

Linnaeus' herbarium cabinet: a piece of furniture and its function

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The Swedish 18th-century naturalist Carolus (Carl) Linnaeus is habitually credited with laying the foundations of modern taxonomy through the invention of binominal nomenclature. However, another innovation of Linnaeus' has largely gone unnoticed. He seems to have been one of the first botanists to leave his herbarium unbound, keeping the sheets of dried plants separate and stacking them in a purpose built-cabinet. Understanding the significance of this seemingly mundane and simple invention opens a window onto the profound changes that natural history underwent in the 18th century.

Introduction

In December 1783, Sara Elisabeth Moræa, widow of the famous Swedish naturalist Carolus (Carl) Linnaeus, wrote to Sir Joseph Banks, then president of the Royal Society, offering to sell him her husband's natural history collection for the price of 1000 guineas. Banks did not buy it himself, but advised James Edward Smith – a member of a well-to-do family of wool merchants from Norwich and amateur botanist – to do so [1].

Linnaeus' collection reached Smith in October 1784. Among manuscripts, letters, index cards, books, minerals, dried fishes and reptiles, and transfixed insects, the collection included three cabinets stacked with sheets of paper (Figure 1). Each sheet displayed a dried plant – this was Linnaeus' herbarium, and it contained a total of about 14 000 specimens. Two of the three cabinets that Smith purchased were returned to Sweden in 1938, although the Linnean Society retained their original contents [2]. Emptied of the herbarium sheets that once occupied their shelves, they are now mere showpieces in a little museum adjacent to the old botanical garden of Uppsala that illustrates the atmosphere in which Linnaeus once lived and worked. Today, the collection of specimens is preserved in a temperature- and humidity-controlled store beneath Burlington house in London – the seat of the Linnean Society founded by Smith in 1788. There they form the material starting point for the work of taxonomists, serving as 'type' specimens for the 5900 plant and 4378 animal species that Linnaeus identified and named in his *Species Plantarum* and *Systema Naturae*, respectively.

The separation of the cabinets from the herbarium sheets they originally contained has destroyed the unity of

what for Linnaeus was a single tool for scrutinizing the 'natural order' of the plant world. Today, plant taxonomists advance their classifications on the basis of the type method. Each species is defined by reference to a single specimen, the so-called 'holotype', which is then preserved in a natural history museum to be accessible for later revisions.

However, historians have established that this was not the method Linnaeus himself employed. The type method was the result of a protracted and often bitter fight over authority in natural history, which took place in the first half of the 19th century and was only resolved by the adoption of international codes of nomenclature in 1842 (for zoology) and 1867 (for botany) [3]. The result of these developments was that authority for the definition of species shifted, in a sense, from people and their ideas about species to specimens and the rules that taxonomists use to handle them – a 'metaphysics in action', as historian of science Lorraine Daston recently put it [4].

But if the type method was not how Linnaeus determined species, how did he do it? This is an interesting question for three reasons. First, modern-day botanists need some understanding of the methods Linnaeus employed when naming and defining species because they are obliged to decide, artificially and in retrospect, which of Linnaeus' many specimens might have been the type specimen described in *Species Plantarum* [5]. Second, Linnaeus played a key role in the history of biological ideas by defining the quest for a 'natural system' as the main task of naturalists [6]. Third, Linnaeus was at the heart of a large-scale social transformation in which the activity of naturalists reached a truly global scale [7]. A look into his herbarium cabinet, restored to life by imagining it at work, can open a window onto the profound changes that natural history underwent in the 18th century.

Making a herbarium

The *Philosophia Botanica*, a botany textbook that Linnaeus based on the lectures he gave at the University of Uppsala, contains careful instructions on how to create a herbarium [8]. Linnaeus described how plants should be collected, dried, pressed and glued onto paper, including such details as what materials and glue to use. These instructions were an attempt to standardize botanical procedures and erase the habits and whims of individual collectors.

