ASBS members reflect
We celebrate the last 50 years of ASBS by asking members what our society means to them

Seed fern discoveries
Eichler grant recipient Miriam Slodownik reports on her recent work on Komlopterus fossils

Historical collectors
Read about collectors Frederick Manson Bailey, and Edith and Ernest Officer
Chasing a ghost through Gondwana’s history – the fossil record of the 'seed fern' *Komlopteris*

Miriam Slodownik University of Adelaide, Robert Hill University of Adelaide, Stephen McLoughlin Swedish Museum of Natural History

Pteridosperms, also known as 'seed ferns', represent an extinct polyphyletic group of plants with fern like fronds. Unlike true ferns, which reproduce with spores, pteridosperms reproduce with seeds. They were particularly common in the Paleozoic and Mesozoic, but declined noticeably with the diversification of angiosperms. They were long believed to have gone extinct at the end-Cretaceous mass extinction 66 million years ago (e.g.,

Figure 1 Examples of *Komlopteris* species from Australia. A–E *Komlopteris cenozoicus* from the early Eocene of Tasmania: A reconstruction of a frond; B UV fluorescence image of a frond; C close-up of UV fluorescence image of a frond with visible intraveinal resin bodies; D scanning electron microscopy image showing the inner cuticular surface including a stomeate with dicyclic subsidiary cells; E photomicrograph of stained cuticle. F *Komlopteris victoriensis* from the Aptian Stage (Early Cretaceous) of Victoria. G *Komlopteris boolensis* Valanginian Stage (Early Cretaceous) of Victoria. Scales: A–C and F–G = 1 cm; D, E = 50 µm.
Recently, however, a 53 million year old pteridosperm species, *Komlopteris cenozoicus*, was discovered at the west coast of Tasmania near Strahan, post-dating the end-Cretaceous extinction by about 13 million years (McLoughlin et al., 2008). The discovery of this ‘ghost lineage’ prompted new excavations at its type locality, which led to the recovery of 52 new leaf specimens of *K. cenozoicus*. Meticulous preparation of the retrieved hand samples revealed that the new *Komlopteris* specimens were more complete than those first described and offered the opportunity to study the frond architecture and micromorphology. The fronds had long petioles and entire pinnae with decurrent to constricted bases, a prominent mid-vein and bifurcating secondary veins (Fig. 1A–C). Scanning electron microscope images confirmed the presence of dicyclic
stomata (two rings of cells surrounding the stomata; Figs. 1D, E) that are diagnostic for the genus (Barbacka, 1994). Furthermore, a striking detail was discovered by illuminating the specimen with ultraviolet light: small resin bodies between the veins (Fig. 1C).

With the new characters retrieved from the Tasmanian fossils, an extensive literature review and a study of unpublished material from museum collections, we were able to trace the Komlopteris lineage through Jurassic to Eocene strata of Gondwana (Slodownik et al., 2023) (Fig. 2). In addition to K. cenozoicus, we identified nine more species that have pinnate leaves with a range of entire to dissected pinna margins (Fig. 1F–H) and sometimes include traces of resin bodies (Fig. G). Many published fossils of Komlopteris-like leaves have been assigned to Komlopteris, some were previously assigned to various other taxa, and others had not yet been described or published. The oldest records that we recognised are derived from the Lower Jurassic of South America. Late Jurassic Komlopteris can be found in Antarctica, India and Australia, while the Cretaceous record is concentrated in India, Australia, and New Zealand. The youngest occurrence is of K. cenozoicus from Tasmania. Another fossil from South America, which is of similar age as the Tasmanian material, has striking similarities with Komlopteris, but needs further study to confirm its affinity (Slodownik et al., 2023).

Furthermore, we noticed striking macro-morphological similarities with the umkomasialean (or ‘corystospermalean’) leaf taxa Kurtziana and Dicroidium which were common in the Triassic but disappeared at the end-Triassic mass extinction (Anderson and Anderson, 1983; Anderson and Anderson, 1989), while pollen typical of these taxa persisted until the early Paleogene (e.g., Harris, 1965; McKellar, 1974; Dettmann, 1986). On the one hand, the leaf architecture of Komlopteris resembles that of Kurtziana, of which, however, the cuticular morphology is unknown. Dicroidium, on the other hand, which always has characteristically forked fonds, has been shown to have interveinal resin bodies. Nonetheless, similar resin bodies are also present in the leaves of Late Triassic Nilssoniopteris sp. (Bennettitales) from China (Xu et al., 2021). This suggests that this trait might have been more common among plants from the middle Mesozoic Era than previously thought.

Umkomasiales played a pivotal role in the ecosystems of Gondwana during the Triassic period, contributing significantly to the coal formation. Our research supports the sustained existence of the Umkomasiaceae beyond the Triassic, albeit with reduced dominance. Specifically, the Komlopteris lineage persisted throughout the Jurassic and Cretaceous epochs and endured as relictual populations into the Paleogene era.

Acknowledgements

I thank the ASBS for funding this research by awarding me the Hansjörg Eichler Award. The funding allowed the study of the collections at the Victorian Museum in Melbourne, Australia, the Natural History Museum in Stockholm, Sweden, and the British Antarctic Survey in Cambridge, United Kingdom. Furthermore, preparation materials, scanning electron microscopical and palynological analyses were funded by the award.

This research has now been published in the journal Review of Palaeobotany and Palynology (Slodownik et al., 2023). We thank the Editor Prof. José Carrión for the support during the publication process and Dr Evelyn Kustatscher and one anonymous reviewer for their input and feedback.

We thank Helen Caville for fossil site access, Prof. Gregory Jordan and Dr Chris Mays for fieldwork support and technical discussions, Tim Ziegler for collection access at Museums Victoria and David Summerhayes for photography support. We thank Dr Margret Steinthorsdottir for travel support to Stockholm and valuable feedback. This work was further supported by the University of Adelaide, Gostralia! [PhD scholarship to Miriam Slodownik] and the Swedish Research
Council [VR grant numbers 2018-04527 and 2022-03920 to Steve McLoughlin].

References


