

The Vasculum

The Society of Herbarium Curators Newsletter Volume 20, Number 2: 2025-26



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Message from the President



Greetings curators and herbarium supporters! I write to you on the heels of a vibrant and well-attended *Botany 2025* meeting and a meeting of the Society of Herbarium Curators Executive Board. The herbarium community is getting more unified and collaborative by the day. Though we face uncertainties about the support we receive from the governments and institutions that benefit from herbarium-related activities, we are addressing these uncertainties on many fronts. Our passions for the importance of natural history collections for understanding the past and meeting future challenges are unwavering. We have developed strong regional, national, and international networks to share data, best practices, and strategies for herbarium sustainability.

These efforts were on full display at the *Botany 2025* meeting in Palm Springs in late July. SHC partnered with the American Society of Plant Taxonomists to organize a session on *Biodiversity Informatics and Herbarium Digitization*. The 14 talks were incredibly diverse in the scope of activities taking place in herbaria, the impacts of these activities on science and society, and the regions of the globe where these efforts are taking place. The talks included announcements and updates to powerful computational tools that use machine learning and other AI techniques to manage, mobilize, and collect data from specimens. They also included important messages and pathways for democratizing and facilitating access and use of herbarium specimens and to better publicize the importance of collections to the public and decision makers at institutions and governments.



Figure 1: Herbarium Curators Meeting at *Botany 2025* (Photo credit: Mark Fishbein)

Sustainability was also the focus of the Herbarium Curators Meeting at *Botany 2025*, cohosted by ASPT and SHC and organized by ASPT and SHC member Jennifer Ackerfield. Under the rubric of “Futureproofing Herbaria,” the meeting consisted of dynamic breakout sessions on topics related to specimen curation, education and outreach, AI and machine learning applications, integration with broader networks, digitization, and fundraising and advocacy. Discussions were lively and optimistic concerning the work we must do to protect and augment the value of herbaria. We hope to publish our findings this winter.

One of SHC’s important activities is to award funds in support of student researchers. This year we provided support for three amazing projects: Andrew Ruegsegger, a University of Arkansas undergraduate, is studying plant diversity in Ozark glades in Arkansas; Marguerite Trost, a University of Wyoming graduate student, is conducting floristic research in montane valleys in eastern Montana; and Garrett Goodrich, a Claremont Graduate University student being trained at the California Botanic Garden, is conducting floristic research in the Sierra Nevada of California. Congratulations to these student botanists!

SHC is growing! Membership is up since the end of last year. SHC leadership is bidding farewell to members who have completed their terms of service and welcoming newly elected officers. Congratulations to our new President-Elect Shawn Krosnick and our new Member-at-Large Angela McDonnell! We also welcome Christian Lopez, who was elected President of the Early Career Section. I am excited to work closely with these deeply committed herbarium champions during the next year. I also warmly thank those who are leaving SHC leadership but remain in our herbarium community: Gilberto Ocampo (outgoing Member-at-Large) and Jacob Suissa (who is now the Past-President of the Early Career Section). I also thank Shawn Krosnick for her able service as the President of the SE Chapter; Shawn has obviously only dug in deeper to serve SHC!

If you enjoy *The Vasculum* (I know you do!), you can help keep the tradition alive by volunteering to become the new Editor. After a strong run, Tilo Roy is moving on to devote time to other responsibilities, and we have an immediate need for her successor. If you think you might be interested, please contact me (mark.fishbein@okstate.edu).

I wish you the best in curating, researching, teaching, and promoting herbaria for the rest of the year. Keep in mind that renewal season is coming up. When the time comes you can renew here (<https://www.herbariumcurators.org/membership/>).

Warmly,

Mark Fishbein
President, Society of Herbarium Curators (2024-2026)

Mark Fishbein
President, Society of Herbarium Curators (2024-2026)
Director of the Oklahoma State University Herbarium (OKLA)
Regents Professor and Associate Head, Department of Biology
Oklahoma State University, USA

Special note: This message was composed in August 2025.

From the Editor's Desk

Dear Readers,

Welcome to the 2025-26 issue of *The Vasculum*. I must begin with an apology for the delay in bringing this issue to you. I understand that many of you look forward to our newsletters every year, and I regret that this volume has taken longer than expected to reach your hands.

This is a shorter issue than usual, featuring three thoughtful contributions that we believe you'll find worthy of your time and attention. While we always strive to bring you a robust collection of work, sometimes quality over quantity serves our mission best, and we are proud of what these pages contain.