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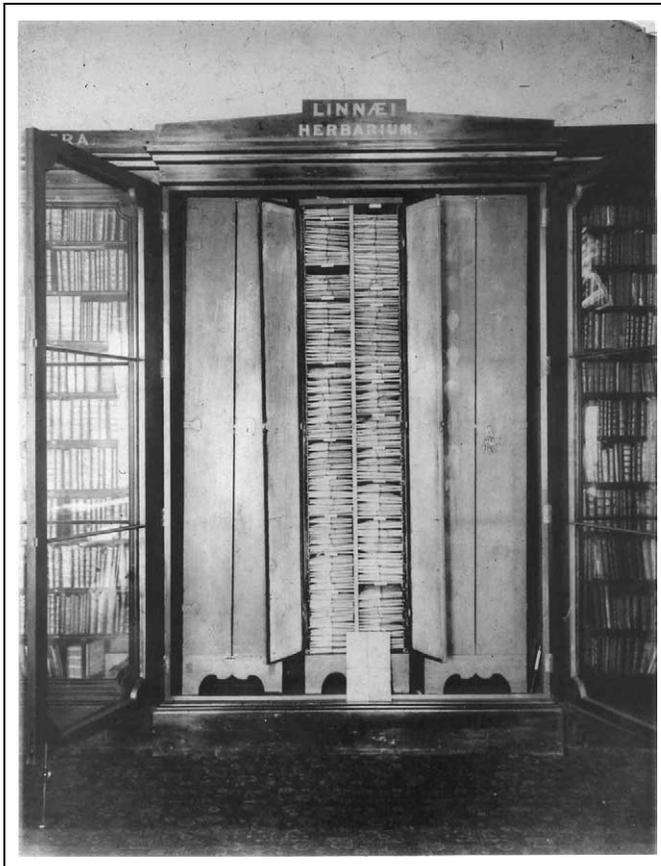


Figure 1. Linnaeus' herbarium cabinets. This image shows the cabinets as they were set up inside a large mahogany unit in the meeting room at the Linnean Society, circa 1907. To the extreme right are the publications of Linnaeus. Image reproduced courtesy of the Linnean Society of London.



Figure 2. A sheet from Paul Hermann's herbarium. © Natural History Museum, London.

In drawing up these instructions, Linnaeus was following a long tradition dating back to the Italian Luca Ghini, who was professor for medicine and botany at the University of Pisa during the 16th century and is usually credited with the invention of the herbarium [9]. Compared to earlier collectors, however, Linnaeus' instructions contained a decisive innovation. Traditionally, several specimens might be glued in a decorative arrangement on a single sheet of paper (Figure 2). These sheets were then bound into volumes, stored in a library and cited like books. Specimens were thus placed into a fixed order from which they could not be removed without destroying the herbarium or even the specimens. Linnaeus, by contrast, advised readers of the *Philosophia Botanica* to mount just one specimen per sheet and refrain from binding them together.

For storage of the mounted specimens, Linnaeus suggested a purpose-built cabinet and gave illustrated guidance on how to construct it (Figure 3). These instructions correspond exactly to the three cabinets that Linnaeus possessed. These are rather plain in design – only one of them was adorned with two rows of leaf impressions on the outside of the doors. The doors open onto two narrow columns of shelves and it appears that at least one of the cabinets that returned to Sweden was also equipped with a dense, parallel series of horizontal slits covering its inner walls, into which the shelves supporting the herbarium sheets could be inserted at variable

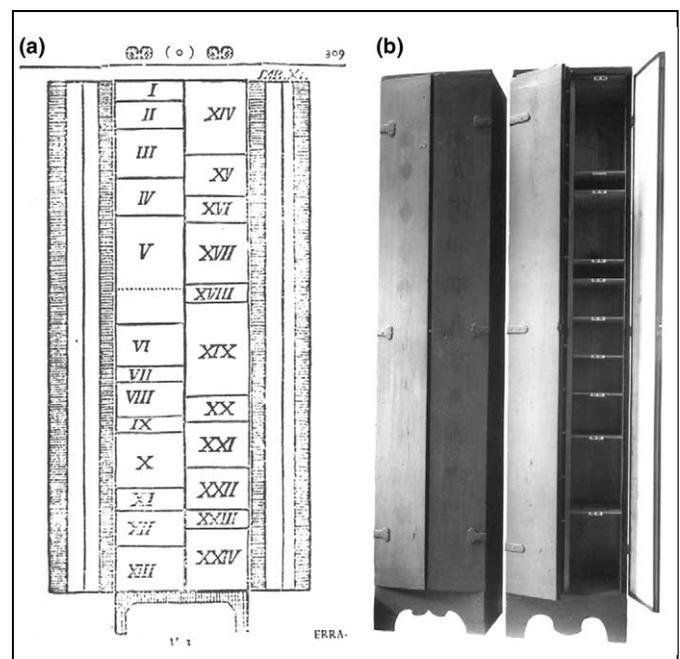


Figure 3. (a) Construction plan by Linnaeus for a herbarium cabinet, reproduced from Linnaeus' *Philosophia Botanica* (1751) (b) Linnaeus' herbarium cabinets circa 1938 – image reproduced courtesy of the Linnean Society of London.

distances [10]. It is impossible to know if these were part of the original design or were added later. However, this detail indicates that the number of shelves and distances between them could be changed easily, either to accommodate new material or to rearrange the collection as a whole. Therefore, although the herbarium of Linnaeus brought his specimens into an order, individual sheets could easily be inserted at any place, removed at any time and reinserted again anywhere in the collection: the herbarium essentially functioned as a filing cabinet.

