der Dyas von Val Trompia; N. Jb. Min. Geol. Paleont., p. 456-461, Stuttgart

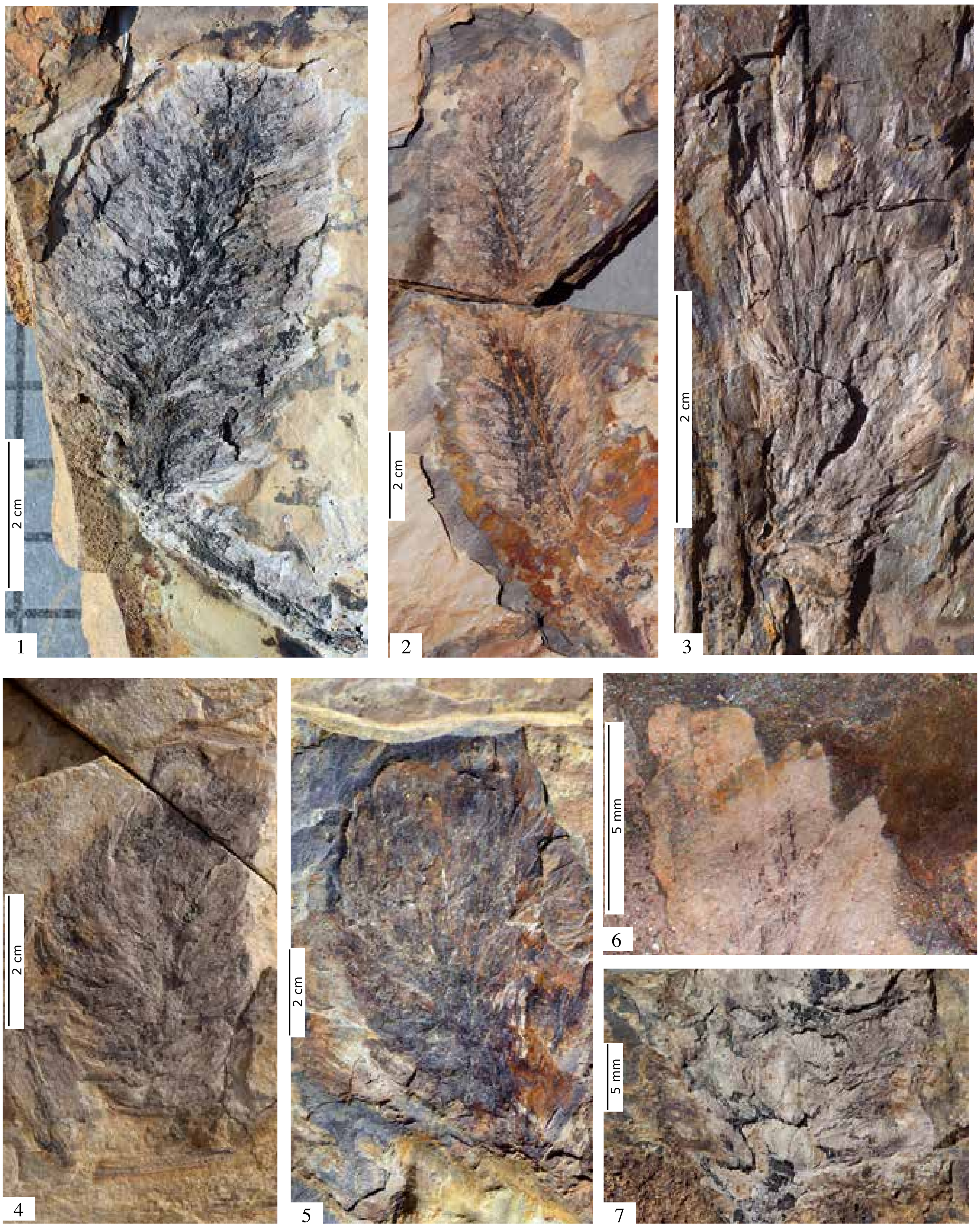
Wachtler M., 2015. The fern Sphenopteris through the Alpine Permian; in Wachtler M., Perner T., 2015. Fossil Permian plants from Europe and their evolution. Rotliegend and Zechstein-Floras from Germany and the Dolomites. Published by Dolomythos Museum, Innichen, South Tyrol, Italy; Oregon Institute of Geological Research, Portland, OR, (USA), ISBN 978-88-908815-4-1; pp. 58-67



The original-plate of Hanns Bruno GEINITZ, (1869, Tav. 5). *Über Fossile Pflanzenreste aus der Dyas von Val Trompia* featuring *Sphenopteris* ferns from the Early Permian Collio Formation. *2. Sphenopteris tridactylites, 3-7. Sphenopteris suessi, 8. Sphenopteris oxydata.* Courtesy Senckenberg, Naturhistorische Sammlungen, Dresden.

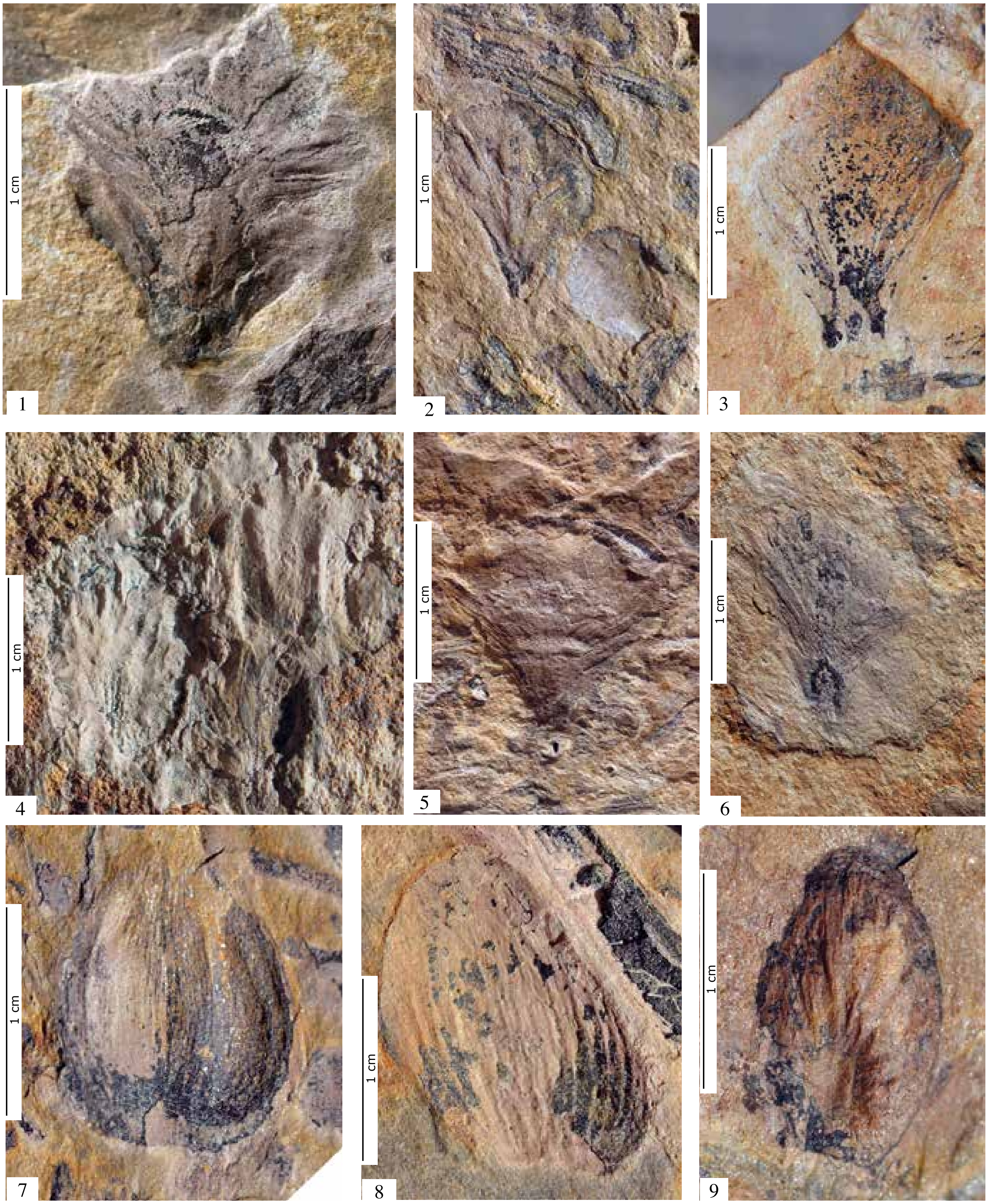
Ortiseia dasdanai **n sp. Araucaria ancestor. Twigs, male cones (Early Permian, Artinskian)**

1-2. Part of a branchlet (COL 207); 3. Twig (COL 261); 4-5. Detail of the foliage and apical part of a twig (COL 288, COL 86); 4-5. Juvenile female cones (COL 66, COL 152); 6-7. Male cone and detail of the bracts (COL 250); 8. Male cone evidencing the pollen sacs (COL 214); All Monte Dasdana (Brescian Dolomites), Coll. Michael Wachtler, Dolomythos Museum



Ortiseia dasdanai n. sp. **Araucaria ancestor. Female cones (Early Permian, Artinskian)**

1. Entire bulbous female cone on a long peduncle (COL 155, designed holotype); 2. Elongated female cone (COL 229); 3. Juvenile female cone attached on a branchlet (COL 262) 4-5. Juvenile female cones (COL 66, COL 152); 6. Detail of a cone with the bracted seed scales (COL 229); 7. Detail of a cone with the small-sized covering leaves (COL 242); all Monte Dasdana (Brescian Dolomites), Coll. Michael Wachtler, Dolomythos Museum



Ortiseia dasdanai n. sp **Araucaria ancestor. Seed scales (Early Permian, Artinskian)**

