Looking back to move forward – Impact of historical moss specimens on modern systematics

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Natural history collections reflect our desire to understand the living world. Each collection is unique based on how it was composed, who composed it, where the specimens originated from, and how it has been enriched. Natural history institutions preserve, curate and enhance their collections on an ongoing basis and they serve as a powerful scientific resource. Collections provide a window into past, present and future biodiversity via the information contained on and in specimens. They play a crucial role in the documentation, description and understanding of species themselves, with the specimens held in global collections forming the foundation for all taxonomic endeavours.

Historical specimens add an important time dimension to the description, circumscription and understanding of species. They show how species were interpreted and how concepts may have evolved over time. Historical collections often contain a disproportionally large number of types which form essential reference points in the taxonomic process. An example of the importance of historical specimens is the moss collection of Johannes Hedwig (8 Dec. 1730–18 Feb. 1799), who was a medical doctor by training and bryologist by passion. Known as the „Father of Bryology," Hedwig revolutionised the way mosses were interpreted by using his 50× linear magnification microscope to observe and document their macro- and microscopic features. He was among the first to fully appreciate their diversity and his opus Species muscorum frondosorum – SMF (Hedwig, 1801, Fig. 1) set out one of the foremost systematic frameworks for mosses. Due to this his work was designated as the starting point of moss nomenclature (excepting the Sphagnaceae) in 1910. SMF contains 372 descriptions of mosses, including 3 *Sphagnum* species and 75 moss species that were new to science. As a result of the designation of this later starting point, the 294 names in SMF from earlier authors were ascribed to Hedwig. The Hedwig herbarium, held in the Conservatory and Botanical Garden of Geneva (G), became a rich source of nomenclatural types for early moss names (Fig. 2).

The cataloguing of the Hedwig type material and collation of typifications of the Hedwig moss names revealed that many of the names in current use, even for common and widespread species, were lacking any formal type designation (Price 2005). Typification of the Hedwig material requires the consultation

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Fig. 1. An illustration from Hedwig's Species muscorum frondosorum of 1801 (Tab. X of *Encalypta crispata* Hedw. and *E. streptocarpa* Hedw.). He taught himself to draw to facilitate his work and his hand coloured plates are a testament to his observations and understanding of moss morphology.

Fig. 2. Hedwig's herbarium contains a set of standardised herbarium sheets (16 × 21 cm) that hold pressed specimens and a hand-written label. Here is the original specimen of Hedwig's *Mnium palustre* Hedw. *(Aulacomnium palustre* [Hedw.]Schwägr.).

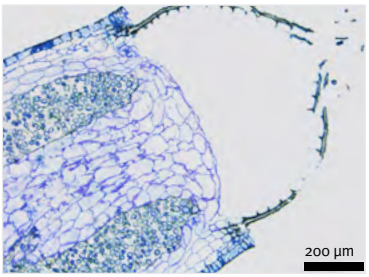

Fig. 3. An image of a longitudinal section of a peristome of *Dicranum scoparium* Hedw. taken by Mathilde Ruche as part of her PhD research into peristome architecture.

of the sources cited in the protologues, disentangling the concepts of early authors and careful examination of the plants on the sheets of original material to confirm their taxonomic identity. In some cases, issues need to be resolved as part of the typification process (e.g., the presence of material added to the original specimens at a later date, two or more species present on a sheet or two sheets present for one name that contain two different species). This careful procedure ensures that the plant or plants from amongst the original material that may serve as the nomenclatural type is/are identified, and that the name is correctly applied.

A series of collaborative articles typifying Hedwig names have been published since 2010, with the most recent on *Polytrichum commune* Hedw. (Kariyawasam et al. 2021). Efforts are currently focused on *Dicranum* Hedw., as work on the original material in G revealed that all was not as it should be for the ubiquitous *D. scoparium* Hedw., the type species of the genus itself. Different taxa are present on the two original herbarium sheets under *D. scoparium* and the protologue contains a mixture of features from two distinct taxa. This discovery led to a more intensive focus on the genus with the aim of establishing solid taxonomic and nomenclatural foundations for it. Research activities explore species circumscriptions and relationships as well as the potential of peristome traits for use in taxon discernment. Histological (Fig. 3) and Scanning Electron Microscopy studies of peristomes across *Dicranum* have revealed novel results. Newly generated data from the sporophyte will contribute to the circumscription of the genus and Hedwig's *Dicranum* species. In addition to the typification of the names, including the troublesome *D. scoparium*, full species descriptions and illustrations will be produced. The careful examination of the over 200 year old material in the Hedwig collection will ensure a better taxonomic understanding of *Dicranum*, with modern microscopy and imaging techniques complementing the traditional approaches.

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