In contrast to the bound volumes of older herbaria, the order Linnaeus' herbarium cabinet brought to his collection was not fixed and perpetual. It was designed to accommodate the steady arrival of new material and enabled its user, in principle at least, to repeatedly rearrange that material. This was clearly important for Linnaeus. While staying in the Netherlands from 1735–1738 he received several herbarium sheets from George Clifford, a former director of the Dutch East India Company whose vast plant collection Linnaeus was curator of in 1737. These sheets had small prints mounted

onto them, creating the impression that the plant specimens they carried grew from a vase. Linnaeus cut these sheets down to a size that would fit into his cabinet, in some instances cutting right through the 'vase' (Figure 4). The internal mobility of his herbarium was apparently of greater importance to Linnaeus than any aesthetic value that the individual sheets or the collection as a whole might possess.

The natural order of plants

How did Linnaeus use his herbarium? Some clues lie in the *Philosophia Botanica*, where he described how to set up what he called 'natural' definitions of plant species and genera. Traditionally, plant species and genera had been defined by the method of logical division: this method consisted in assigning a species to its genus (or a genus to its 'order') and establishing a single character by which it could be distinguished from its congeners [11]. Linnaeus believed that this method was insufficient and called the definitions and taxonomic systems that resulted from it 'artificial'. Such definitions, he reasoned, needed revision whenever a new species was discovered; there was no guarantee that characters used to distinguish congeners would work for newly discovered species.

By contrast, natural definitions, or 'natural characters' as Linnaeus also called them, were more descriptive. They assembled all possible traits of a species or genus, not just a few selected for their diagnostic value. The method that Linnaeus proposed for establishing natural characters was simple and straightforward. The botanist started with a 'first species' (*prima species*) represented by a garden exemplar, a herbarium specimen or a drawing, and drew up a full description of its morphology. In a series of further steps, additional representative specimens were gathered one by one. Characters that deviated from the original were then cancelled from the description. What was left was the set of characters that had proved to be 'constant'.

In some instances Linnaeus referred to this comparative method as 'collation', a legal term for the word-by-word comparison of an original document with its copy. This metaphor can be taken literally. Garden exemplars were seasonal, and plant drawings often unreliable. The herbarium, on the other hand, provided a reliable source of concrete evidence: stable and ready at hand throughout the year. Linnaeus' description of collation enables us to imagine how he actually used his herbarium. In setting up natural characters, he would first take out one herbarium sheet, and then adduce others to compare the mounted specimens systematically, point-by-point, as if comparing two texts.

The design of the herbarium cabinet thus enabled Linnaeus to put together any set of specimens at a time for the purpose of collation. As a result, the relations among plant forms represented by natural characters transcended the local differences exhibited, say, by two specimens permanently fixed on one and the same herbarium sheet. The 'natural system' of plants, as Linnaeus saw it, consisted of a two-dimensional web of relations in which 'all plants exhibit their contiguities on either side, like territories on a geographical map.' Each species



Figure 4. The type specimen of *Helianthus strumosus* L. This is one of the specimens that reached Linnaeus' herbarium from George Clifford. These were ornately decorated with the print of a vase (visible at the bottom of the image) that Linnaeus cut through when adapting the size of the sheets to his herbarium cabinet. Image (sheet no. 1024.7 of the Linnaean herbarium) reproduced courtesy of the Linnaean Society of London.

represented by a specimen in Linnaeus' herbarium was defined by the affinities it exhibited with respect to all the other specimens in the collection. The potential for a complete permutation of specimens, which the herbarium cabinet offered in principle, enabled a global representation of taxonomic affinities [12]. Accordingly, it was the herbarium in its totality, rather than arbitrary type specimens, which served as a tool in the determination of plant species and genera.

The social order of botany

The enormous numbers of plant specimens that Linnaeus' three cabinets accommodated were accrued from a worldwide network of botanists, professionals as well as amateurs, with whom Linnaeus exchanged seeds and specimens [13]. Two parties played a crucial role in this network. First were the botanists presiding over major European botanical gardens – contacts Linnaeus had primarily established during the time he spent in The Netherlands. They included Johann Jacob Dillen in Oxford, Antoine and Bernard Jussieu in Paris, Adriaan van Royen in Leyden, Albrecht von Haller in Göttingen and Johann Georg Gmelin in St Petersburg [14]. It seems likely that it was as curator of Clifford's botanical garden that Linnaeus found the inspiration for the peculiar construction of his herbarium. None of the surviving specimens from Clifford's collection seems to have been bound and there were a few other botanists in the Netherlands that kept their specimens on loose sheets, although this might already have been due to Linnaeus' influence [15].