1. Isolated seed scale with the protecting leaves and the heightening of the hidden seed (COL 244, designed paratype); 2. Seed scale and seed (COL 138); 3-4. Seed scales outer side (COL 191, COL 254); 5-6. Seed scales with micro-leaves (COL 199, COL 292); 7-9. Mature seeds/scales (COL 106, COL 94, COL 22); All Monte Dasdana (Brescian Dolomites), Coll. Michael Wachtler, Dolomythos Museum

Coniferophyta

Araucaria-ancestors

The family of the Araucariaceae today consists of three living genera: *Araucaria, Agathis* and *Wollemia* (first discovered only in 1994). They are almost completely endemic to the Southern hemisphere. From the Permian to the Triassic, however, their ancestors dominated extensive parts of the Earth. Many Araucariaceae today (with the exception of *Wollemia*), are dioecious (i.e., they have male and female organs on different trees), and are characterised by their relatively large male cones growing individually or in bunches at the end of the branches. In contrast to other conifers, they are distinguished by slender pollen sacs that hang freely from the end of the microsporophylls towards the rachis of the cone. The female cones are usually globular, and most can reach significant sizes, with diameters of up to 30 cm, like those of *Araucaria bidwillii*. The seed scales themselves differ greatly from those of other conifers: they contain only one single seed, and in many species, they are merged with the ovuliferous scales, forming an inseparable unit. Upon maturity, the cones drop their seeds and scales one by one. The noticeably regular structure of the crown, with more or less equally distributed branches, makes the Araucariaceae unique in the world of conifers. This is why it can be assumed that their ancestors also exhibited these properties. In fact, almost all the characteristics appeared, albeit in slightly modified forms, in the earliest stages of the Permian.

Ortiseia dasdanai sp. nov. (WACHTLER, 2021)

Holotype

COL 155, **paratype** COL 244 (Seed scale),

Etymology

Named after the locus typicus, the Monte Dasdana, a mountain between the villages Bagolino and Collio in the Brescian Alps.

Diagnosis

Shoots pinnately branched. Cones bulbous till elongated; ovuliferous scales with a fair amount of sterile scales coating one seed. Pollen cones elongated.

Description

Branchlets and leaves: Shoots symmetrically branched (Col 261), leaves slightly falcate, up to 1 cm long (COL 207).

Male cones: Slender, up to 10 cm long about 2 cm in width, with an axis bearing numerous spirally arranged and overlapping microsporophylls equipped with short bracts (COL 250). Pollen sacs probably araucaroid (COL 214).

Female cones: Sometimes bulbous, about 6 cm long (COL 155 designed holotype), from 2.5 till 3.5 cm wide, sitting on a naked peduncle, or elongated at least 10 cm long, and 2 to 2.5 cm wide (COL 229). Various minute sterile leaves cover the seed scale, densely on the outer side. Scale with seed dropped after maturity as a single unit (COL 244, paratype). Single ovules/seeds up to 1 cm long and 0.7–0.9 cm wide (COL 106), sometimes evidencing the impressions of the protective leaves (COL 22).

Taxonomic notes

The *Ortiseia*-species are dominant, especially in the Alps, beginning from the Carboniferous-Permian border till the late Permian and in a modified form also in the Triassic. The oldest evidence we have is from the Gzhelian Rattendorfer Alm in the Carnic mountains. Unmistakable female cones and additionally branchlets thought to belong to *Ortiseia* were found there, but till now not well preserved enough to establish a new species.

Therefore, Artinskian *Ortiseia dasdanai* represents the first unmistakable Araucaria-progenitor from the Alps, followed in the Kungurian by *Ortiseia daberi* (Wachtler, 2012). In the Late Permian of the Dolomites, we encounter a life-explosion of the Araucariaceae with many sub-species (*Ortiseia leonardii, Ortiseia, visscheri, Ortiseia, jonkeri, Ortiseia zanettii*).

The Alpine Permian *Ortiseia*-species did not change many over the whole Permian regarding their female cones and also their pollen organs. More differences are present in the foliage structure, that reached from extremely acicular awl-shaped till falcate and in the Kungurian *Ortiseia daberi* till the late Permian (*Ortiseia leonardii)* ovate to lanceolate, but symmetrically spreading.

Ortiseia dasdanai n. sp **Araucaria ancestor. Reconstruction (Early Permian, Artinskian)**

a. Bulbous female cone (COL 155, holotype); b. Elongated female cone (COL 229); c. Seed scale, adaxial side with impression of the juvenile ovule (COL 244); d. Seed scale abaxial side with the covering sterile leaves (COL 292); e. Mature seed with impressions of the sterile foliage (COL 22); f. Mature naked seed (COL 106); g. Isolated shoot (COL 66); h. Branchlet (COL 207); i. Male cone (COL 250); j. Microsporophylls (COL 250, COL 214)

Abietaceae-ancestors

One of the greatest discoveries of palaeobotany is that there were already fully developed precursors of firs in the early Permian period. The concept of the alate seed evolved as early as the tasty nuts or seeds coated by a fleshy aril of other conifers like the Taxaceae or Araucariaceae. The first fir-ancestors can just be encountered worldwide (USA, New Mexico, Kinney Brick, Carrizo Arroyo), Niederhausen, Oberhof (Germany), Lodéve (France) from the late Carboniferous (Kasimovian) on with the two bracted *Gomphostrobus bifidus* and the one-bracted *Wachtlerina bracteata*. In the Early Permian the recoveries of fully developed Abietaceae-ancestors change than to the Alps, located about 280 million years ago a few longitudes south of the equator.

Today the Abietaceae have a discontinuous distribution in the northern hemisphere and can be encountered in a wide range from the 14th latitude north (North America) to the 67th (Siberia). About 50 species are recognized, inserting them in the Northern hemisphere as the second largest conifer tribe after the genus *Pinus* (Farjon, 1990). The various firs are rather uniform in appearance; but they can be distinct from other conifers like the spruces by their up-growing and on the tree decaying female cones distinguished by the seed scale more or less projecting bract.

Majonica suessi (WACHTLER, 2015)

2015 Majonica suessi WACHTLER, pp. 68-75

Holotype

COL 143 (Seed scale), **Paratypes:** COL 39 (branchlet), COL 47 (male cone), COL 41 (female cone)

Description

Branchlets and leaves: Twigs forking irregularly, plagiotropic, often with heterophyllus needles and bending grades. Needles from awl-shaped to deeply keeled, even hanging down. Moreover, on the same twigs longer and shorter foliage can be encountered; from 1.1 cm to 4 cm long but only 0.1–0.2 cm wide, with a deep furrow in the middle.

Male cones: Globose, from 2.0 to 3.0 cm long (COL 90, 70, 32) and 1.5 to 2.0 cm wide. The microsporophylls are shortly bracted.

Female cones: Female cones slender, usually with four or five times dissected bract-cluster, with one bigger and separated bract overlapping the seed-scale for about 1 cm in a juvenile stage (COL 253, COL 41, paratype, COL 04, COL 72). In adults, the main bract only slightly protrudes the scale. The elongated bract decays after maturity separately from the other smaller sized protective leaves. The seed scales are up to 1.5 cm long and 1.0 cm wide with two single segments rounded on the apical part forming a horn. There is a small elevation in the middle. The seeds are winged, about 0.7 till 1 cm long, incorporating basally the 0.1 cm long ovule (COL 195, COL 197, COL 258).