I also write to you today with important news about the future of *The Vasculum*. We are currently seeking a new Editor-in-Chief to guide our publication into its next chapter. This is an exciting opportunity for someone passionate about botanical and herbaria-related scholarship and community building to shape the direction of our newsletter. If you're interested in this position, or know someone who might be, please feel free to reach out to me. We would be delighted to discuss the role and what it might mean for *The Vasculum's* future.

Thank you for your continued patience and support. Your readership sustains us, and we look forward to bringing you more in the seasons ahead.

Sincerely, Tilo

Tilottama Roy
Editor, *The Vasculum*
Vice Provost for Graduate and Sponsored Programs, Academic Affairs
Missouri Western State University, Saint Joseph, MO, USA

The Society of Herbarium Curators (SHC) unites the world's herbarium professionals in discussion, training, action, and support for the benefit of herbaria, science, and society. SHC envisions a network of innovative, well-trained herbarium professionals, empowered to recognize and address local and global stakeholder needs with organizationally sustainable strategies that advance the well-being of herbaria, science, and society. For more information, please join us online:

— www.herbariumcurators.org —

Herbarium BREM Goes Digital: Current Status of the Digitization Project

Introduction

The Übersee-Museum Bremen, Germany, comprises the three departments of natural history, ethnology, and trade history, a unique combination of departments not only in Germany but also in Europe. Some parts of the natural history collection have origins dating back to the 17th century. They contain over one million specimens of fungi, plants, and animals (Stiller et al. 2018), many of them acquired in colonial contexts. Therefore, the digitization and accessibility of its zoological and herbarium collections from colonial contexts is one of the main current priorities of the natural history department. This report provides a brief insight into the current state of the herbarium digitization efforts and gives an outlook on next steps.

The Herbarium of the Übersee-Museum Bremen (BREM), founded in 1865, has always been an essential part of the natural history collection. Since 1998, the newly built facility “Übermaxx” houses most of the plant specimens in an air-conditioned storage. A small part of the herbarium collection is on public display in the visible storage (Fig. 1), one of the Übersee-Museum’s permanent exhibitions. Although an inventory of the collection has never been carried out, the Herbarium BREM is roughly estimated to hold at least about 400,000 specimens from all over the world (Metzing 1999). The main botanical collection splits up into four parts: The “General Herbarium” with specimens from all over the world, the “Bremen Herbarium” with native specimens from Bremen and North Western Germany, the “Island Herbarium” with specimens from the Frisian Islands/ North Sea, and the “Adventive Herbarium” with neophytes and ruderal plants of North Western Germany. Beyond that, there are some smaller herbaria kept separately from the main collection, for example the *Rubus* collection that contains a significant number of type specimens (Fig. 2). Besides, there are small collections of wood, seeds, fruits, and other plant components. For detailed information on



Figure 1: Plant specimens in the visible storage of the Übersee-Museum with standard herbarium sheets fixed in vertical drawers. Photo: CC BY-SA 4.0 Übersee-Museum Bremen (Photo credit: Matthias Haase)

the Herbarium BREM, its history, significant collectors, and importance of its collection see Metzging (1999) and Steinhof (2010).

Digitization of the herbarium collection

According to a national survey carried out in 2019, German herbaria hold almost 23 million specimens with 87% of them still not digitized (Borsch et al. 2020). First attempts to digitize the collection of BREM took place around 30 years ago. So far, about 10% of the collection has been recorded digitally. Under the guidance of the museum's digital strategist the cross-departmental project team "Digital Collections" formed in 2019 in order to advance the overall digitization efforts. Within this team, we elaborated a common strategy to digitize the museum's natural history, ethnographic, and trade history collections and to make them publicly accessible to a global audience. From 2020 to 2023, the Natural History Department received funding for the digitization project "Making the natural history regional and colonial collections of the Übersee-Museum Bremen available for research, education and cultural participation." The project objectives were to 1) purchase high-resolution imaging technology and implement the respective workflows, 2) perform specimen data consolidation and introduce a database-based inventory, and 3) make our already-digitized natural history collections accessible online. In addition to the "Digital Collections"-team, all colleagues of the natural history department were involved in the funded project and contributed with their respective experience and expertise. Parallel, the Museum für Naturkunde Berlin, Germany, highly experienced in all terms of digitizing natural history collections, and the DINA (DIgital information system for NATural history data) Consortium became valuable cooperation partners.

