

## **Carl Linnaeus's botanical paper slips (1767–1773)**

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The development of paper-based information technologies in the early modern period is a field of enquiry that has lately benefited from extensive studies by intellectual historians and historians of science.<sup>1</sup> How scholars coped with ever-increasing amounts of empirical knowledge presented in print and manuscript – leading to the so-called early modern “information overload” – is now being increasingly analysed and understood.<sup>2</sup> In this paper we will turn to an example at the close of the early modern period. Towards the very end of his academic career, the Swedish naturalist Carl Linnaeus (1707–1778) – best known today for his “sexual” system of plant classification and his binomial nomenclature – used little paper slips of a standard size to process information on plants and animals that reached him on a daily basis. From today’s perspective, these paper slips look surprisingly like modern index cards.

This is surprising, because throughout the early modern period, the medium of choice to cope with information overload was a different one: the commonplace book, promoted by humanists and philosophers such as Erasmus of Rotterdam (1466–1536), Francis Bacon (1561–1626), and John Locke (1632–1704). Commonplace books usually took the form of bound manuscripts that were subdivided by headings indicating the particular topics under which information was to be subsumed. The collected information was thus brought into a fixed and permanent order, and an index was usually added at the end of the volume to provide access to this information.<sup>3</sup> One of the areas where information overload made itself felt in particular, and for which the commonplace book was adopted quickly, was natural history. As new worlds were discovered, and more species described, the circulation of information grew rapidly, in print and manuscript. Naturalists like Conrad Gessner (1516–1565) and Ulisse Aldrovandi (1522–1605) collected observations from specimens, annotated and excerpted new publications, and engaged in far-flung correspondence networks, all along developing their own common-placing techniques to process the information thus gained.<sup>4</sup>

In the process, some scholars and naturalists occasionally strove to find more flexible ways of accessing, storing, and retrieving information than the bound and structured commonplace book. One such way was processing and communicating information in the form of simple, open-ended lists of key words or short factual statements.<sup>5</sup> Another, even more flexible way was to keep notes on loose pieces of papers, which enabled information to be shuffled around, collated, and rearranged readily. Thus Robert Boyle (1627–1691) kept his notes in a haphazard way on loose sheets and paper slips, apparently to prevent others from making sense of them, while Gottfried Wilhelm Leibniz (1646–1716) preferred to order his loose notes according to a contraption

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invented by Thomas Harrison: an “ark of studies” where pieces of paper were attached onto hooks arranged according to a pre-established system of heads, or commonplaces.<sup>6</sup>

As the example of Harrison’s “ark of studies” shows, there remained a distinct tendency to literally “file” – the term derives from the practice to use a string (Latin *filum*) to bundle loose papers – notes in the early modern period, and thus to retain a fixed, topical order in their material arrangement. This is what distinguishes Linnaeus’s paper slips from earlier instances, and also from the range of filing systems that he himself had been experimenting with in earlier stages of his career.<sup>7</sup> The paper slips which Linnaeus produced in the last years of his working life, from 1767 to 1773, were strictly of a standard size, used a uniform format for the information contained, and show no sign of ever having been fixed or “filed” in a particular order. It is these features that make them strikingly similar to modern index cards.

In this article, however, we do not want to establish whether “Linnaeus invented the index card.”<sup>8</sup> As our analysis will show, there is much that speaks for this claim, but there are equally arguments against it. First of all, Linnaeus seems to have turned to the use of loose paper slips for purely idiosyncratic reasons, and there is no sign that he ever tried to rationalise or advertise the new practice. Moreover, it was only towards the very end of his working life that he began to use the new technology to note the names, geographical origin, and morphological features of newly discovered plant genera and species. And finally, there are many indications that he himself never envisioned his stack of paper slips as a system that would permanently store information for collective use, which is perhaps the feature that is most characteristic of the modern index card. Ironically, as we will show, it was only shortly before and after Linnaeus’s death in 1778 that his slips were used in this way.

Rather than documenting the history of a momentous invention, our case study will throw light on the eighteenth century as a period of transition – be it in scholarly, literary, medical, administrative, or commercial contexts – towards increasingly flexible media of information processing, such as tables, files, and card catalogues.<sup>9</sup> Studying Linnaeus’s paper slips will not only provide insight into the use eighteenth-century naturalists made of such media, but also reveal something about the dynamics of paper tools as research technologies in general.<sup>10</sup> We propose that it was the sheer amount of new information that fed back to Linnaeus as a result of the success of tried and tested information processing technologies which led to their eventual breakdown and adoption of a new working method. Linnaeus’s “invention,” that is, was entirely inadvertent, and it is therefore hardly surprising that he himself did not realize its full potential. We will make this point in three steps. In the first two sections of our paper, we will look at the contexts in which loose paper slips and cards were used for information processing during Linnaeus’s time, explore the reasons why contemporaries – and in all likelihood Linnaeus himself – hesitated to use them for storing knowledge, and finally discuss what motivated Linnaeus to adopt this paper technology late in his career. In the third and fourth section, we will describe Linnaeus’s paper slips in detail, and reconstruct the way in which he used them. The two final sections will focus on their legacy, partly in the hands of Linnaeus’s son and successor Carl Linnaeus the Younger (1741–1783), but mainly through the successful and independent use that his student Daniel Solander (1733–1782) made of a similar paper technology in the early years of the British Museum.

### “Hanging by a thin thread”: Paper slips before Linnaeus

The great advantage of the modern index card as an information management technology is its flexibility: the individual card is small, and takes less space than a notebook or loose sheets of standard-sized paper. Yet, collectively, these cards form a system that can easily be expanded *ad libitum*. Moreover, they enable easy insertion of new information at any place within the

system, reshuffling of the individual bits of information for purposes of collation and comparison, as well as rearrangements to accommodate new classifications. The main disadvantage of index cards, on the other hand, is the precarious stability of the system they form: because index cards are not bound, but kept loose in stacks, their order can easily be disturbed or destroyed. To misplace a card among thousands of its like, for example, amounts to a more or less permanent loss. Because of this instability, the value of index cards as a device for storing and ordering knowledge is far from obvious, and its development had to prevail against longstanding intuitions about how to organise knowledge in a stable way.

Attempts to organise notes through more flexible systems making use of loose paper slips or cards can be found throughout Europe in the eighteenth century: Ann Blair mentions the philosopher Montesquieu (1689–1755) and the botanist Abbé Rozier (1734–1793) in France, as well as the German Jurist Johann Jacob Moser (1701–1785) and the Swiss physiognomist Johann Kaspar Lavater (1741–1801), all of whom are known to have kept notes on cards, sometimes stored in boxes.<sup>11</sup> In Sweden, Laurentius Normannus (1651–1703), professor of logic and rhetoric at Uppsala and later university librarian, used an information storage system akin to a pigeon-hole filing system.<sup>12</sup> In Sweden, as in the rest of Europe, there remained a vibrant manuscript culture, parallel to that of print, in all intellectual domains, and in the eighteenth century this was increasingly used as a playing ground for experimentation with new paper technologies.<sup>13</sup>