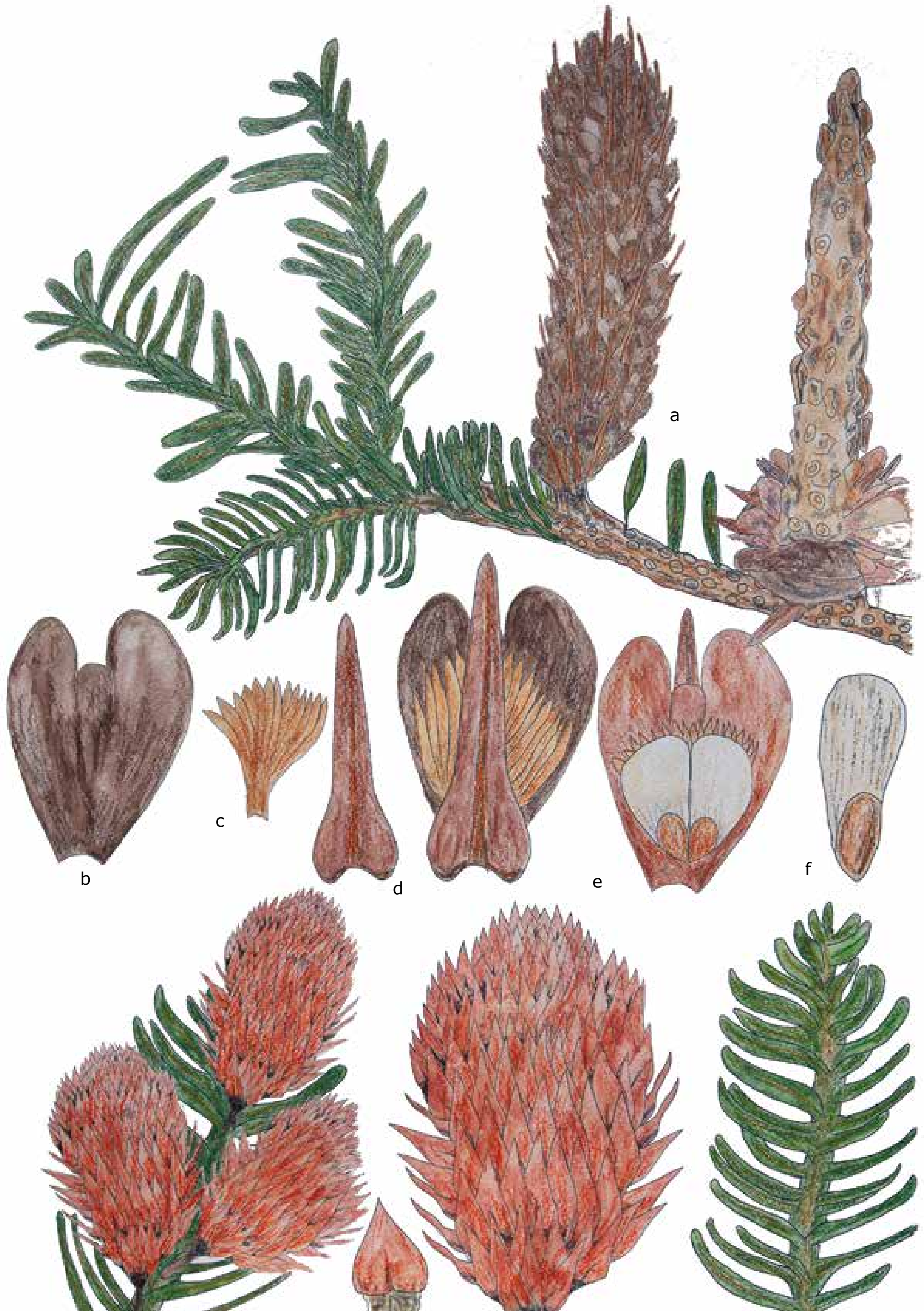
Taxonomic notes

Majonica suessi (Wachtler, 2015) plays an intermediate role between Late Carboniferous *Wachtlerina bracteata* with its symmetrical arranged branchlets and Upper Permian *Majonica alpina* (Clement-Westerhof, 1987) equipped both with irregularly forking plagiotropic twigs as we encounter in today's firs. From the Artinskian *Majonica suessi* on we have in the Alps an uninterrupted succession of Abietaceae ancestors going from Kungurian *Majonica ambrosii* over Upper Permian (Wuchiapingian) *Majonica clement-westerhofae* and *Majonica alpina*.

All were characterized by their alate seeds, a long the scale projecting bract, decaying cones at maturity and falcate needles. Together with coeval Araucaria ancestors (*Ortiseia dasdanai)*, Voltzia-progenitors (*Voltzia triumpilina*), and additionally the first real Pinoidea (*Férovalentinia wachtleri)* (Perner, 2015) began to dominate the landscape of the Alps in the Early-Permian (Artinskian).

Early Permian Multiple seeded conifers

From the Carboniferous-Permian border on we encounter additionally conifers that are distinct by their more-lobed (three till five and even more) seed scales, characterized by small-sized seeds dorsiventrally hanging on the upper side of each fruit-blade. They were first found in Triassic sediments of Europe and named by the French palaeobotanist Adolphe Brongniart in 1828 *Voltzia,* to honour Philippe Louis Voltz, a pioneer in exploring the Sandstone-flora in the French Vosges.

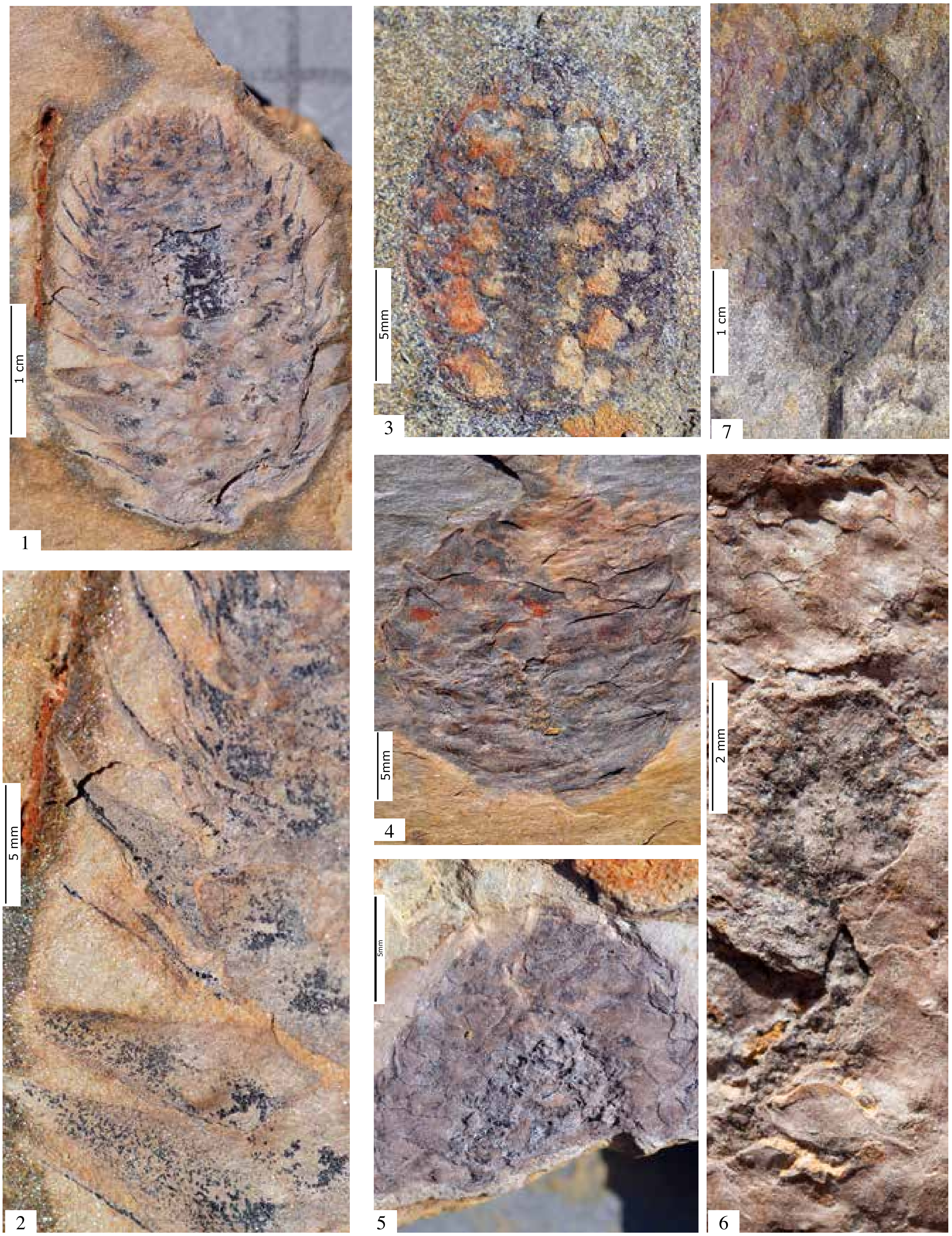


***Majonica suessi*. Abies ancestor. Reconstruction (Early Permian, Artinskian)**

a. Twig with female cones (COL 39, COL 41, COL 04, COL 72); b. Naked seed scale, c. Protective leave outer side (COL 36, COL 38, COL 75, COL 196); d. Main bract and complete seed scale abaxial side (COL 28); e. Seed scale adaxial side COL 143, designed holotype, f. Winged seed (COL 195, COL 197); g. Branchlet (COL 83); h. Male cones; i. Pollen cone (COL 189, COL 24); COL 32, COL 47 paratype); j. Microsporophyll (COL 37)

***Majonica suessi*. Abies ancestor. Twigs and needles (Early Permian, Artinskian)**

1. Part of a shot, described as *Walchia germanica* (N. Inv. 108); 2. Branchlet with male cone (N. Inv. 107, both Museo Civico di Storia Naturale "Giuseppe Ragazzoni", Brescia); 3. Paratype. Branch with heterophyllous leaves (COL 39) 4. Apical part of a branchlet (COL 51); 5. Incurved needles (COL 83); 6. Shed needles and bracts (COL 89); 7. Keeled needles (COL 1); all Monte Dasdana (Brescian Dolomites), Coll. Michael Wachtler, Dolomythos Museum



***Majonica suessi*. Abies ancestor. Male cones (Early Permian, Artinskian)**

1-2. Pollen cone with detail of the bracts and pollen-sacs (COL 189); 3. Male cone with pollen sacs (COL 24); 4. Typical globose polliniferous cone (COL 32); 5-6. Detail of male cones with pollen dust (COL 47 paratype, COL 37); Coll. Michael Wachtler, Dolomythos Museum 7. Male cone (N. Inv. 107, Museo Civico di Storia Naturale "Giuseppe Ragazzoni", Brescia); all Monte Dasdana (Brescian Dolomites)

***Majonica suessi*. Abies ancestor. Female cones (Early Permian, Artinskian)**

1-2. Juvenile female cone on a branchlet (COL 253); 3. Female cone (COL 41, paratype); 4-5. Female cones (COL 04, COL 72); 6. Decayed cone (COL 151); 7. Bract and decayed female cone (COL 36); 8-10. Several isolated bracts (COL 38, COL 75, COL 196); all Monte Dasdana (Brescia-Dolomites), Coll. Michael Wachtler, Dolomythos Museum

***Majonica suessi*. Abies ancestor. Seed scales and winged seeds (Early Permian, Artinskian)**

1. Perfect preserved seed scale, abaxial side (COL 143, designed holotype); 2-3. Winged seeds (COL 195, COL 197); 4. Coverbract adaxial coating the scale (COL 28); 5. Bract and scale outside (COL 92); 6. Scale with bract (COL 153); 7. Seed scale (COL 40); 8. Seed scale and bract appendix (COL 187); 9-10. Seed-scales, abaxial side with the shadows of the winged seeds (COL 258, COL 52); 11. Seed scale and separated alate seed (COL 258); all Monte Dasdana (Brescia-Dolomites), Coll. Michael Wachtler, Dolomythos Museum

Voltzia triumpilina nov. comb (SORDELLI, 1896, WACHTLER, 2021)

1896 *Curionia triumpilina,* Sordelli, p. 31 pl. 7 fig. 3
1896 *Walchia piniformis*, Sordelli, p.l 7 fig. 2
2015 Walchia triumpilina, Wachtler, p. 75-82

Holotype

Coll Ragazzoni, Brescia N. 77, described by Sordelli as *Curionia triumpilina;* **Paratype:** Coll Ragazzoni, Brescia N. 5 (ex 1763)

Etymology

Latin name for the Val Trompia in the Brescian Alps (Lombardy).