1. Imaging technology

The funded project included, among other things, the planning, acquisition, and implementation of photographic digitization systems for herbarium sheets (Fig. 3) and glass jars. As the plant collection comprises various kinds of specimens such as dried specimens mounted on herbarium sheets or stored in envelopes, specimens preserved in glass jars either dry or in ethanol (wet collection), and even a small collection of microscope slides, we had to develop and establish digitization workflows and standards for all of these preparation types. We documented the standardized procedures, which have been under constant improvement since, in a newly set up project wiki. This wiki, currently only available for staff members of the Übersee-Museum and selected external partners and contractors, provides easy access to all the most recent information on the digitization process. During the digitization process, all herbarium specimens receive an inventory number and, if necessary, get cleaned and restored (i.e., loose labels and plant parts are re-mounted or stored in glass-



Figure 2: Herbarium specimen of *Rubus schlechtendalii* Weihe ex Link (Neotype), http://coll.uebersee-museum.de/v/BREM_0015206. CC BY-SA 4.0 Übersee-Museum Bremen (Photo credit: Alexander Horn)

ine envelopes). All specimens are photographed with a scale bar and a color checker. Photographs are taken as high-resolution images (Fig. 2) following the standards proposed by JSTOR (no date). They are stored as JPG files for daily use, as well as TIF and DNG files for long-term storage.



Fig. 3. One of the museum's technical staff imaging specimens in the herbarium collection.
CC BY-SA 4.0 Übersee-Museum Bremen (Photo credit: Volker Beinhorn)

Following the example of the Museum für Naturkunde Berlin, we introduced a stable, globally unique, unambiguous identifier, the “UEM-URI” (Uniform Resource Identifier of the Übersee-Museum) into the digitization process. This identifier, which also contains the inventory number of the respective specimen, can always be assigned to the Herbarium BREM, even in a global context. The respective label contains the UEM-URI in both a human-readable font and machine-readable QR code, and it is additionally stored in the title section of IPTC metadata. In the future, we intend to use the UEM-URI as a web link and lead directly to the specimen's metadata in a web browser, but we have not yet implemented this for herbarium specimens. Additionally, we introduced the UEM-URI not only for herbarium specimens, but also for locations in the various storage areas and exhibitions, as well as for organizational units and lots (any kind of container with multiple specimens) (Fig. 4).

2. Database

The acquisition and implementation of a database system for managing specimen metadata of the natural history collections and the transfer of the already existing datasets into the new database system was also part of the funded project. We chose the open-source collection management system DINA (= “Digital Information System for NATural History Data”) because of its open, modular structure and its connectivity which allows us to exchange collection information already implemented and kept in other database systems of the museum with DINA. This is of particular importance to us as some information, such as acquisition events and agents, is kept in a separate database mainly used to manage the collection data of the ethnographic and trade history collections. As the items of the three museum departments often have a common history, we want to avoid data redundancy in several databases at all costs. Detailed information on DINA was published in Glöckler et al.

(2020) and can also be found on the DINA website (<https://www.dina-project.net/>).

As to the herbarium collection, about 30,000 data records with basic location and specimen information were already available, organized in various MS Access and Excel files. However, data in these files were not at all standardized with regard to data structure, column names, and terminology. Therefore, we had to revise all of these heterogeneous datasets in order to create uniform and consistent data records. We performed data cleaning and data transformation in the software OpenRefine (<https://openrefine.org/>) as it is a free, open source tool for working with messy data. As the manual revision of existing datasets is a very time-consuming process, data consolidation of the herbarium specimen records is still ongoing. Again, we documented all information necessary for data consolidation (such as internally developed standards, international standards, and writing instructions) in the project wiki mentioned before. Currently, the completely revised datasets are being transferred to DINA.



Fig. 4. UEM-URI as stable identifier for compactor and specimen boxes in the herbarium storage. CC BY-SA 4.0 Übersee-Museum Bremen, Photo credit: Volker Beinhorn.

3. Publishing online

As our goal is to make the herbarium collection internationally accessible to researchers and other interested parties, we are going to export specimen data to various internet portals such as GBIF (Global Biodiversity Information Facility, <https://www.gbif.org/>), museum-digital (<https://www.museum-digital.de>), and the DDB (Deutsche Digitale Bibliothek, www.deutsche-digitale-bibliothek.de). Although the groundwork for publishing our herbarium specimen data online was successfully achieved as part of the funded project, the respective export routines still have to be finalized. The consolidation of the implemented workflows and the digitization of collection specimens still is an ongoing project that will continue for many years to come.

Acknowledgements

The author and staff of the Übersee-Museum thank the Federal Government Commissioner for Culture and the Media and the Senator for Culture of the Free Hanseatic City of Bremen, Germany, for funding the project “Verfügbarmachung der naturkundlichen regionalen und in kolonialen Kontexten erworbenen Sammlungen des Übersee-Museums Bremen für Forschung, Bildung und kulturelle Teilhabe” within the INVEST Germany programme. We are also grateful to the staff of the Museum für Naturkunde Berlin, Germany, and the DINA Consortium for their valuable assistance.