The index card as we know it, however, did not become a prominent tool for information processing until the very end of the eighteenth century when libraries such as the court library in Vienna adopted card catalogues to record their holdings.<sup>14</sup> Blair has pointed out that “the use of manufactured cards for note-taking began with the backs of playing cards.”<sup>15</sup> Judith Hopkins indicates that playing cards were commonly used throughout eighteenth-century France as temporary supports for library catalogues, and that the post-revolutionary French cataloguing code of 1791 instructed that playing cards should be used for that purpose.<sup>16</sup> But most libraries worldwide took a surprisingly long time to move to card catalogues. In American university libraries, for example, the first card catalogues did not appear until the 1850s.<sup>17</sup> The index card really only came into its own in the late nineteenth century, with the increased bureaucracy that was associated with the second industrial revolution.<sup>18</sup>

That library card catalogues were known in Sweden is clear from Georg Wallin's (1686–1760) account of his travels to the continent. Wallin was trained by the renowned philologist and librarian Erik Berzelius (1675–1743), who in turn had been a student of Normannus. Wallin served as university librarian at Uppsala from 1726 to 1732, corresponding to Linnaeus's own student years at the university.<sup>19</sup> He then moved to Gotland before becoming bishop of Gothenburg in 1744, from where he corresponded with Linnaeus.<sup>20</sup> In 1721 and 1722 Wallin had been in Paris where he visited numerous libraries, and surveyed their collections as well as their catalogues.<sup>21</sup> Wallin notably visited the library of the *Pères de l'Oratoire* (Fathers of the Oratory), a congregation founded in 1611 and dedicated to teaching and reforming the secular clergy. Their library on rue Saint Honoré was the most prestigious of the order, and Wallin described their cataloguing system in the following words:

In the Library of the Fathers of the Oratory, there are no catalogues, but only *bundles of paper slips* kept apart from each other in alphabetical order (*fasciculi schedularum*, ordine alphabetico a se invicem distincti). At all events, I could not make out another [method], since whenever I asked some books from the librarian, I always saw him resorting to these bundles. The size of the slips scarcely exceeds that of the cards that are usual in games, and each contained fifteen and more book titles. 50 to 60 of these slips formed a bundle, tied up to separate it from the neighbouring bundles. It is a type of catalogue that seems not very practical and exposed to various dangers; a light draught, when the string is broken, might easily scramble the neat order, so that one could say with some reason that this beautiful library *hangs by a thin thread* [*tenui pendere filo*].<sup>22</sup>

Wallin here expressed beautifully the intrinsic distrust in loose pieces of paper as a means to hold information for later retrieval. The fear that a gust of air might upset a carefully ordered set of papers was indeed a *topos* in learned literature of the early modern period.<sup>23</sup> Even the Fathers of the Oratory were not willing to go all the way to the modern card catalogue. The cards they used contained information on more than one item, and they were tied together in bundles for storage, each bundle, as Wallin's report suggests, representing one letter of the alphabet.

Beyond the world of academia and libraries, loose sheets of a standard format were familiar enough to eighteenth-century European men and women in a variety of contexts. Looking at German-speaking regions, Claudia Vismann has traced how a set of subtle administrative changes (such as keeping drafts of writs without cancelling them) resulted in a dramatic increase in legal and administrative files in the sixteenth century, which were then stored in repositories to form archives. From the mid-seventeenth century, these collections of loose manuscripts started to become organised by file and shelf marks.<sup>24</sup> By the eighteenth century, the jurist Moser was using octavo sheets stored in slip boxes of his own design, one example out of many pointing to the familiarity of dealing with loose files in legal and administrative contexts.<sup>25</sup> Recording case histories in hospitals also became increasingly standardized in the eighteenth century through the use of single-sheet forms.<sup>26</sup> From his return from Holland in 1738 to his taking up of the professorship in Uppsala in October 1741, Linnaeus practiced as a physician in Stockholm, and his close friend Abraham Bäck was engaged in the administration and reform of the Swedish medical system at the time.<sup>27</sup> As a medical practitioner, Linnaeus used to keep track of patients' histories via case records, a few of which have survived and are kept on loose sheets – but not of a standard format.<sup>28</sup>

To accumulate and exchange information on slips, cards, or sheets of a standard size was thus clearly not alien to the culture of the time.<sup>29</sup> It seems quite likely that Linnaeus, through his contacts with people such as Wallin and Bäck, was quite familiar with the concept of storing information in this way. Certainly, Linnaeus's wife Sara Lisa enjoyed card games, and playing cards, based on word games, have been found under the floorboards of their home.<sup>30</sup> Linnaeus must thus have had strong reasons that kept him from readily adopting this paper tool, probably the very same reasons that Wallin expressed so well in his description of the library of the Fathers of the Oratory. Using paper slips to command a more flexible and yet stable hold over complex and large amounts of information seems to have been far from obvious to Linnaeus and his contemporaries.

### **“Packing my luggage in the evening of my life”**

Just as many of his contemporaries, Linnaeus himself experimented with different paper-based information technologies throughout his life. Starting with his early student manuscripts, one can see a heavy reliance on displaying and ordering information synoptically on a page of paper, through tables, maps, lists, and diagrams.<sup>31</sup> In the early 1730s, he embarked on the project which would take up most of his career, namely that of cataloguing plant species on a global scale. For this purpose he noted down bibliographical references to species descriptions in notebooks that were divided into spaces of uneven size, each dedicated to a particular genus.<sup>32</sup> By the late 1740s, some years before the publication of *Species plantarum* (1753), Linnaeus seems to have realised that bound volumes seriously constrained his ability to collect and integrate new information, and moved to a file system constructed from bifolia.<sup>33</sup> He was probably inspired to do this by the way he kept his own herbarium, with the specimens on loose sheets, rather than in bound volumes, and arranged in bundles representing the species of a particular genus. These bundles were then stacked in a purpose-built cabinet that was divided into compartments by movable shelves.<sup>34</sup>

Despite these indications of moving towards more flexible information processing systems, it is quite clear that Linnaeus followed a “centralizing impetus” for most of his career, sticking to methods by which “as much information as possible [was kept] in one tightly and expediently organized place.”<sup>35</sup> From the early 1750s onwards, his preferred method became the annotation of interleaved copies of his own publications, a method that had been endorsed by some Renaissance scholars, and was used by jurists and historians in the early eighteenth century to produce revised editions of their works.<sup>36</sup> It was also a relatively common practice in Sweden, and was particularly used on printed academic dissertations.<sup>37</sup> Linnaeus perfected this method for natural history, designing his taxonomic publications accordingly. Other naturalists soon followed him in this practice.<sup>38</sup>

With the exception of a slim supplement volume to the first edition of *Genera plantarum*, entitled *Corollarium generum plantarum* (1737), Linnaeus always published full, amended editions of his major taxonomic works (*Systema naturae*, 12 editions; *Genera plantarum*, 6 editions; *Species plantarum*, 2 editions). Each of these editions provided him, and other naturalists, with a new platform and working tool for further annotation. In many ways, this publication strategy was the key to Linnaeus’s success as an author. Yet from 1767, Linnaeus resorted to publishing supplements again: *Mantissa plantarum* (1767) and its successor *Mantissa plantarum altera*, published in October 1771.<sup>39</sup> A third *Mantissa* was in preparation at the time of Linnaeus’s death: the preparatory manuscript was copied out by two amanuenses and contains corrections from both Linnaeus and his son Carl.<sup>40</sup> It was eventually published by Linnaeus the Younger, not as a further *Mantissa*, but as *Supplementum plantarum* (1781).<sup>41</sup>

*Mantissa* (or *mantisa*) means a small or worthless addition or gain in economic transactions, and the full title explains that the volumes were meant to supplement the latest editions of *Species plantarum* and *Genera plantarum*. The modesty expressed by the title does not seem fitting, though. Both volumes had nearly 600 pages; the first *Mantissa* alone contained 25 new genera and – as Linnaeus explained himself – “more than 400 of the rarest species, which partly have never been referred to a particular genus, and partly are completely new.”<sup>42</sup> It is likely, then, that the title rather expressed the fact that Linnaeus had failed to integrate new information into further complete and updated editions of his taxonomic works, thus reducing the value of the book.