Description

Branchlets and leaves: Twigs are slender and extend regularly and symmetrically (COL 31, COL 02). The minute needles are dwarfish and stiff, only 0.2 cm long and 0.1 cm wide. They are transitional between claw- and scalelike, sometimes overlapping like a braided cord.
Male cones: Not recorded with certainty.
Female cones: Almost 10 cm long, 2 to 3 cm wide, slender, equipped basally with a long and naked petiole (COL 76). Seed scales evidencing three fertile lobes and some sterile protective leaves. Entire scales about 1.5 cm wide and 1.5 till 2.0 cm long, including the partially 0.7 till 1.0 cm long stipe (COL 209), COL 226). Seeds from 0.1 till 0.2 cm long, ovoid, hanging down from the upper part of the apically rounded blade. Sterile bract leaves pointed, especially the outer side of the scale covered with compressed tiny leaves.

Taxonomic notes

Decorative *Voltzia triumpilina* branchlets are fairly common in the Collio-Formation but their real nature—in which conifer family they have to be classified—remained obscure for a long time. In 1896, the Italian geologist Ferdinando Sordelli introduced the name *Curionia triumpilina* believing the Walchian female cone was from the Collio Formation. In the same plate 7 he figured a conifer branchlet with the name *Walchia piniformis.* The discovery story of the cone is highly interesting. The specimen was sent to him by the Italian geologist Torquato Taramelli (1845–1922), but was probably found by Giuseppe Ragazzoni. Sordelli in his description (1896) mentioned it as a conifer cone, but not knowing "*if we have an intermediate stage between Walchia and Voltzia*" (*se si tratti o meno di un genere intermedio fra le Walchie e le Voltzie*) he chose the name Curionia, leaving the solution until "*more complete specimens were found" (... quando si potranno aver esemplare più completi,* Sordelli p. 32).
Rudolf Florin (1940, p. 261) was of the opinion that the organisation of *Curionia* is insufficiently known, so that this genus can not be regarded as a practical taxon for classifying female *Walchia* cones. Visscher et al. (1986) agreed with this point of view. With the recovering of more material by Michael Wachtler, as well as examining the old material in the Brescia Natural history Museum, the following solution can be proposed: *Curionia triumpilina* represent a Voltzialean female cone, because additionally also ovuliferous scales, typically for the Voltziaceae, were found. The proposed name for the entire conifer is therefore *Voltzia triumpilina*, with the holotype of Sordelli's cone (N. 77) and a paratype of Ragazzoni's twig (N. 5).
One of the most interesting features of *Voltzia triumpilina* are their branchlets having so small-sized and mimicry leaves, which we do not encounter before or later. Since the entire vegetation of the Collio-Formation is reduced, with mainly no ferns and only a few horsetails, it can be suggested that the climate in that period was extremely harsh, although the Dolomites were located in that time near the equator.

Permian (Artinskian) Pinoidea ancestors

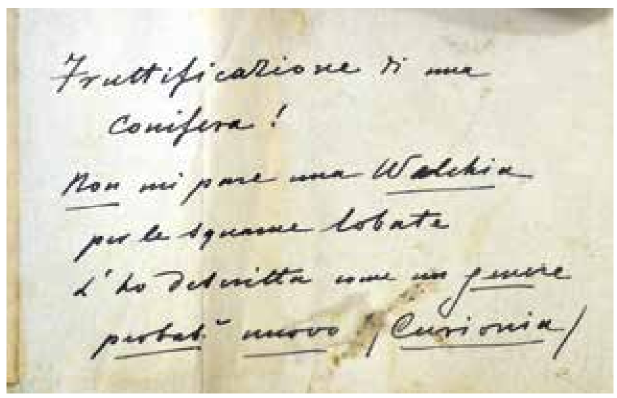
The origins of the Pinoideae or Pines, consisting today of about 110 species in the only genus *Pinus,* have till now been surrounded by a lot of mysteries. They indirectly exhibit the same Darwin's "abominable mystery" as the origin of the flowering plants. Like the Early Permian frequency of angiosperms and insects that lived in a fruitful symbiosis on the former Angara-continent (Ural region, part of today's Russia), we encounter in the same time fully evolved pines in the Alps, that are not so different from the extant. And like the firs (*Abies*), or the flowering plants, they strangely disappeared globally on the Permian-Triassic border. There exists some

***Voltzia triumpilina*. Reconstruction (Early Permian, Artinskian)**

a. Twig (COL 31, COL 65); b. Branchlet and leaves, c. Female cone (COL 76); d. Seed scale abaxial side (COL 124); e. Seed scale adaxial side COL 226, COL 209); f. Single seed (COL 209)

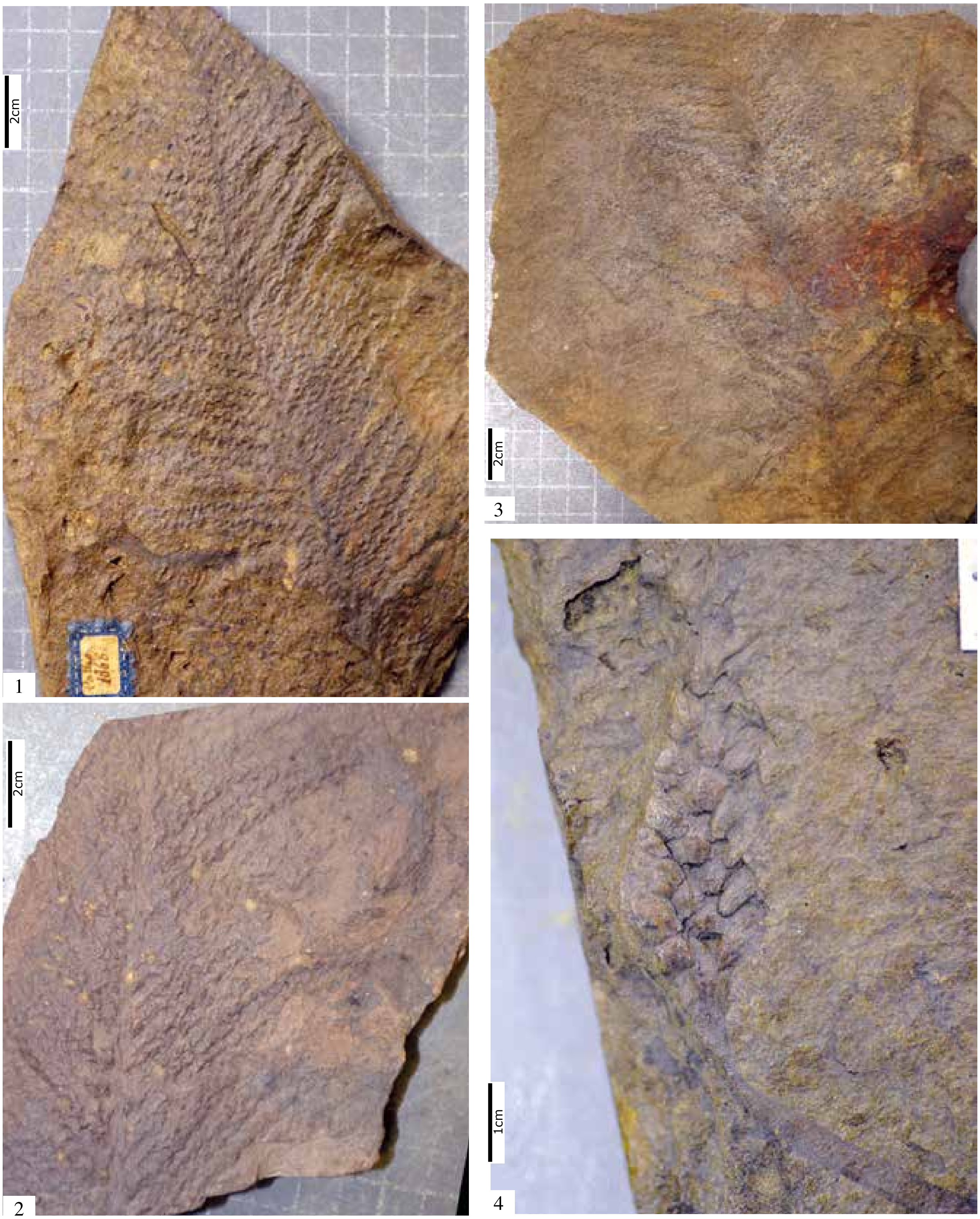
Voltzia triumpiina. 1-2. Part of a twig and detail of the needles (COL 65); Coll. Michael Wachtler-Dolomythos); Monte Dasdana (Brescian Dolomites).