The author thanks the staff of the Übersee-Museum, especially the “Digital Collections”-team and the colleagues of the natural history department, for their teamwork and versatile support in this project. Additional thanks go to Volker Lohrmann (Übersee-Museum) for critically reading the manuscript.

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Michaela Grein
Curator of Botany
Herbarium BREM, Übersee-Museum Bremen, Germany

Featured Herbarium

Herbarium C at the Natural History Museum of Denmark, University of Copenhagen

Introduction

Herbarium C is part of the Natural History Museum of Denmark which is a department of the Faculty of Science at the University of Copenhagen. The earliest herbarium in Denmark belonged to Ole Worm (1588–1654), the Danish physician and natural historian, who collected natural curiosities and artifacts from around the world. He was a professor at the University of Copenhagen from 1613 to 1654. Worm created a Cabinet of Curiosities, called the Museum Wormianum, to house his collections and some of the earliest botanical specimens in Herbarium C come from here (Fig. 1. A and B). Worm acquired the Marcgrave herbarium from the Netherlands in 1653. This bound herbarium of 177 plant specimens from Brazil, dating from c. 1641, contains the first dried specimens of plants from tropical America (Ossenbach 2017).



Figure 1A (top left): Ole Worm's Cabinet of Curiosities from the frontispiece of Museum Wormianum published in 1655. On the top shelf on the right-hand side is a gourd with a curved top; this specimen is still in Herbarium C today; Figure 1B (top right): Gourd from Worm's Cabinet of Curiosities.

The Museum Wormianum collections were later acquired by 'Naturaliekabinettet' in Copenhagen, which was founded in 1759. This museum also received the collections from the Arabia Felix expedition which travelled to Egypt, Arabia, and Syria (1761 to 1767). A team of six people set off on the expedition but only one person survived, the surveyor Carsten Niebuhr. The expedition collected manuscripts and notes on the geography, history, and culture of the area, along with natural history specimens. Per Forsskål, the Swedish

natural historian and student of Linnaeus, was responsible for collecting the natural history specimens. When Naturaliekabinettet closed in 1770, the botanical material, including that from Worm's collections and the Arabia Felix expedition, was delivered to the University of Copenhagen's Botanical Garden, at that time located at Amalienborg in Copenhagen. Later the garden acquired several other private herbaria after the deaths of their owners.

The *Flora Danica* project, an unprecedented effort to illustrate the flora of the Danish territories, provided impetus for collecting and cataloguing the Nordic flora. Collections came from the dukedoms Schleswig and Holstein in the south, to the double monarchy of Denmark-Norway, to the Faroe Islands, Iceland, and Greenland in the north. The first volume of *Flora Danica* was published in 1761 and over the next 120 years, 3240 hand-coloured plates were produced, published in 17 volumes (Knudsen 2016). Some of the herbarium specimens used as reference material for the illustrations are still in Herbarium C today, within a dedicated *Flora Danica* Herbarium.

During the nineteenth century, Denmark's colonial activities resulted in collections from the Danish West Indies (consisting of the islands of Saint Thomas, Saint John, Saint Croix, and Water Island in the Caribbean), Danish Guinea (now southern Ghana and Benin) and Tranquebar (now Tharangambadi) in India. In the nineteenth and early twentieth centuries, Eugenius Warming (1841–1924), regarded as a founder of modern plant ecology, contributed significant collections from Brazil (Matagne 2024).

Over this time the location of the botanical garden and the botanical collections changed with the botanical garden being established in its current location in Øster Voldgade, Copenhagen in 1874. In 1877 a Botanical Museum was built in the Botanical Garden to house the collections. Very soon there was insufficient space, and the collections were also located in a number of additional places close to the Botanical Garden.

In 2004, the Botanical Museum, Botanical Garden, Zoological Museum, and Geological Museum were joined to create the Natural History Museum of Denmark, part of the Faculty of Science of the University of Copenhagen. In 2015 Herbarium C was moved to a temporary storage facility outside of Copenhagen while new facilities are built for the Museum.

Today Herbarium C houses about three million specimens representing all major groups of plants, algae, and fungi. The collections are organised into five principal categories:

1. Vascular Plants: Approximately 1.9 million specimens, including herbarium sheets, alcohol preserved specimens, seeds, wood samples, and biocultural objects.
2. Bryophytes: Approximately 300,000 specimens.
3. Algae: Approximately 400,000 specimens, including marine and freshwater taxa, both macro and microalgae.
4. Lichens: Approximately 280,000 specimens, with extensive representation of European and Arctic taxa.
5. Fungi: Approximately 300,000 specimens, notably macro and microfungi from Denmark and Greenland.