The reason why Linnaeus switched to a new publication strategy late in life simply seems to have been that he saw himself overwhelmed by the sheer amount of material that was returned to him due to the success of his prior publications. Most botanists of his time had teams of students, secretaries, or volunteers to help them deal with their correspondence, their collection of specimens, and their classification.<sup>43</sup> Not so Linnaeus, who preferred to work alone at the centre of a network of correspondents. With the exception of two manuscripts – the *Museum Ludovicae Ulricaе* from 1753 which we will discuss in the third part of our paper, and a late annotated copy of the 12th edition of *Systema naturae* (1766–1768), which also contains annotations made by Linnaeus the Younger – we have never come across handwritings other than Linnaeus’s own during our extensive study of his manuscripts. Apparently, Linnaeus did not need – or want – a whole team of helpers, but the downside of this independence was the high volume of work required on a daily basis. It is only after his first stroke in 1774 that the handwritings of others appear in Linnaeus’s working papers, in the manuscript for the third *Mantissa* mentioned above.

Since the early 1750s, Linnaeus had routinely complained about feeling overworked in letters to his good friend Abraham Bäck, and to numerous other correspondents.<sup>44</sup> But now, between the first and second editions of *Mantissa*, several important publications on new plants saw the light, which Linnaeus had to read and collate with his own findings, most notably Peter Bergius’s *Descriptiones plantarum* (1767), and Nicolaas Burman’s *Flora Indica* (1768).<sup>45</sup> In addition, Linnaeus continued to receive specimens from all over the world in ever-increasing quantity, largely due to his success in attracting correspondents overseas and recruiting research students that went

on global plant-hunting trips (Linnaeus's so-called "apostles"). At the same time, he was growing old and feeling it. He had turned 60 in 1767. References to illness and death start to pepper his letters.<sup>46</sup>

The feeling of having very little time left was acutely expressed in the preface to *Mantissa plantarum altera*: "There have come to notice here and there while packing my luggage, as it were, in the evening of my life, scattered *memoranda* with observations not known to all; I have raked these together, to add to the first *Mantissa*."<sup>47</sup> The word which William Stearn here translated as *memoranda*, is actually *adversaria*, which referred to a miscellaneous collection of excerpts from literature, "generally presented in the order of the text from which they were produced."<sup>48</sup> As we will see in the next part of our paper, it was *Mantissa plantarum altera* for which Linnaeus first used his paper slips, and the quoted passage from the preface to this book is the only instance, as far as we can see, where Linnaeus makes explicit reference to this new working method. He clearly associated the new tool with the feeling of having reached the limit of his working capacity, and there is no sign that he wanted to recommend or advertise it.

It thus seems that Linnaeus developed the new method of keeping annotations on loose paper slips in connection with a change in publication strategy, creating an expedient in order to keep up with the influx of new material while preparing supplements to, rather than full re-editions of, his taxonomic works. In order to see whether this is the case, we will describe the paper slips in detail in the next section, reconstruct their chronology, and establish how exactly Linnaeus used them to extract botanical information from the many letters and botanical specimens he received.

### Format and content of Linnaeus's paper slips

Linnaeus's paper slips are today kept at the Linnean Society in London, along with other manuscripts of Linnaeus, his personal library, and his specimen collections.<sup>49</sup> The slips are of uniform dimensions – 13×7.5 cm – and approach the size of future custom-made index cards. They were used horizontally, and are made of the same paper that Linnaeus used for correspondence and notes. As such they are not especially sturdy in the way we might think of twentieth-century index cards. The edges of the cards are slightly uneven, indicating that they were cut by hand, and not with the help of some mechanical device.

In total, there are 1,030 cards. The majority of the cards (901) are botanical in content; a smaller proportion records information on mammals and the remainder contain mineralogical notes. The cards are now kept in three stacks wrapped in paper and are arranged in alphabetical order by genus name, but it is possible that they were originally kept according to the systems developed by Linnaeus in his major classificatory publication *Systema naturae* (1735). The botanical cards would thus originally have followed each other according to Linnaeus's sexual system. Indeed, on many slips containing genus descriptions the sexual system's classes and orders are indicated. For example the slip for the genus *Sparmannia* indicates "VI:3," signalling that this genus belongs to the class Hexandria (six "men" or stamens) and the order Trigynia (three "women" or pistils).<sup>50</sup>

In order to describe and reconstruct the use of Linnaeus's paper slips, we will concentrate on the 901 botanical slips. All in all, they relate to 449 different plant genera. With a few exceptions of slips bearing miscellaneous notes of unclear significance, such as a list of plants "put together by the gardener [*Hortulano commisit*]," the slips can be divided into two kinds. Sixty-four cards consist of morphological descriptions of individual genera that describe the main features of the flower and the fruit, in a layout similar to that in *Genera plantarum* (1737). Thus, under a heading citing the genus name in capital letters, we find detailed morphological descriptions of the seven main parts of flower and fruit, always in the same order and prefixed with an abbreviation indicating each part: calyx ("CAL."), corolla ("COR."), stamen ("STAM."), pistil ("PIST."), perianth

(“PER.”), seed (“SEM”). Occasionally, Linnaeus adds observations (“OBS.”) highlighting peculiarities or discussing the taxonomic status of the genus in question (see Figure 1).

The remaining slips consist of species descriptions, either based on specimens of new species sent to Linnaeus by his correspondents or travelling students, or based on information gleaned from new publications. Most of the slips concern exotic species – only 10% of them relate to European species. Each slip is headed by the name of the genus in capital letters at the top, followed by a diagnostic phrase describing the chief differences characteristic of the species, and with the “trivial” name, or specific epithet on the left hand side (Figure 2). The number of species per genus varies between a single one and up to 19 species in the case of the genus *Erica*. There are eight slips with descriptions of genera and species that carry no name, indicating that Linnaeus tended to describe unknown genera or species first, before he settled upon a name. In one case, Linnaeus added a note after the description saying “the same genus as 148 [*ejusdem generis cum 148*].” A paper slip with that number exists which shows that Linnaeus became clear about taxonomic affinities only after he had gone through a detailed description.<sup>51</sup>

Linnaeus sometimes struck one or two vertical lines through the slip, in the manner he used elsewhere in his manuscripts to indicate that a passage of text had been copied out or published (see Figure 1). Some slips which were thus discarded were later recycled using the verso side for the description of another unrelated species or genus. These recycled slips provide a clue as to how Linnaeus considered his new technology. Out of the 49 slips that are crossed out and reused on the back, 27 can be traced to *Mantissa plantarum altera* (1771).<sup>52</sup> Linnaeus was thus happy to discard slips once he had published the information they contained. Initially, at least, they were not meant to form a permanent system.