Second were collectors at the periphery of the known botanical world that Linnaeus engaged for his purposes. His students, in particular, were a major source for seeds and specimens as they travelled the world with support from the Royal Academy of Sciences in Stockholm or the Swedish East India Company: Per Kalm travelled North America from 1749–1751, Daniel Solander accompanied the first circumnavigation of the globe with James Cook and Carl Peter Thunberg's voyage from 1770–1779 took him as far as Sri Lanka and Japan [16]. Linnaeus' own garden at Uppsala functioned as a hub in this two-tiered system of exchange. The acquisition of 'new species' from peripheral collectors strengthened his position as an exchange partner in the European system of large botanical gardens, whereas the material he exchanged with these centres enabled him to compensate his exchange partners at the periphery through the provision of seeds and specimens of species they lacked in their own collections [17].

The botanical garden in Uppsala thus became a place not only dedicated to the local production of specimens, but also to their reproduction for purposes of exchange. Its wealth was not determined by the splendour of the individual plants inhabiting it, but rather through the number of identically reproducing species that could be harvested for seeds and specimens and then offered in exchanges with other botanists. This is reflected in the characterization of two kinds of botanist Linnaeus distinguished in the *Philosophia Botanica* – the collectors who were 'primarily concerned with the number of species

of vegetables' and the systematists who 'arranged the plants in particular ranks'. The role of collectors was not merely to accumulate, however, and nor were the systematists just passively ordering material. When Linnaeus discussed the way in which natural characters of plant genera should best be set up, he curiously conflated both the role of collector and systematist: it is only 'the most accomplished botanist, and he alone [who] achieves the best natural character; for it will be made by the agreement of the greatest number of species; for every species excludes some superfluous feature' [18].

This enigmatic statement, typical of Linnaeus' condensed style of writing, begins to make sense when we recall his method of collation. This consisted of the comparison of two or more specimens and the removal of all varying characters from a description produced from some 'first species'. Each 'new' species entering collation would thus indeed 'exclude superfluous features' from the natural character, and the latter would only collect those traits that enable diverse specimens to stand in for each other, or by which they could be judged to be copies or duplicates. The 'most accomplished botanist' – in his usual self-confident way, Linnaeus was clearly thinking of himself – was thus not simply the botanist with the largest collection but also the one who, by collation, could determine the specimens that were 'duplicates' and therefore free to be exchanged [19]. Managing a large collection for the purposes of comparison and exchange was a complex task. Linnaeus' herbarium cabinet, designed for the flexible realization of any set of exemplars, was clearly an effective tool for quickly checking which species were already represented in his collection, and which were not and thus (to him at least) new.

Another feature of the herbarium cabinets emphasizes their function. The shelves were arranged according to Linnaeus' famous sexual system, which divided the plant realm into 24 classes according to the number and position of stamens and pistils. Although this might appear to embrace a relatively fixed arrangement of the collection, Linnaeus made it clear that this enabled him to 'pull out and produce [any plant] without delay'. The methodical arrangement of specimens according to the sexual system served as a retrieval system for previously gathered information, and was therefore an arbitrary device that did not represent any natural order. 'Others', as Linnaeus therefore emphasized in the *Philosophia Botanica*, 'may arrange [their herbarium] according to any other system, observing what should be observed'.

The agitated background of 18th century taxonomy

According to some famous remarks that Michel Foucault made in his *Order of Things*, 18th-century natural history was profoundly shaped by 'herbaria, natural history cabinets, and botanical gardens.' These institutions formed the 'timeless rectangle' of 18th century taxonomies, in which 'beings presented themselves side by side with their visible surfaces, without any commentary and surrounding language, approaching each other by their common traits, and thus virtually analyzed, bearers of their sole names' [20]. To some, this might suggest an

18th-century mentality that preferred order and stability above diversity and variation, measurement above experiment: a static and tendentially conservative outlook. Indeed, Carl Linnaeus has often enough been portrayed as the prototypical protagonist of this mind-set [21].

However, Linnaeus' preoccupation with a taxonomy of 'constant' characters resulted from his engagement in a dynamic practice of transplantation and exchange, which had deep roots in the rapid and ongoing globalization of European economies [22]. Furthermore, it should not be ignored that his taxonomic works were published in several editions: Linnaeus authorized two editions of the *Species Plantarum* during his lifetime; the *Genera Plantarum* went into six; and the *Systema Naturae* into 12, growing from a 12-paged folio volume into three octavo volumes of approximately 1500 pages. Taxonomy had become the art of revising prior classifications in the light of 'new' species, and Linnaeus' herbarium cabinet was perfectly designed to accommodate this progressive movement.

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