Vascular Plants

The vascular plants are divided into three main herbaria: the General Herbarium, Danish Herbarium, and Greenland Herbarium along with smaller collections focusing on key collectors or projects including the herbaria of Forsskål, Isert's and Thonning, Seidenfaden, Marcgrave, and *Flora Danica*. There is also a significant Biocultural Collection, along with collections of wood and seeds, including the Dr. Nobbe Seed Collection. Herbarium C also houses the herbarium of the former Agricultural University of Copenhagen (CP) which is

now a department of Copenhagen University.

General Herbarium

The General Herbarium contains almost 1.4 million specimens of flowering plants, gymnosperms, and other vascular plants from all parts of the world except Denmark and Greenland (Fig. 2). Of the c. 1,370,000 specimens, about 1,320,000 of these are mounted on herbarium sheets, and about 50,000 are stored in bottles, boxes, and bags; about half of these are dried specimens and about half are preserved in alcohol. Almost all plant families and over 11,000 genera are represented. There are c. 21,500 known types. The collections have been built over 400 years through field expeditions and exchange with other herbaria across the world. The most important collectors in the General Herbarium are H. von Eggers, P. Forsskål, I. Friis, A. Hansen, B. Hansen, O.J. Hansen, J.P. Hjerting, J.W. Hornemann, P.E. Isert, B. Kamphøener, M. Køie, J. G. König, J. Lange, K. Larsen, F. Liebmann, P. W. Lund, G. Marcgrave, A. S. Ørsted, C. H. Ostenfeld, O. Paulsen, T.M. Pedersen, F.C. Raben, K. Rahn, C. Raunkiaer, D. Rolander, J. Ryan, J. Schmidt, P.K.A. Schousboe, J.F. Schouw, C.F. Schumacher, G. Seidenfaden, C. Smith, A. Strid, P. Thonning, M. Vahl, J.O. Voigt, K. Vollesen, N. Wallich, E. Warming, and H. West. Vahl's herbarium, now in the General Herbarium, contains many duplicates given to him by prominent European botanists whom he visited on his long European journeys in 1783-1785 and 1799-1800. These duplicates are often original material of new species.



Figure 2: Part of the General Herbarium of vascular plants in C.

Danish Herbarium

The Danish Herbarium houses more than a quarter of a million specimens of flowering plants, gymnosperms, and other vascular plants from Denmark, including around 529 types. Approximately 95% of Denmark's c. 1,925 native and introduced species are represented, making the herbarium the largest existing collection of Danish vascular plants. Important collections include: *Hieracium* collected by O. Gelert, E. Keld, and K. Wiinstedt; *Potamogeton* collected by J.S. Baagøe; *Rubus* collected by M.P. Christiansen, K. Friderichsen, O. Gelert, and A. Pedersen; and *Taraxacum* collected by M.P. Christiansen, C. Raunkiaer, and H. Øllgaard.

The herbarium also includes important collections from the Topographic-Botanical Investigation of Denmark (TBU, 1904-1989) and the *Atlas Flora Danica* project (AFD, 1992-2015). Several Danish floras have been prepared primarily using information from the collections in the Danish Herbarium, and it was also an important resource for the *Atlas Florae Europaeae* and *Flora Nordica* projects. The long time series of the collections offer excellent opportunities for global change research. The oldest specimens from Denmark are found in the two-volume bound herbarium of C. Heerfordt dating from c. 1650. It contains plants from the islands of Lolland and Falster and is the oldest known Danish herbarium deposited in Denmark. An older herbarium, J. Burser's herbarium from c. 1625-1635, was taken as spoils of war by Sweden in the mid-1600s and is now kept in Uppsala, Sweden (Lind 1917).

Greenland Herbarium

The Greenland Herbarium contains c. 181,000 flowering plants, gymnosperms, and other vascular plants collected from Greenland. There are 185 types. The most important collectors are: T.W. Böcher, B. Fredskild, P. Gelting, M.P. Porsild, T. Sørensen, J. Vahl, and M. Wormskjold. The oldest specimens are those collected by Paul Egede (son of Hans Egede) and preserved in his bound herbarium, dated 1739 (Fig. 3A and B). The oldest specimens on loose sheets were collected by M. Wormskjold from 1812-1813. There is an important collection from the Greenland Botanical Survey 1962-1996. Digitisation of the Greenland Herbarium (Ahlstrand 2023a) has greatly facilitated curation and research including a recent project that has updated and harmonised all the Greenland species names (Whitley et al. 2025).



Figure 3: The Paul Egede Herbarium of 1739. A (top left): Inside the front cover; B (top right): An example of one of the herbarium sheets.