But it seems that Linnaeus realised the usefulness of the new technology at some point, and instead of discarding the slips, kept them and added to them periodically, as variations in ink colours and handwriting indicate. Hence the slip for *Hedysarum argenteum* contains at least two sets of additions, one of which is a reference to Peter Simon Pallas’s account of his travels around Russia and Siberia from 1771 to 1773, written in a very shaky hand. The volume Linnaeus cites appeared in 1773, and he reports having received this volume in a letter to his friend

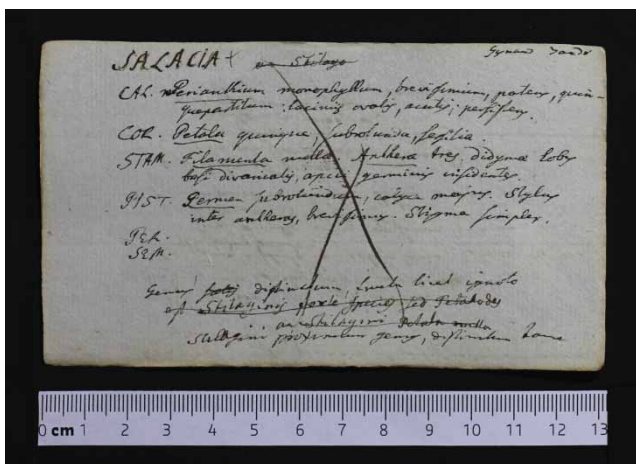


Figure 1. Slip describing the genus *Salacia*, according to the genus description layout found in *Genera Plantarum* (1737). The information on this card was published in *Mantissa* 1771, p. 159, struck through to indicate that it had been used, and reused on the back for the genus *Psoralea*. Carl Linnaeus, “Botanical Paper slips,” Library of the Linnean Society. By permission of the Linnean Society of London.

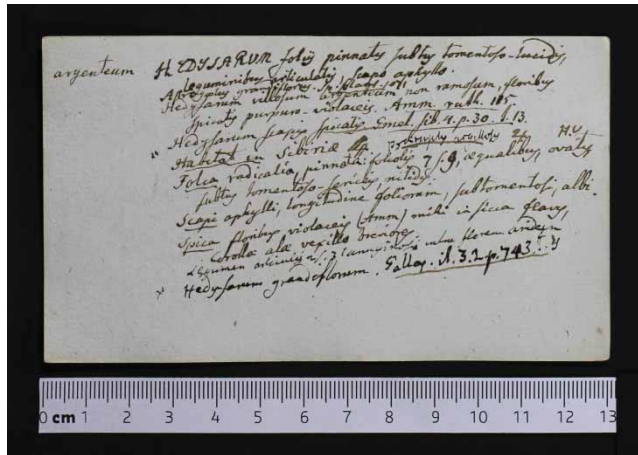


Figure 2. Slip for *Hedysarum argenteum*, with entries penned at different points of time. The reference to volume 2 of Pallas's *Reise durch verschiedene Provinzen des Russischen Reichs* (1771–1776) at the bottom (“Pallas it. 3.2 p. 743”) is probably one of the last entries on a paper slip in Linnaeus’s hand. The reference is confusing, since it seems to indicate book 2 of volume 3, whereas Pallas does in fact describe *Hedysarum grandiflorum* on p. 743 in book 2 of volume 2. Other references include J.G. Gmelin’s *Reise durch Sibirien, von dem Jahr 1733 bis 1743* (1752) and J. Amman’s *Stirpium rariorum in Imperio rutheno icones et descriptiones* (1739). The slip also indicates that the plant was grown in the Uppsala Botanic Garden (“H.U.”), that its geographical origin was Siberia, and that it is a perennial (the symbol looking like the numbers 2 and 4 interlocked). Carl Linnaeus, “Botanical Paper Slips,” Library of the Linnean Society. By permission of the Linnean Society of London.

Abraham Bäck dated 18 November 1774 – so this is possibly one of the last entries Linnaeus ever wrote on his paper slips (see Figure 2).<sup>53</sup> Linnaeus initially seems to have used the paper slips much like he had used loose sheets for his *Species plantarum* in the late 1740s, that is, as a preparatory manuscript. Later on, however, the slips seem to have become an integral part of his working method that functioned independently of particular publication projects and that he would use for the rest of his working life. The next section will clarify the chronology.

### Chronology and use of Linnaeus’s paper slips

None of the cards bear a date, but two sets of annotations help to date individual paper slips more precisely. Firstly, Linnaeus often provided abbreviated references, complete with page numbers, to the literature he was excerpting. Some 96 different works are referred to – the earliest being Bauhin’s *Pinax* (1596), and the latest work, as seen in the previous section, dating to 1773 (Figure 2).<sup>54</sup> However, it is rarely possible to establish with certitude when exactly Linnaeus read a particular book, and the bibliographic references can only provide a *terminus a quo* date.

Secondly, where species descriptions were based on specimens that Linnaeus had received from correspondents, Linnaeus also specified its geographical origin and the name of the collector (see Figures 2 and 4c). In total, 342 species are attributed to a specific correspondent and collector, and the paper slips bear a total of 30 names of collectors, all of whom sent parcels of specimens, drawings, or plates of plants to Linnaeus along with their letters. Amongst the most cited are José Celestino Mutis (South America, 105 species), Johan Gerhard König (Cape of Good Hope and India, 50 species), as well as two of Linnaeus’s travelling students, Carl Peter Thunberg and Anders Sparrman (Cape of Good Hope, 70 and 50 species respectively).



In the case of specimens sent by collectors, it is often possible to relate the respective slip to the letter sent by the correspondent and to a specimen that is still preserved in Linnaeus's herbarium.<sup>55</sup> On the likely assumption that Linnaeus processed information contained in letters shortly after their receipt, it is possible to conclude that Linnaeus started the process of collecting information on paper slips just after the publication of the first *Mantissa* in 1767, and that he did not stop using paper slips after *Mantissa plantarum altera* was published in 1771. Indeed, the paper slips were used for other publications well after 1771: for at least one dissertation, *Hypericum* (1776);<sup>56</sup> for an article on the palmfern *Cycas* in the *Mémoires de l'Académie des Sciences* (1778);<sup>57</sup> and most importantly, as already mentioned, for the planned third *Mantissa*.