Drawing made by Ferdinando SORDELLI (plate 7) N. 3 corresponds to the specimen 77 *Curionia triumpilina* figured on the right side (N 4). The others were classified as 1c. *Cordaitea*, 2. *Walchia piniformis*, 4. *Cardiocarpus orbicularis*. All Monte Colombine, Collio


Fruttificazione di una
Conifera!
Non mi pare una Walchia
per le squame lobate
l'ho descritta come un genere
probab. nuovo / Curionia /

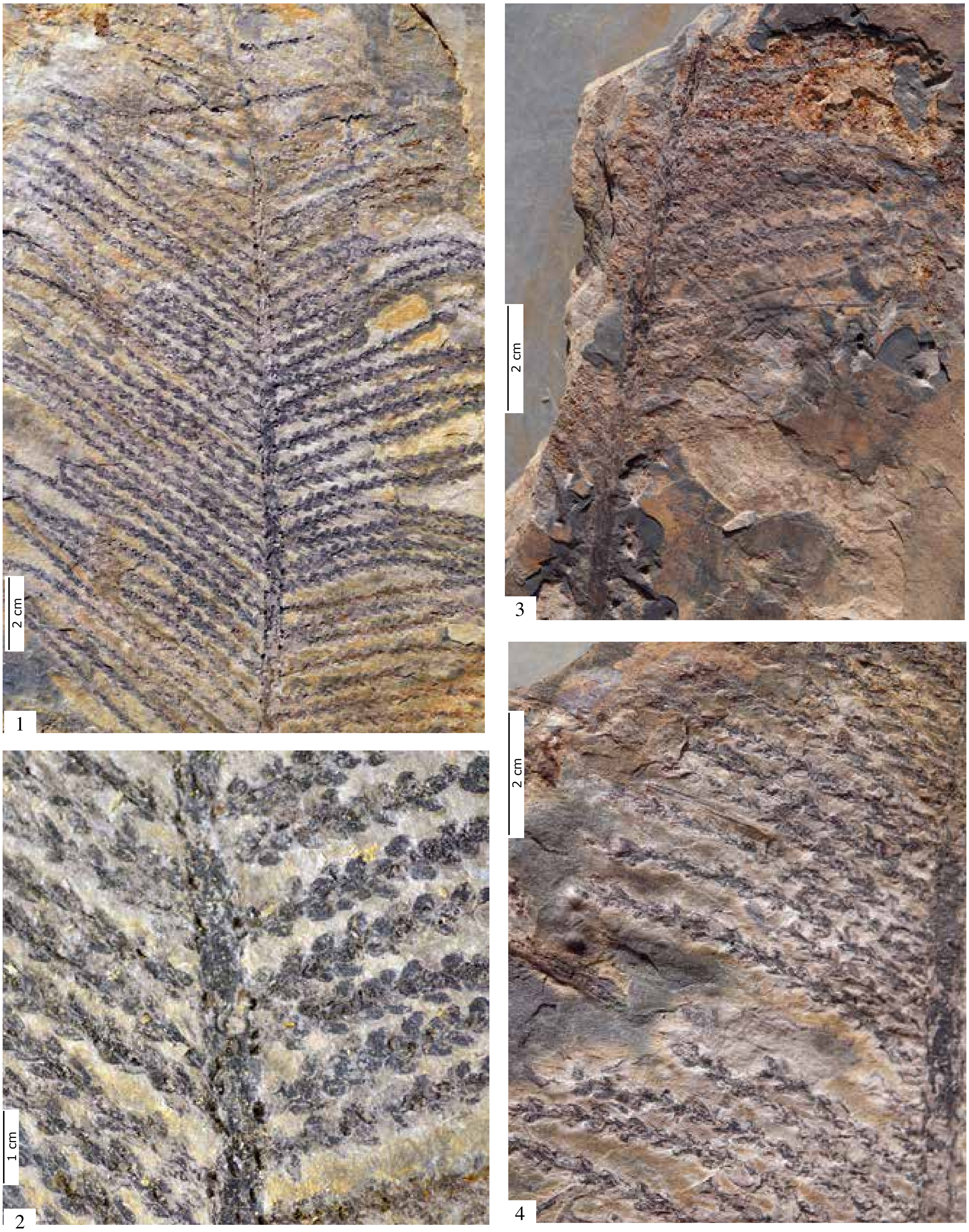
Fruttificazione di una conifera! Non mi pare una Walchia per le squame lobate. L'ho descritta come un genere probabilmente nuovo - Curionia.

Original label made by Sordelli, 1896: *"Fructification of a conifer! It doesn't seem to be a Walchia due to the furcate bracts. I have described it as a new genus - Curionia"*



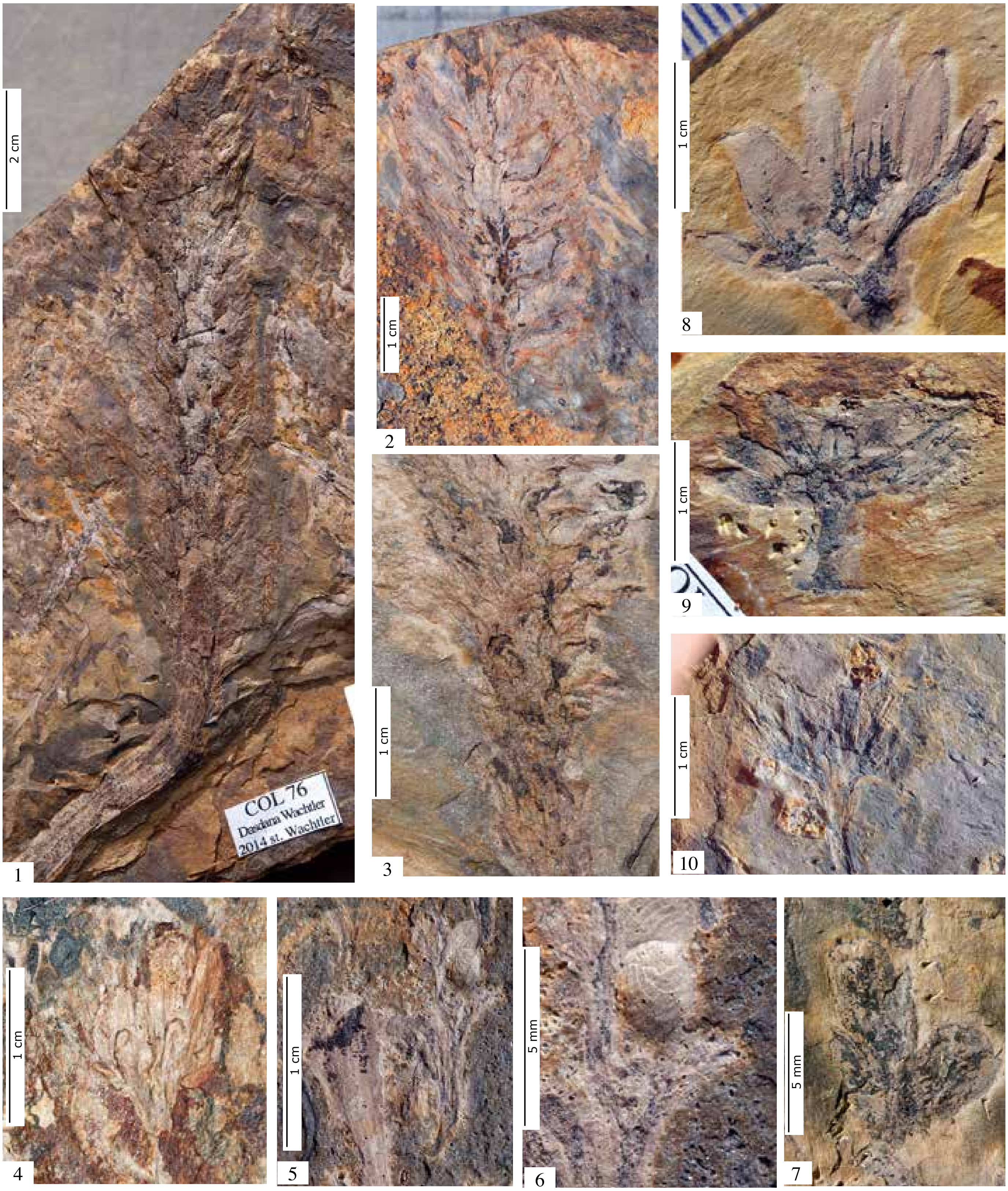
Voltzia triumpilina. Twigs and leaves (Early Permian, Artinskian)

1. Part of a twig, new paratype. Specimen found by Giuseppe Ragazzoni in 1868 (Brescia Ex 1763 (now 5); 2. Part of a twig found by Don Bruni (Ex 1867 (now 130); 3. Part of a twig, classified in 1862 by Tyroff as *Walchia geinitzii* (BR 1765); 4) New holotype. Female cone described by Ferdinando Sordelli in 1896 as *Curionia triumpilina* (N. 77); all Museo Civico di Storia Naturale "Giuseppe Ragazzoni", Brescia



***Voltzia triumpilina*. Twigs and leaves (Early Permian, Artinskian)**

1-2. Part of a twig and detail of the leaves (COL 31, Coll. Valentini-Wachtler); 3. Part of a twig with a long stipe (COL 02); 4. Branchlet (COL 10); All Coll. Michael Wachtler-Dolomythos); Monte Dasdana (Brescian Dolomites).



***Voltzia triumpilina*. Female cones and seed scales (Early Permian, Artinskian)**

1. Entire female cone with stipe (COL 76); 2. Detail of a cone with the seed scales (COL 202); 3. Basal part of a cone (COL 227); 4. Seed scale with the seed scars (COL 226); 5-6. Scale with an seed (COL 209); 7. Part of a scale with a dorsiventrally hanging seed (COL 239); 8-9. Blueprint of the seed scales (COL 44, COL 99); 10. Outer side of a scale with protective leaves (COL 124); All Coll. Michael Wachtler-Dolomythos); Monte Dasdana (Brescian Dolomites).

doubtful pine-remains in the Triassic, but certainly they were not common in this period. Whether the generally warmer climate played an essential role or there were other reasons must be investigated in the future. That no remains were found in all the following 100 million years looks strange. Or even the fact that super-spreaders (such as birds today) that could contribute to radiate fruits and seeds in remote areas were missing (but they appeared in the fossil record only in the Late Jurassic). Between the Cretaceous and the Paleogene the angiosperms, pines and firs appear worldwide again and in many subspecies.