Biocultural Collection

The Biocultural Collection consists of plant products and ethnographical objects made of plant material. While many objects were collected or bought by botanists, considerable parts of the collection are donations from specialists from various walks of life: explorers, researchers, pharmacists, merchants, etc. Besides strong representation of colonial goods and produce relevant to Danish history, the Biocultural Collection has a compre

hensive collection of herbal drugs, botanical jewellery, and straw hats. The Biocultural Collection was established in 1906 and has recently expanded with the Copenhagen pharmacists' Pharmacognostic Collection, which was established in 1892 and encompasses more than 7,000 herbal drugs. Important specialist collections include the Reddelien collection (the entire inventory of Danish pharmacy in 1825), the Riise collection focusing on neotropical medicinal plants (1868), the Clemensen collection of Brazilian medicinal plants (1898–1918), the Hjalmar Jensen collection of southeast Asian medicinal plants (1923), a considerable *Cinchona* collection, and the Paulsen collection of central Asian medicinal plants (1899). The most recent addition is the Danish Medicinal Plant Biobank dedicated to all plants and plant products of Danish medicinal tariffs and pharmacopoeias from 1619–2022 with a corresponding herbarium voucher, tissue, and research sample library.

Specialist Collections

Marcgrave Herbarium: The Marcgrave herbarium is a bound herbarium containing the earliest collections from Brazil, collected by Georg Marcgrave (1610–1644) who visited the former Dutch colony at the state of Pernambuco in 1638–1644.

Forsskål's Herbarium: Per Forsskål's herbarium was collected during the Royal Danish Expedition to Arabia Felix (1761–1763). On his way to Yemen, Forsskål also collected in southern France, Malta, Turkey, Greece (Rhodos), Egypt, and Saudi Arabia (coastal towns along the Red Sea). The herbarium contains c. 1,850 specimens, including original material of c. 775 new names of genera and species, published in the *Flora Aegyptiaco-Arabica* in 1775 (Hepper & Friis 1994).

Flora Danica Herbarium: The *Flora Danica* Herbarium contains vascular plant specimens that were depicted in the hand-coloured plates of the *Flora Danica* volumes 1761–1881 (Fig. 4A and B).



Figure 4A (top left): Specimen of *Carum carvi* L. from the Flora Danica Herbarium; Figure 4B (top right): The *Flora Danica* plate of the same specimen from 1877

Iser's and Thonning's Herbarium: Iser's and Thonning's Herbarium contains 1,484 herbarium sheets collected in Danish Guinea (southern Ghana to Benin) by P.E. Iser in the years 1783–1886, P. Thonning in the year 1799–1803, J. von Rohr before 1793, and L. Mortensen before 1821 (Hepper 1976; Friis and Callmander 2021).

Seidenfaden's Herbarium: G. Seidenfaden (1908-2001), Denmark's first ambassador to Thailand, developed the largest collection of southeast Asian and especially Thai orchids in Europe. Living plants were brought to the botanical gardens and when these flowered, Seidenfaden preserved the flowers in alcohol. The alcohol collection now consists of c. 11,000 specimens, almost 700 of which are types. Often the same individuals are represented by sketches, line drawings, and colour slides which are now within the Museum archives.

Agricultural University Herbarium (CP): The Agricultural University Herbarium consists of a Danish herbarium, a general herbarium, seed and cone collections, along with plant pathology collections.

Bryophytes

The bryophyte collection includes c. 300,000 specimens of all bryophyte groups (mosses, liverworts, and hornworts) from all parts of the world. It holds the world's largest collections of Danish (c. 650 species) and Greenlandic (c. 750 species) bryophytes with a coverage of 90-100% species. The bryophytes of Iceland and the Faroe Islands are also well represented. The collection includes approximately 650 type specimens.

One of the oldest mosses in the collection is a specimen of *Dicranum elongatum* Schlecht. ex Schwägr. collected in Greenland by P. Egede and found within his bound herbarium from 1739. Serious bryological research in Denmark began with T. Jensen (1824-1877) and his publication *Bryologia Danica* in 1856 which was based on his own collections and material received from other botanists like C. Rosenberg and M. T. Lange. In 1866 he published *Conspectus Hepaticarum Daniae*, which laid the basis for the knowledge on Danish liverworts. Later, the Danish pharmacist C. Jensen (1859-1941) increased the knowledge of the bryophytes of Denmark, Scandinavia, Greenland, and the Faroe Islands with his extensive collections and the floristic works *Danmarks Mosser* (1915-1923) and *Skandinaviens Bladmossflora* (1939). The bryophyte flora of Greenland has been well explored and is represented by the early collections of J. Vahl and the subsequent collections of N. Hartz, E. Warming, K. Holmen, E. Clausen, K. Damsholt, J. Lewinsky, and G. Mogensen. There is also an important collection of Mexican liverworts collected by F.M. Liebmann from 1841-1843. Finally, the European bryoflora is well represented by historical collections received by exchange with other herbaria, and the incorporation of the herbarium of the Danish phycologist N. Hofman Bang (1776-1855).