Three examples will demonstrate more precisely how and when Linnaeus used his collection of paper slips. One of the earliest paper slips refers to “Baro [sic] Capucinus” which stands for Friar Gabriel, a Capucin brother who collected in Provence and who sent 11 extant letters to Linnaeus (1757–1768).<sup>58</sup> Only one paper slip linked to his name survives. Originally, it was headed by the genus name *Adiantum*, with the specific epithet *pusillum*. Both designations were later crossed out, and replaced by the trivial name *Polypodium fragrans* – *Polypodium* being a genus of ferns. The paper slip refers to a specimen that Friar Gabriel sent to Linnaeus with a letter dated 25 August 1767, in which he referred to the specimen as *Adiantum pusillum*.<sup>59</sup> The specimen survives in Linnaeus's herbarium with “Baron [sic]” written on the sheet.<sup>60</sup>

Linnaeus probably amended both species and genus name more than a year later following the receipt of another specimen of the same species from Johann Gerhard König (1728–1785), a former pupil of Linnaeus and Danish physician who travelled to Tranquebar, Thailand, and Ceylon from 1773 to 1785.<sup>61</sup> König sent a long letter from Tranquebar dated 22 February 1769, which was accompanied by some specimens. After drawing up a slip for the species *Pteris fragrans*, based on a short description sent by König along with a specimen, Linnaeus later crossed out *Pteris* and replaced it with *Polypodium*, but retained the specific epithet *fragrans*.<sup>62</sup> Now, the slip drawn up for the specimen received from Friar Gabriel, and later amended to *Polypodium fragrans*, has a little note at the bottom reading “conf. *Pteris fragrans*,” while the slip based on König's specimen carries a note on its back reading “confer *Adiantum pusillum*.” Information from both paper slips was finally systematically drawn together in the description of *Polypodium fragrans* in *Mantissa plantarum altera*.<sup>63</sup> In this case, a pair of slips drawn up from different sources was used over a period of more than two years to systematically collate information and settle on taxonomic assignments (Figure 3). It is highly likely, although

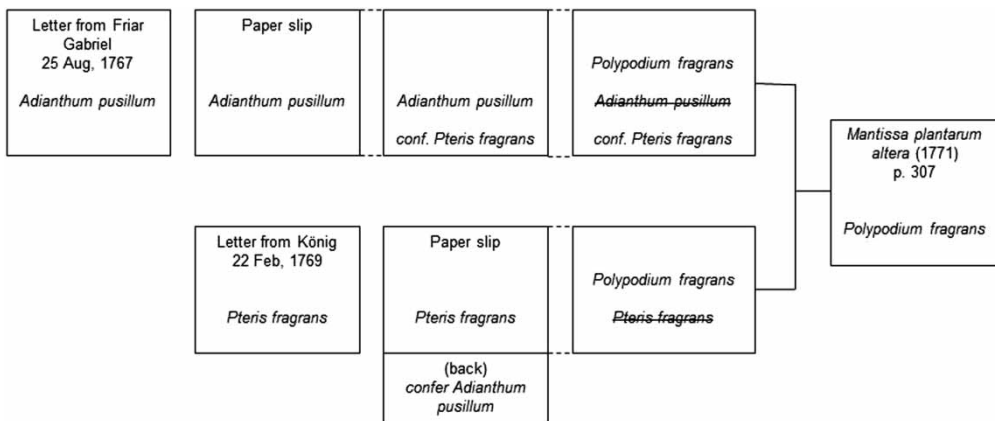


Figure 3. Schematic chronology of paper slips for *Polypodium fragrans*, in relation to specimens sent by Friar Gabriel (25 August 1767) and by Johan König (22 February 1769).

impossible to demonstrate conclusively, that this went along with a re-shuffling of the paper slips. At least today, both slips are kept together with slips on three other *Polypodium* species.

Another example will show that Linnaeus continued to use his paper slips for other publications than *Mantissa plantarum altera*, until a first stroke in the summer of 1774 significantly weakened his ability to work. Six slips correspond to the genus *Hypericum*, also known as St. John's wort. One slip was reserved for the genus description, while the rest described species based on specimens Linnaeus had received at different points in time. *Hypericum guineense*, for example, was based on a specimen sent from Guinea by Andreas Berlin (1746–1773) with a letter dated 15 April 1773,<sup>64</sup> while the slip for *Hypericum mexicanum* was drawn up following a shipment of specimens and images from José Celestino Mutis (1732–1808) dated 6 June 1773.<sup>65</sup> Both species descriptions were later published verbatim in the dissertation *Hypericum*, defended by Linnaeus's student Carolus von Hellenius on 20 November 1776.<sup>66</sup> All the information on the slips, except for the genus description, was published finally also in *Supplementum plantarum* by Linnaeus's son in 1781.<sup>67</sup>

The two examples so far reveal the crucial role that Linnaeus's slips played in correlating information and specimens received from correspondents. A final example will show how this worked in detail. Upon receipt of letters, Linnaeus would occasionally draw up a list of the specimens sent, allocating each specimen a number, or use an existing list sent by the collector. Some of these lists are still among Linnaeus's correspondence, while others have been separated from their initial letter, and are now kept with his manuscripts. Among the lists that are still extant are one of specimens sent from South Africa by Sparman, probably in November 1772;<sup>68</sup> and a list dated 6 June 1773 referring to specimens and drawings sent by Mutis from Nova Granada (now Colombia).<sup>69</sup>

The significance of these lists derives from the fact that Linnaeus used them to systematically cross-reference his herbarium sheets with corresponding paper slips. On the herbarium sheet, Linnaeus would note the species name, the name of the collector, sometimes abbreviated, and the number allocated to the specimen on the list he had drawn up. Having filed the specimen in this way, the paper slip would be written up, containing the description of the specimen received, along with its provenance, and the specific epithet attributed to it. On many occasions, a paper slip would also feature the number from the specimen list, thus linking it unambiguously with a particular specimen in Linnaeus's herbarium. For example, the species *Hydrocotyle ranunculinus* (a species of water penny wort) is mentioned under the numbers 65 and 66 in the list that Linnaeus compiled on the specimens received from Mutis (Figure 4a). Two herbarium sheets of *Hydrocotyle ranunculinus* exist bearing the numbers 65 and 66 respectively, and one paper slip on the same species also carries the number 65 (Figures 4b, c).<sup>70</sup> This paper slip was copied out in the third *Mantissa* preparatory manuscript by an amanuensis (Figure 4d), and printed posthumously by Linnaeus the Younger, in his *Supplementum plantarum* of 1781 (Figure 4e).<sup>71</sup>

From these three examples, we can see that Linnaeus started collecting information on paper slips shortly after the publication of *Mantissa plantarum* (1767) to prepare the follow-up volume *Mantissa plantarum altera* (1771), and that he then continued to use the new tool for other, more occasional publications as well. It served him to keep information together on new species and genera, specimens of which he received from different sources at different times; to reshuffle this information once his taxonomic judgements changed; and to extract it readily, together with corresponding specimens and letters, when occasions for publication arose. What is most striking about this system, however, is that Linnaeus's son, and successor to the post of Professor of Botany and Medicine at the University of Uppsala, was able to use it when his father's health declined, and after he had died. Indeed, the preparatory manuscript for Carl Linnaeus the Younger's *Supplementum plantarum* was based entirely on his father's paper slips. What initially had been an expedient for Linnaeus the Elder had grown into a system that outlived him. As Linnaeus