Férovalentinia wachtleri (PERNER, 2015)

2015 *Valentinia wachtleri,* PERNER, pp. 83-88

Holotype

COL 127 (branchlet with attached female cone), **paratype**:COL 129 (detail of a branchlet); COL 43 (female cone)

Etymology

Named after Michael Wachtler, who collected scientific material on the Collio Formation and made profound studies in.

Description

Branchlets and leaves: They are characterised by an extreme shoot dimorphism and varying from regular to irregular (COL 127, designed holotype, (COL 64, COL 129, paratype). Single sets of leaves bundled in whorls. Needles various, depending probably on seasonal growth stages. Juvenile leaves densely clustered (COL 150, COL 56), in adult stage elongated till 1.5–2.0 cm long by 0.1 cm in width, apical rounded or sometimes tapered.

Male cones: Collocated on the end of a minute needle. Small-sized ovoid till ellipsoid, only 1 cm long and from 0.5 to 0.8 cm wide, forming catkin-like structures (COL 159). Dwarfish microsporophylls densely arranged and grouped together on a thin axis.

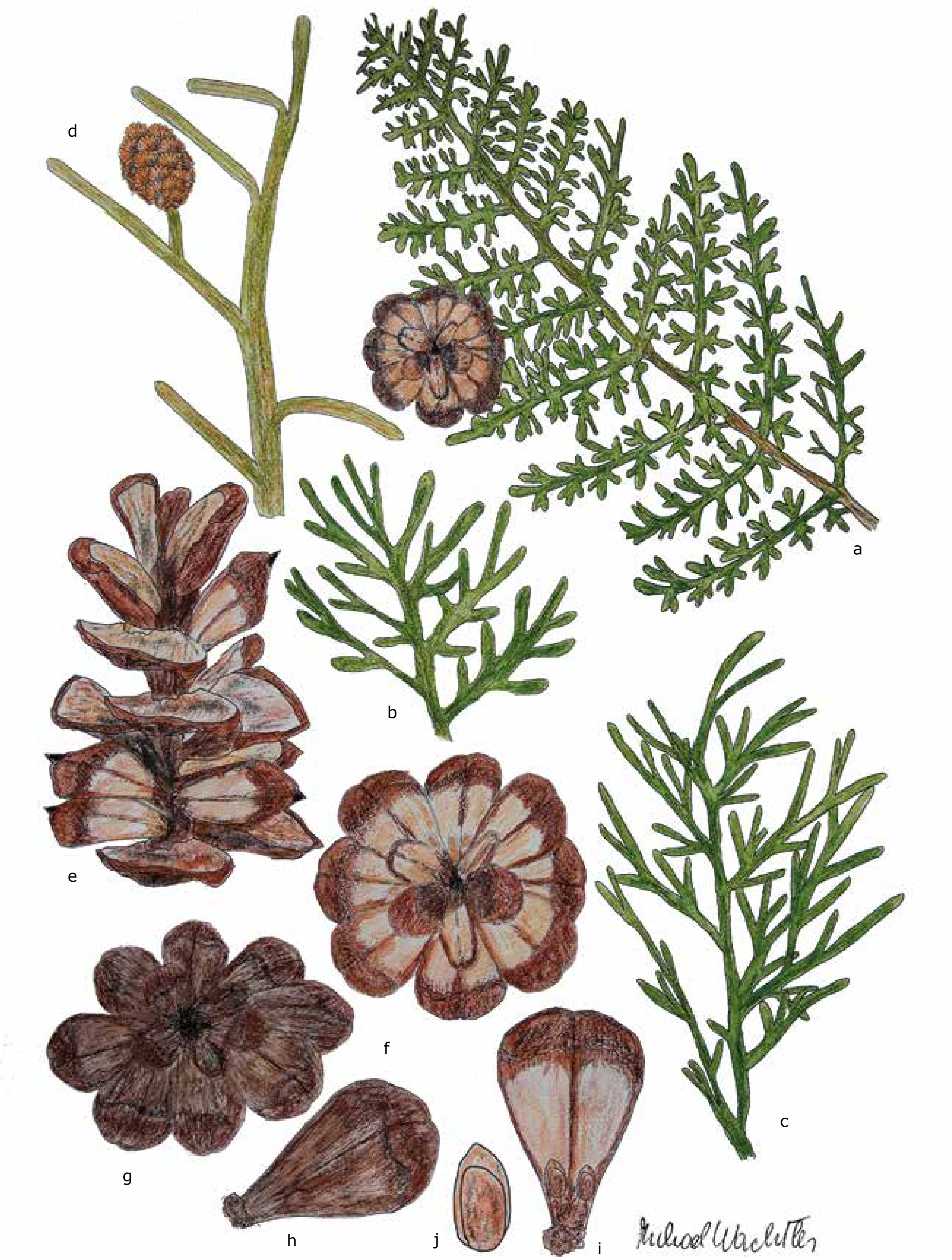
Female cones: Ovuliferous organs symmetrical ovoid, nearly sessile to small stalked, having a diameter of 1.5 to 2 cm. Macrosporophylls spreading around an axis, with only a few seed scales (COL 43, paratype, COL 117, COL 116, COL 134, COL 46, COL 28). In a lateral view perhaps only three till four scale rows form a cone (COL 78, COL 282). The lower side of the cones is crenate and rugose. The apophysis is keeled with a short umbo, like most of today's pines. Single scales, apically incised hold basally two small 0.1 cm long ovoid, nutlike or shortly winged seeds.

Taxonomic notes

The discovery of nearly 300-million-year-old ancestors of the Pines represent a milestone in palaeobotany. *Férovalentinia wachtleri* from the Early Permian (Artinskian) Collio-Formation in the Italian Alps constitutes till now the oldest known ancestor of the genus *Pinus.* It confirms that we have to deal with a conifer close to the crown group of Pinoideae, and it holds just the whole botanical spectrum of today's pines. The most important and widespread gymnosperms-families evolved therefore, not step by step, but in a relatively short time on the Carboniferous-Permian border. The whys and wherefores can be answered only speculatively. The fact that in the Early Permian we encounter just truly Araucarian-like ancestors (*Ortiseia*), as well as Abietoidea-progenitors (*Majonica*), Picea-conifers like *Kungurodendron,* primitive ginkgos (*Baiera, Ginkgoites*) and cycads *(Macrotaeniopteris, Taeniopteris, Nilssonia)* must lead to a new interpretation of the evolution of the plant world (Perner & Wachtler, 2015).

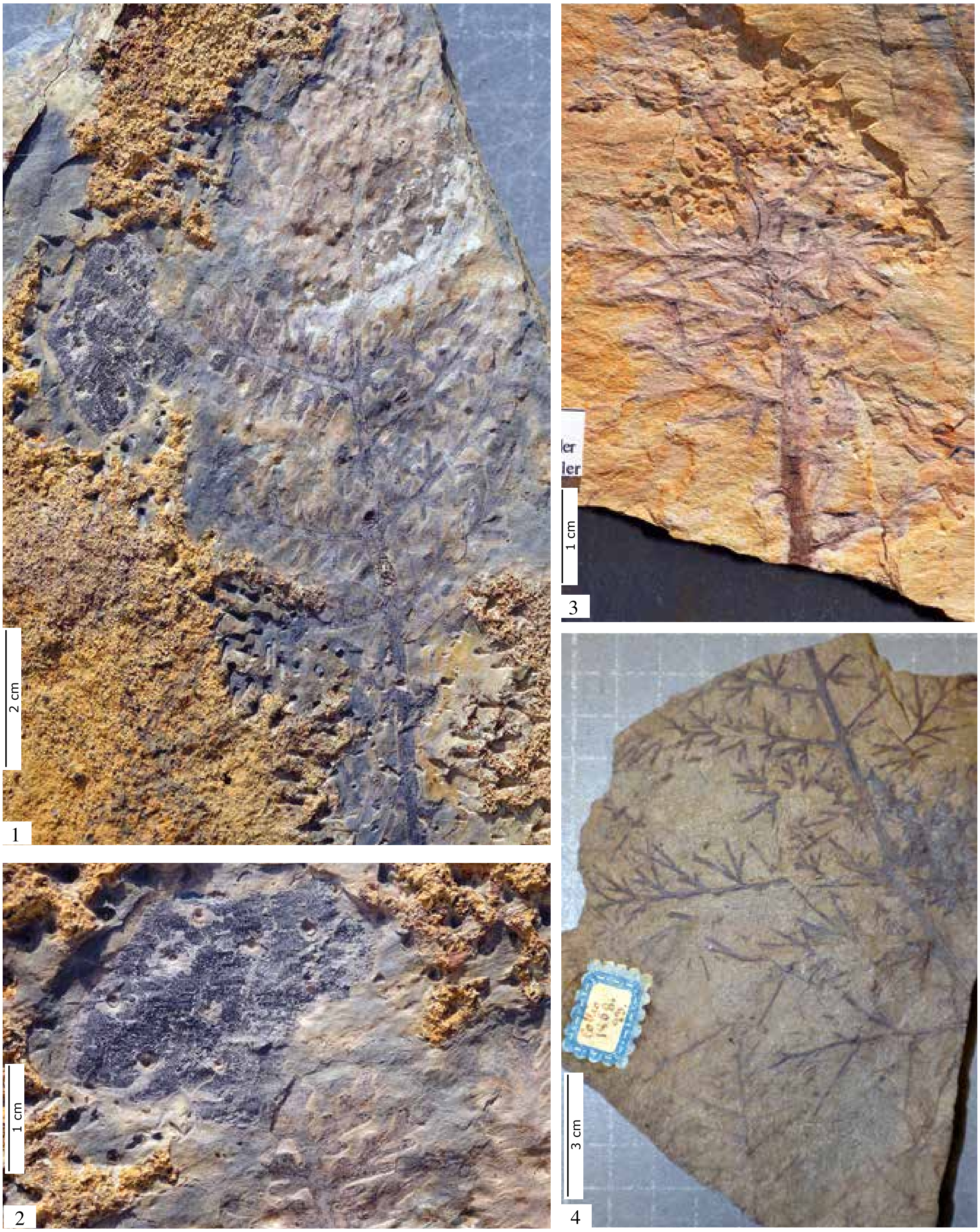
The irregularly forking needles from *Férovalentinia wachtleri* are variegate and grouped in bundles from one till eight. The cones are collocated on the apical side of a single leaf. This is valid for the dwarfish pollen organs, as well as the ovuliferous ones. The female cones are rounded to elliptical and segmented in scales, exhibiting two seeds on each. Each scale is still slightly divided in two, an archaic feature recognized also in the most primitive Abietaceae like Early Permian *Majonica.* The apophysis is keeled with a short umbo, like most of today's pines (Perner, 2015).