Algae

The collection holds around 400,000 species including 2,025 types, covering all taxonomic groups of algae from different parts of the world. The collection has a focus on macroalgae and among the microalgae on diatoms. It holds the largest collections of Danish macroalgae with an almost complete coverage, and has important collections from Greenland, Iceland, the Faroe Islands, the Canary Islands, the West Indies, and Scandinavia.

The most important historical part of the collections includes Forsskål's collection of algae from the Arabia Felix expedition. There are also important collections by H. C. Lyngbye, L. Kolderup Rosenvinge, F. Børgesen, and R. Nielsen. There is a large collection of marine and freshwater diatoms from all around the world, including many types. These originate from Lyngbye (1782-1837), E. Østrup (1845-1917), J.B. Petersen (1887-1961), and N. Foged (1906-1988). For Arctic algae (Iceland and Greenland), the main collections start in the 18th century with H.C. Lyngbye, L.K. Rosenvinge, and E. Østrup, up to the more recent F. Børgesen, H. Jónsson, S. Lund, N. Foged, I. Munda, and R. Nielsen.

Lichens

The lichen collection holds c. 280,000 specimens of lichenized fungi from all taxonomic groups and from all

over the world, including 1,200 types. It holds the largest collection of Danish (c. 900 species) and Greenlandic (c. 950 species) lichens, where the coverage is almost complete.

Important collections include those by J. S. Deichmann Branth and E. Rostrup, the authors of *Lichenes Daniae eller Danmarks Laver* from 1869 and material of *Cladonia* collected by H. Mølholm Hansen and M. Lund. In addition, C. F. E. Erichsen, O. Galløe, M. Skytte Christiansen, V. Alstrup, U. Søchting, and S. Svane have contributed with valuable material of Danish lichens. Since 1995, E. S. Hansen assisted by S. N. Christensen and P. Corfixen has edited *Lichenes Danici Exsiccati* consisting of 36 volumes with 845 lichens from most parts of Denmark.

The Greenland lichen herbarium holds the collections of J. Vahl, who visited Greenland around 1830, and T. M. Fries, who some years later collected lichens mainly from West Greenland and N. Hartz from East Greenland. B. Lynge, P. F. Scholander, and E. Dahl are the most important contributors in the first half of the nineteenth century. Since then, K. Hansen, V. Alstrup, F. J. Daniels, S. Svane, P. Gelting, and E.S. Hansen have contributed numerous collections, in particular the last two with around 100,000 specimens. G. Degelius and K. Hansen are important contributors with lichens from the Faroe Islands.

Fungi

The fungarium houses around 300,000 specimens (c. 2,500 types) of all groups of fungi from all over the world. It is especially rich in material from the Nordic countries and from the Arctic. There are c. 11,000 collections of basidiomycetes from the North Atlantic area (Greenland, Iceland, and the Faroe Islands) and c. 11,000 collections from Siberia. It holds the largest collection of Danish fungi including c. 6,000 species. Important collectors include C.F. Schumacher (1757-1830), E. Rostrup (1831-1907), E.C. Hansen (1842-1909), J.E. Lange (1864-1941), F.H. Møller (1887-1962), M.P. Christiansen (1889-1975), K. Hauerslev (1905-2000), and M. Lang (1919-2003).

Recent contributions include 12,000 collections from the *Danmarks Svampeatlas* project (Danish Fungal Survey) and the Plant Pathology Herbarium (CP) of about 25,000 fungi. A further addition to the Fungarium is an extensive collection of entomopathogenic fungi donated by H. Evans (Emeritus Researcher from CABI-UK) comprising collections from the Americas, Africa, Asia, Europe, and Oceania on a variety of arthropods, including important crop pests (Fig. 5).

Plant Pathology Herbarium (CP)

The Plant Pathology Herbarium was founded by E. Rostrup (1831-1907) who was Denmark's first Professor of Plant Pathology. The collection was established in 1883 and now contains c. 30,000 plant specimens showing symptoms of genetic abnormalities and infectious diseases, primarily caused by fungi, bacteria, and viruses.