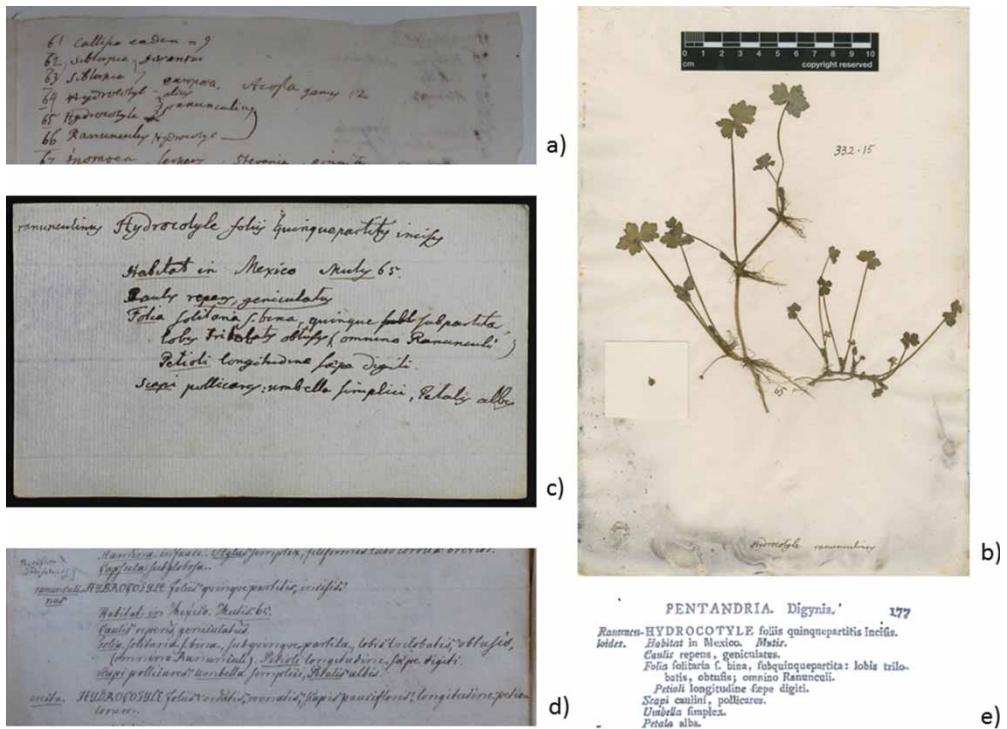


Figure 4. *Hydrocotyle ranunculinus* in list, specimen, and card: a) Details from Carl Linnaeus, “Mutis,” 1773, p. 3, Library of the Linnean Society. The species *Hydrocotyle ranunculinus* is listed as numbers 65 and 66; Linnaeus confuses the name, and links the two entries by a line, indicating that they belong to the same species. By permission of the Linnean Society of London. b) Specimen of *Hydrocotyle ranunculinus*, LINN 332.15, Linnean Herbarium, Linnean Society. The number 65 is noted close to the root. By permission of the Linnean Society of London. c) Slip for *Hydrocotyle ranunculinus*. Carl Linnaeus, “Botanical Paper Slips,” Library of the Linnean Society. Note the number 65 next to Mutis’s name. By permission of the Linnean Society of London. d) Entry for *Hydrocotyle ranunculinus* in Linnaeus the Younger, “Supplementum plantarum,” Library of the Linnean Society. The text was copied out *verbatim* by an amanuensis from the corresponding paper slip. By permission of the Linnean Society of London. e) *Hydrocotyle ranunculoides* in Carl Linnaeus the Younger, *Supplementum plantarum*, Braunschweig, 1781, p. 177. By permission of the Linnean Society of London.

the Younger put it in the preface to *Supplementum plantarum*: “I weigh out my remaining time for perfecting those works that my beloved father, as long as he was among the living, took up, and that he left behind with me as an heir.”<sup>72</sup>

### Carl Linnaeus the Younger

The paper slips took another dimension when Linnaeus became too ill and fragile to work on his own after his stroke in the summer of 1774. The preparatory manuscript for the third *Mantissa* demonstrates that towards the end of the 1770s Linnaeus was working in close collaboration with his son and two amanuenses. While the amanuenses neatly copied out Linnaeus’s paper slips in a notebook, Linnaeus himself corrected some of the text.<sup>73</sup> At the same time, his son continued the practice of drawing up paper slips for new species of plants. The manuscript is a mixture of tidy handwriting, and paper slips from both father and son inserted, glued, or pinned on the pages (Figure 5). Some of these slips are Linnaeus’s original paper slips, while

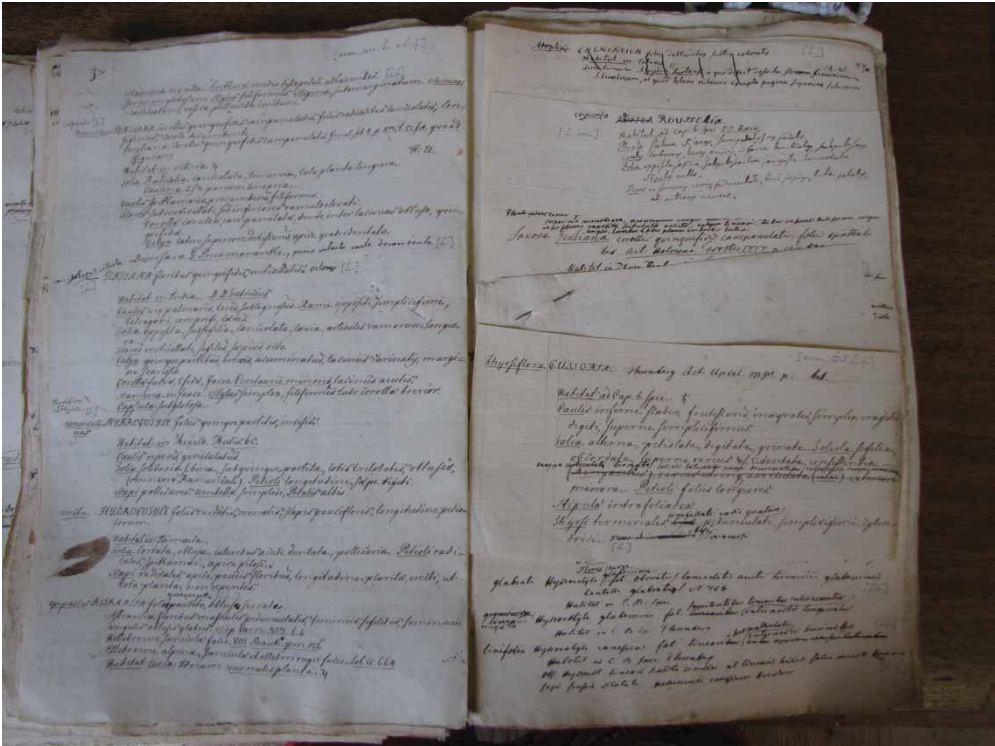


Figure 5. Two pages from Linnaeus the Younger, “Supplementum plantarum”, Library of the Linnean Society, 44–44a. This preparatory manuscript for the third *Mantissa*, eventually published by Carl Linnaeus the Younger as *Supplementum plantarum* in 1781, is based on the content of some of his father’s paper slips copied out by two amanuenses onto the pages of a folio notebook. Both father and son then amended the text, either directly entering corrections and additions in the text, or by gluing or pinning paper slips into the manuscript (cf. 4.c for an enlarged view of the entry for *Hydrocotyle ranunculinus* on the left-hand side). By permission of the Linnean Society of London.

others are roughly cut, and were clearly written up while someone else was working on the manuscript, to be inserted later. Working from and on loose paper slips meant that up to four people worked on one piece of work simultaneously without impinging the copying process.