But the needles can not be regarded as truly pine-like; that follows some million years later in the Artinskian-Kungurian Tregiovo-Formation with *Férovalentinia angelellii*



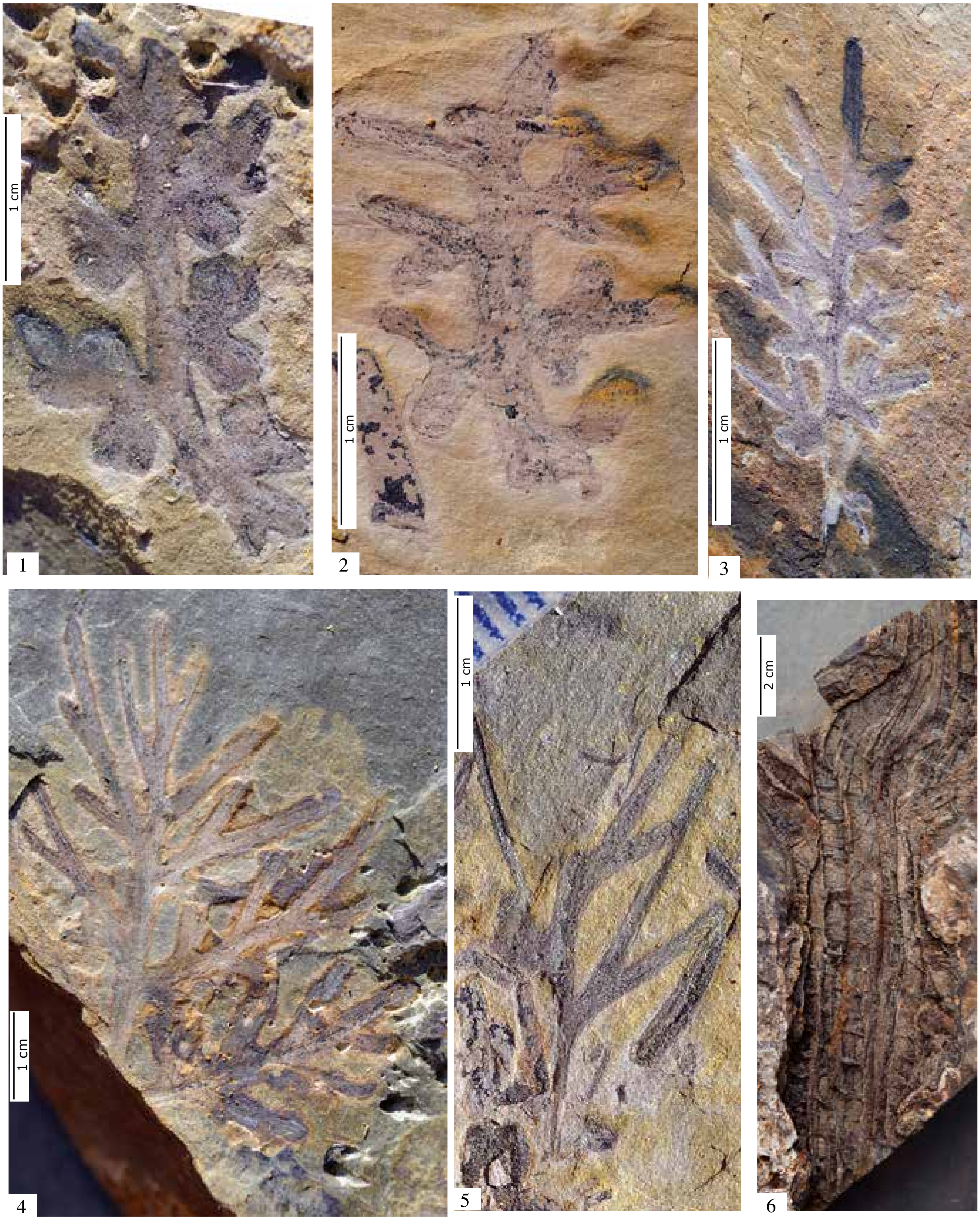
***Férovalentinia wachtleri*. Reconstruction (Early Permian, Artinskian)**

a. Branchlet with female cone (COL 127, holotype); b. Single leave tufts (COL 129, Paratype); c. Detail of a twig (COL 71); d. Branchlet with pollen cones (COL 159); e. Female cone lateral view (COL 78, COL 282); f. Female cone, upper view (COL 43, paratype, COL 117, COL 116); g. Female cone lower surface (COL 134); h. Single macrosporophyll lower surface; i. Single macrosporophyll upper surface with two seeds; j. Single seed (COL 284)



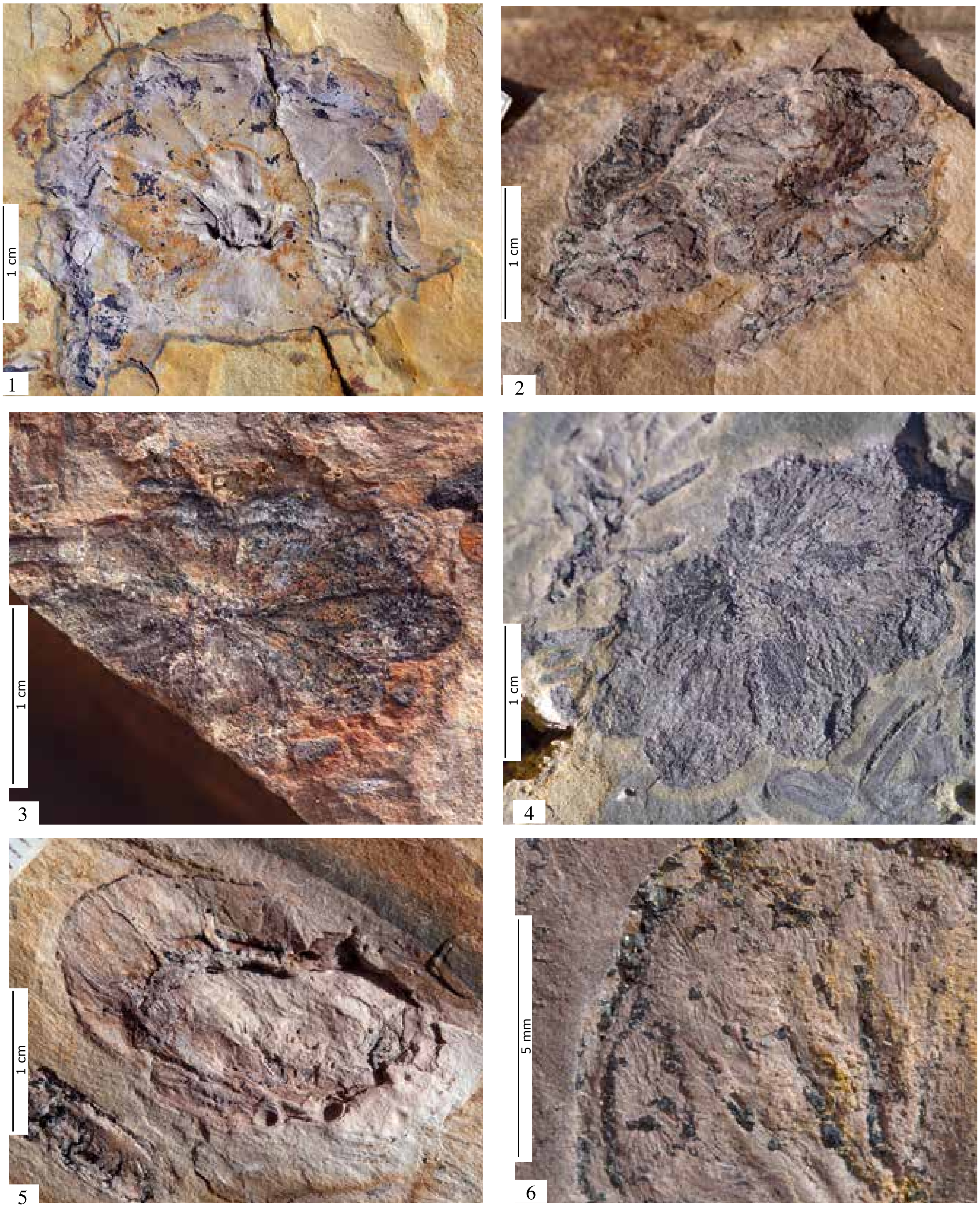
***Férovalentinia wachtleri*. Branchlets and leaves (Early Permian, Artinskian)**

1-2. A mostly whole twig with an attached female cone and detail of the cone (COL 127, designed holotype, Coll. Wachtler, Brescia Museum of Natural history); 3. Detail of a twig (COL 71); All Coll. Michael Wachtler-Dolomythos); Monte Dasdana (Brescian Dolomites); 4. Specimen found by Ragazzoni in 1868 (Nr. 12, new 1772, Museo Civico di Storia Naturale "Giuseppe Ragazzoni", Brescia