Herbarium C Staff

The Herbarium staff consists of a team of Curators, Collection Managers, emeriti, and volunteers. Curators are faculty staff within the University, their responsibilities are divided into 50% research, 30% curation, 10% teaching, and 10% administration. Our current curatorial team consists of Natasha de Vere (Professor and Curator of Vascular Plants), Nina Lundholm (Professor and Curator of Algae, Bryophytes, and Lichens), and João Araújo (Assistant Professor and Curator of Fungi). Our Collection Managers work within Herbarium C full-time and oversee its daily operations. Collection Managers for vascular plants are Hannah May Elvery and Jens Soelberg. Christian Lange is collection manager for fungi, lichens, bryophytes, and algae. We have a dedicated team of emeriti and volunteers who provide vital knowledge of the collections. For

vascular plants this includes: Ib Friis (Professor Emeritus), Olof Ryding (Associate Professor Emeritus), and former Curator Henrik Ærenlund Pedersen. Working with the fungal collections are former Curator Henning Knudsen and volunteer Peer Corfixen. For Bryophytes we have collections worker Justin Wynn.



Figure 5A: *Ophiocordyceps philippinensis* on Asilidae fly; Figure 5B: *Entomophaga grylli* on locust; Figure 5C: *Entomophthoroid* on rice leafhopper (Cicadellidae); Figure 5D: *Ophiocordyceps* sp. on beetle.

Digitisation and Data Access

Herbarium C is committed to expanding access to its collections. For vascular plants, digitisation began with the work of Olof Ryding to digitise the vascular plant types, and these specimens are available on JSTOR Global Plants and GBIF (GBIF 2021). Natalie Ahlstrand (Assistant Professor and Curator within the Museum's Science and Society Section) led the project that digitised the Greenland Herbarium which is available on GBIF (Ahlstrand 2023a). In 2021, an ambitious project called DaSSCo began with the aim of building the infrastructure to support mass digitisation at a national scale in Denmark (DaSSCo 2025). One of the first areas of focus was the Danish Herbarium of vascular plants in C and work is currently ongoing to digitise this collection. The Biocultural Collection was digitised in 2019 and is available on GBIF (Bruun-Lund 2019). Additionally, about half of the fungal specimens and all Danish lichens and macroalgae are databased.

Research and Use of the Collections

Herbarium C is actively used by researchers throughout the world, who access the collections either in person, through loans, or by using the digitised material online. The collections continue to grow, through the acquisition of herbaria from private collectors and other institutions, exchange of material with other herbaria, and ongoing collection activities by Herbarium C staff and other researchers.

Research activities encompass multiple disciplines, including:

Systematics and Taxonomy: Ongoing revisions of plants, algae, and fungi, supported by the Herbarium C collections (e.g. Polcarpo Mendes et al. 2024; Pedersen et al. 2024).

Floristics: Comprehensive inventories and descriptions of flora and funga using the collections for reference material. Current examples include the Seidenfaden orchid collection, which is a key source of material for the *Orchidaceae of Thailand*, coordinated by Henrik Ærenlund Pedersen; extensive collections of vascular plants from Ethiopia collected by Ib Friis, used for publications on Ethiopian flora and habitats (e.g. Friis et al. 2022); a huge number of fungi used for a forthcoming funga of arctic and alpine basidiomycetes (Knudsen et al. 2025); and the recent publication *Seaweeds of Denmark* (Nielsen et al. 2022) that relied on the extensive collection of macroalgae in C.

Global Change Research: Analyses of phenological trends and range shifts derived from specimen data (Meineke et al. 2018). The Danish and Greenland Herbaria of vascular plants are a particular focus for research in this area due to their extensive time-series with many specimens available for each species (e.g. Ahlstrand et al., 2023b; 2025a; 2025b).

Museomics: Use of the collections for genomics studies is an emerging area of research (e.g. Theodoridis et al. 2025). The Museum is currently developing a national facility for museomics, which will provide dedicated facilities for extracting and analysing DNA from historical specimens.

Humanities Research: Understanding the cultural and colonial history of the collections is a growing area of research. A recent example led by Associate Professor Martha Flemming called “Field/Work in the Archive: Herbaria as Sites of Cultural Exchange” investigated the global histories and cultural meanings of some of the oldest collections of vascular plants with a focus on plants collected from the Danish West Indies; Danish Guinea; Tranquebar, India; and Greenland.

Herbarium C is also an important resource for public engagement. New permanent exhibition galleries are currently being constructed at the Natural History Museum of Denmark and many of the Curators and Collection Managers are involved with the creation of the new exhibits. Some of the key treasures of Herbarium C will be on permanent exhibition for the first time once the new museum opens to the public.

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Natasha de Vere
 Professor and Curator of Botany
 Herbarium C, Natural History Museum of Denmark,
 University of Copenhagen, Denmark

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Cover Photo: The *Flora Danica* plate of *Carum carvi* L. from the Flora Danica Herbarium (Please refer to the *Featured Herbarium* section for details)



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