The nature of this collective work is well illustrated by two species of the genus *Ixia*, a genus of cormous plants native to South Africa which includes the corn lily, and which Linnaeus had described for the first time in the second edition of *Species plantarum* (1763). A specimen of *Ixia* had been sent to Linnaeus by his student Sparrman in 1772, who named it *Ixia crispa* in an accompanying list.<sup>74</sup> There exists a corresponding paper slip which was entitled *Ixia crispa* by Linnaeus, with the annotation that the specimen came from the Cape of Good Hope and had been communicated by Sparrman. In the following year, in a letter from Thunberg dated 5 March 1773, another specimen was named *Ixia crispa* in a list of specimens shipped to Linnaeus.<sup>75</sup> Linnaeus now had two herbarium specimens carrying the same name, and a letter to Bäck on 12 September 1773 mentions that he had “received so many of this genus [i.e. *Ixia*] that they need close examination.”<sup>76</sup>

In the course of this examination, Linnaeus apparently reached the conclusion that the two specimens of *Ixia crispa* actually represented different species, since he changed the trivial name of Sparrman’s specimen from *Ixia crispa* to *Ixia undulata*. In addition, he noted on the paper slip the main differences between the two species. He did not, however, bother to

change the trivial name on the 1772 list, presumably because the list acted as an intermediary step in his work, which became useless once the herbarium sheet and paper slip had been connected by a formal, botanical name. Both *Ixia crispa* and *Ixia undulata* were then copied out by an amanuensis in the preparatory manuscript for the third *Mantissa*.<sup>77</sup> In a final revision, Linnaeus the Younger stepped in. He mostly kept the entry for Thunberg's *Ixia crispa* intact, slightly amending the diagnostic phrase and the description of the leaves only.<sup>78</sup> But the Sparrman specimen was allocated to a different genus altogether by Linnaeus the Younger, who changed its name from *Ixia undulata* to *Gladiolus crispus*.<sup>79</sup>

Despite this reassignment, Linnaeus the Younger made full use of the information copied out from the original paper slip into the preparatory manuscript, and even kept the differential characters his father had listed to distinguish this species from Thunberg's *Ixia crispa*. The reason why he returned to the specific epithet *crispus* emerges from a line that his father added on the paper slip. It reads "*Ixia undulata* Burm prodr. 1," indicating that Linnaeus had become aware that Burman had already described another species under the name *Ixia undulata* in his *Flora Indica* (1768).<sup>80</sup> With the change of genus from *Ixia* to *Gladiolus*, the epithet *crispus* became available again to refer to the species that Sparrman's specimen belonged to without risking confusion with Thunberg's *Ixia crispa*.

It is interesting to note that Linnaeus the Younger did not record the name change on the corresponding paper slip. Just as the specimen list lost its function once a link was established between specimen and paper slip by choosing a name, the paper slips became redundant once the species description was published. What the above example shows, however, is that both lists and slips retained their value in retracing the steps that lead to the distinction of species in a complex process of comparing specimens and drawing up species diagnoses and descriptions on this basis, and that they evolved into a system that was used across particular publication projects, and by different people.

### “Her Majesty’s extensive cabinet”

Not only did Linnaeus the Younger continue to use his father's botanical slips, but he adopted the technology from his father, and drew up paper slips of his own making, in a slightly bigger format (16×10 cm).<sup>81</sup> These slips are very tidily and regularly cut, implying that more effort was invested in their presentation – and perhaps that they were cut when the paper was bought. They catalogue only mammals, each group of slips belonging to the same genus kept together by a longer piece of paper acting as a folder. Linnaeus the Younger adopted the technique of paper slips, using it at the end of his father's life to work alongside him for his last (and posthumous) publication, and continuing to use it after his father's death for his own research into mammals.

But even beyond the Linnaeus household, the collaborative and information retrieval advantages of the paper slips were readily adopted. Back in 1752, Linnaeus had been asked to catalogue the royal natural history collections, and he called on his student Daniel Solander for help.<sup>82</sup> The Queen's collection of butterflies was catalogued using small paper sheets of roughly the same size (10.5×17 cm approximately).<sup>83</sup> Because the slips were used vertically, they are more akin to the pages of a small octavo volume than to customary index cards. The presence of a title page confirms this impression. What looks like a collection of cards, ready to be extended and reshuffled at will, is therefore rather an unbound manuscript put together for a particular book project. This is confirmed by the fact that the tenth edition of *Systema naturae* (1758) referred to the manuscript with the abbreviation “MLU” (Musaeum Ludovicae Ulricaе) in the case of species that had not been described elsewhere yet.<sup>84</sup>

One of the most distinctive features of this manuscript, if compared with other manuscripts left by Linnaeus, is that the slips cataloguing the Queen's collection bear both Linnaeus's and

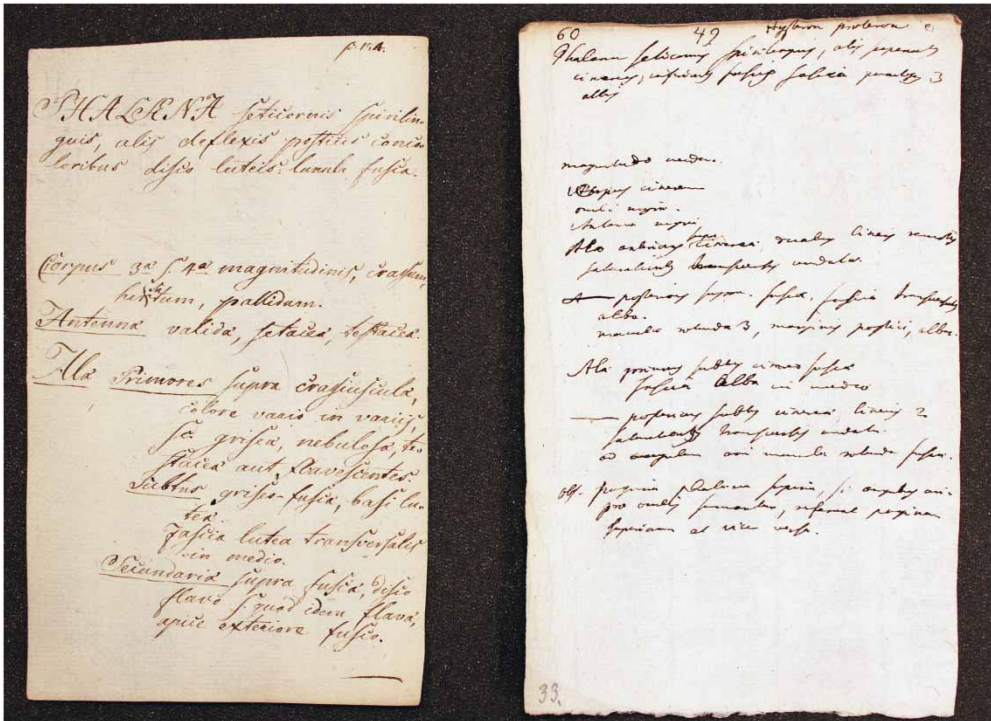


Figure 6. Catalogue of the Queen's insect collection, two paper slips for the genus *Phalaena*. On the left is a card drawn up by Daniel Solander, on the right one drawn up by Carl Linnaeus. Carl Linnaeus, "Museum Reginae", von Linné, Carl Ms. 1, Royal Swedish Academy of Science, Stockholm. Courtesy of The Center for History of Science.