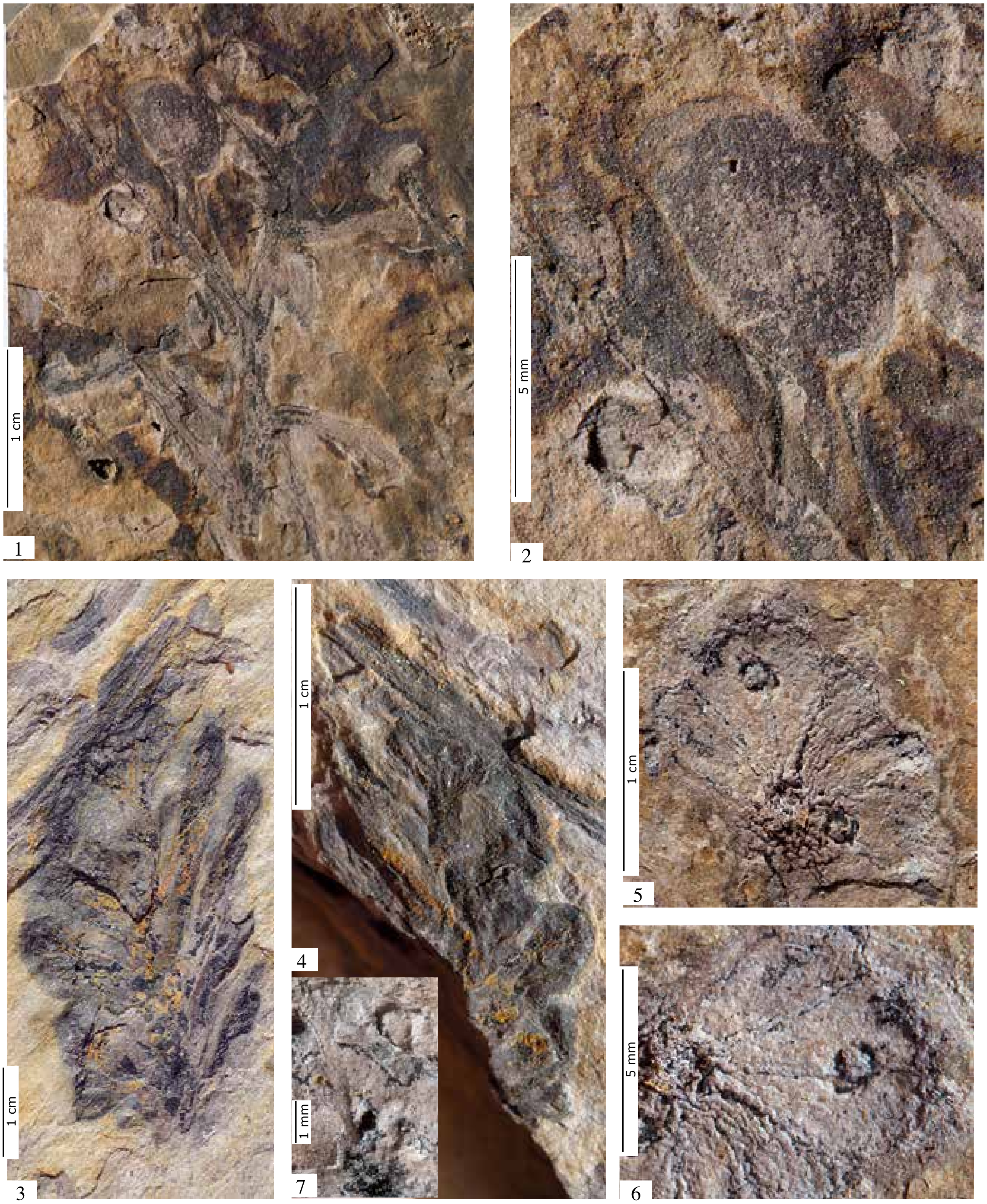
***Férovalentinia wachtleri*. Leaves (Early Permian, Artinskian)**

1. Young enfolded needles (COL 150); 2. Slightly open needles (COL 56); 3. Apical tuft (COL 64); 4. Single leave tufts (COL 129, Paratype); 5. Extra-long needles (COL 79); 6. Crippled stem (COL 286); All Coll. Michael Wachtler-Dolomythos); Monte Dasdana (Brescian Dolomites).



***Férovalentinia wachtleri*. Female cones (Early Permian, Artinskian)**

1. Female cone, upper side (COL 43, paratype); 2. A bigger and a smaller female cone upper side (COL 117); 3. Female cone upper side with a seed on the right side (COL 116); 4. Female cone lower surface (COL 134); 5. Female cone with two shed seeds on the lower side (COL 46); 6. Detail of a cone lower side showing the dorsal, mucronate umbo (COL 28); All Coll. Michael Wachtler-Dolomythos); Monte Dasdana (Brescian Dolomites).



Férovalentinia wachtleri. Male and female cones (Early Permian, Artinskian)

1-2. Pollen cones and detail (COL 159); 3-4. Female cones lateral view (COL 78, COL 282); 5-6. Female cone with detail of two isolated seeds and the seed scale (COL 284); 7. Scale with the shadows of two seeds (COL 232); All Coll. Michael Wachtler-Dolomythos); Monte Dasdana (Brescian Dolomites).

and *Férovalentinia cassinisi* (Wachtler & Valentini, 2017). There we have just a splitting in the diploxyl pines with only two till three needles per bundle (subsection Pinus) and the haploxyl, which usually bore five long needles into a sheath (subsection Strobus) (Wachtler, 2015).

Férovalentinia wachtleri stands a little isolated inside the conifer-community of the Collio-Formation and its cones, as well as its foliage cannot be confused with falcate *Majonica suessi* or the minute nestled *Voltzia triumpilina* needles. The Araucarian-like *Ortiseia* leaves and cones are also too different.

More complicated is answering questions about the even earlier ancestor-line of *Férovalentinia* or of the whole genus Pinus. Surprisingly their needles correspond in some aspects to primitive Gingkoales like *Baiera perneri* or *Ginkgoites pohli* from the Lower Permian or *Baiera digitata* from the Upper Permian. However, the berries of the Ginkgoales are completely different from the wooden, winged seeded cones of *Férovalentinia.*

But this does not resolve the problem of the earliest progenitor. The concept of two-Ypsilon segmented leaves (or needles) predates the origin of all gymnosperms like the Cycadophyta, Coniferales or Ginkgoales till the Devonian or across the Carboniferous. Unfortunately, during the entire Carboniferous the gymnosperms played only a marginal rule or we have no knowledge about the fossil record. Then, beginning from the Carboniferous-Permian border several gymnosperms-lines started, already highly evolved and separated in the main families. A valid alternative as earlier relative can be Carboniferous-Permian *Perneria thomsonii* holding swollen seed-scales. There the median incision is more pronounced, suggesting that each seed scale of *Férovalentinia* or the *Pinus*-family represents a fusion of two fertile scales (Wachtler, 2015).

Pines could also be a good climatic indicator. Usually they do well in rough, windy exposed, repudiating landscapes, such as semi-dry rock-deserts or islands. *Férovalentinia wachtleri* testifies that the Early Permian Collio area was probably a volcanism infected landscape maybe like today's Yellowstone Park, also covered by extensive Pinewoods influenced by strong and heavy winter-storms. The presence of lichens like *Ragazzonia schirollii* support this theory. If their deposition area was located at a high attitude or near the coast cannot be established. Strangely, another conifer from the Collio Formation, *Majonica suessi,* was frost-adapted, losing its needles in the cool season. The till now complete absence cycads and the limited presence of some isolated horsetails and ferns stand also in net contrast to other later deposited Permo-Triassic landscapes in the Alps.

References

Perner T., 2015. Ferovalentinia wachtleri n. sp. from the Early-Permian, a conifer-species on the base of all Pinoideae; in Wachtler M., Perner T., 2015. Fossil Permian plants from Europe and their evolu- tion. Rotliegend and Zechstein-Floras from Germany and the Dolomites. Published by Dolomythos Mu- seum, Innichen, South Tyrol, Italy; Oregon Institute of Geological Research, Portland, OR, (USA), ISBN 978-88-908815-4-1; pp. 83-88

Perner, T., Wachtler, M., 2015. The Permian - Birth of a New World, Dolomythos, Innichen and Oregon-Institute, Portland

Wachtler M., 2013. The latest Artinskian/Kungurian (Early Permian) Flora from Tregiovo-Le Fraine in the Val di Non (Trentino, Northern Italy) - Additional and revised edition. In Perner & Wachtler: Permian fossil plants in Europe and their evolution, Dolomythos and Oregon Institute of Geological Research, Portland

Wachtler M., 2015. The Lower Permian (Sakmarian/Artinskian) Collio-Flora from Val Trompia (South- ern-Alps, Italy); in Wachtler M., Perner T., 2015. Fossil Permian plants from Europe and their evolution. Rotliegend and Zechstein-Floras from Germany and the Dolomites. Published by Dolomythos Museum, Innichen, South Tyrol, Italy; Oregon Institute of Geological Research, Portland, OR, (USA), ISBN 978-88- 908815-4-1, pp. 45-51

Wachtler M., 2015. Interesting conifer-evolution in the Early-Permian (Artinskian) Collio Flora (Brescian Alps - Northern Italy); in Wachtler M., Perner T., 2015. Fossil Permian plants from Europe and their evolution. Rotliegend and Zechstein-Floras from Germany and the Dolomites. Published by Dolomy- thos Museum, Innichen, South Tyrol, Italy; Oregon Institute of Geological Research, Portland, OR, (USA), ISBN 978-88-908815-4-1; pp. 68-82

Wachtler M., Valentini F., 2017. La Flora Fossile del Permiano Inferiore di Tregiovo. Un interessante periodo nell'evoluzione delle piante, in Atti I. Conferenza, Revò 22-23- Agosto 2015, Coord. Francesco Angelelli

Permian Fossil Floras and Faunas from the Dolomites
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