Solander's handwritings.<sup>85</sup> Only nine slips are actually in Solander's very regular hand, most of which concern the genus *Phalaena*, now an obsolete genus in which Linnaeus included moths in general. All the other cards are in Linnaeus's distinctive scrawl (Figure 6). The division of labour between the two was certainly an important motivation to work with loose sheets that could later be assembled to form a complete manuscript. That there was a division of labour between the professor and his student is revealed by a closer look at the structure and content of the slips. Solander was meticulously following the model provided by Linnaeus's earlier taxonomic publications, and also the prescriptions about how to lay out a proper species description put forward in Linnaeus's *Philosophia botanica*.<sup>86</sup> By contrast, Linnaeus's slips are more cluttered and harder to decipher. They look more like private research notes than a manuscript carefully prepared for the typesetter. And indeed, in the preface to the catalogue of the Queen's collection that was published a good 10 years later, Linnaeus recalled how he had originally collected some of his "modest observations [*observatiunculas*] on paper sheets [*schedulas*], primarily devoted to my own use, so that I would retain some kind of idea of [the specimens in the collection]."<sup>87</sup>

Solander moved to England in 1760, and from 1763 he was employed at the British Museum to catalogue Sir Hans Sloane's collection. There, he started using paper slips similar to the ones cataloguing the Queen's collection, although made from sturdier paper, and most importantly, used horizontally and slightly smaller in size (15×10 cm approximately).<sup>88</sup> As Solander's letter offering his services to the Trustees of the British Museum indicates, the information contained on his slips continued to uphold the Linnean model of species description: "A catalogue such as I

should think proper and fit for this purpose, should consist of: the true generical name, with a *differentia specifica* and a trivial name; a good Synonyme – the native country – the use, if any – and in case it was a new subject, then to add a short description.”<sup>89</sup>

Solander kept on using this slip catalogue throughout his career, to take notes on species collected when he accompanied Joseph Banks (1771–1782) on Cook’s first circumnavigation from 1768 to 1771, and continuing to do so when working on herbarium specimens as curator and librarian to Banks after his return from this voyage.<sup>90</sup> These slips were initially kept loose in 57 Solander boxes – boxes to contain manuscripts that Solander had introduced to Banks’s library and that bear his name to this very day – but were later bound into 24 volumes.<sup>91</sup> They bear a striking resemblance to Linnaeus’s later slips (Figure 7).

It is tempting to conclude that, while cataloguing the Queen’s collection, the first seeds were planted for the later independent “invention” of paper slips by Solander and Linnaeus. Both men could rely on a common previous experience of working with loose paper sheets of a standard size when cataloguing an especially rich and complex set of natural history specimens. What distinguishes this earlier use of loose paper sheets from the later use of smaller paper slips arranged in series is that the earlier sheets were still compiled to form the manuscript in the context of one particular publication project. Linnaeus continued thinking in terms of individual publications right up to the publication of his 1771 *Mantissa*, as we have shown earlier. The Queen’s cabinet slips, the loose sheets for the *Species plantarum* manuscripts, and even the first paper slips for *Mantissa plantarum altera* were all drawn up with a specific publication in mind. It is only after 1771 that the tendency for a “centralizing impetus” and the fear of relying on a paper tool that “hangs by a thin thread” seem to have been replaced by the realisation of the practicality of the new technology. By contrast, Solander seems to have realised this potential much earlier, employing it in his cataloguing work eight years before his former teacher and mentor.

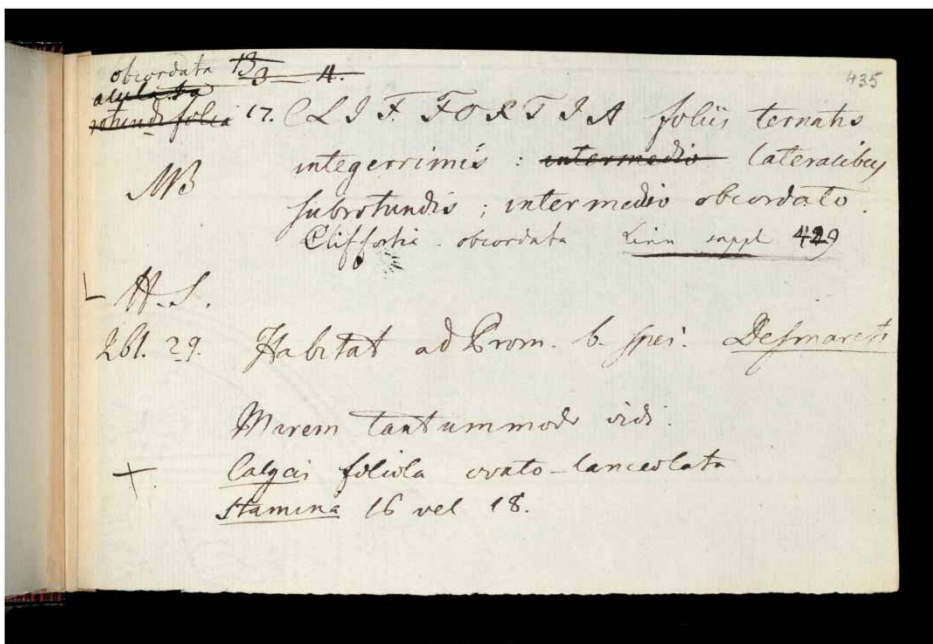


Figure 7. Daniel Solander’s paper slip for the species *Cliffortia obcordata*, 1763. Manuscript descriptions of plants, Library & Archives, Natural History Museum, MSS BANKS COLL SOL. Reproduced by permission of the Trustees of the Natural History Museum (London).

Solander's paper slips became an integral part of cataloguing specimens within the British Museum. Following Solander's death in 1782, Jonas Dryander (1748–1810), another student of Linnaeus's, succeeded him as curator and librarian of the British Museum. Almost half of the cards in the slip catalogue are in Dryander's hand. Upon his own death in 1810, Dryander was succeeded by Robert Brown (1773–1858), who had previously taken part in the voyage of the *Investigator* to Australia as the on-board naturalist, during which trip he consigned his notes to slips fashioned on the model of Solander's manuscript slips. He continued to do so as Joseph Banks's librarian, and these slips are in 77 Solander cases of the Botanical Library (Natural History Museum). On Banks's death in 1820, he inherited his library and herbarium, which were transferred to the British Museum in 1827. Brown then became Keeper of Sir Joseph Banks's Botanical Collection – or what would become the Department of Botany of the British Museum.<sup>92</sup> Through Solander, Dryander, and Brown, the card catalogue had become one of the centrepieces of a natural history that was no longer dominated by individuals such as Linnaeus, but by institutions whose workings reached beyond the time span of an individual's life. The paper slips had now fully realised their collaborative and trans-generational potential, and would become one of the earliest examples of a proper card catalogue.

### Conclusion

It was only towards the end of his life that Linnaeus fully integrated loose paper slips with his working methods, at a time when he was in a way paying the price for his own celebrity and success. With his many correspondents and travelling students inundating him with specimens, with new literature on new species coming out in quick succession, and with his own failing health to deal with, these slips provided an expedient solution to an information overload crisis which threatened to engulf the naturalist in his later years. The late stage at which the slips appear in Linnaeus's career as well as the few rather dismissive words that Linnaeus spent on the new technology in the preface of *Mantissa plantarum altera* indicate that he adopted this solution reluctantly, and without regarding it as a path-breaking innovation. Indeed, for him, and despite their smaller format, they were much on a par with the loose sheets he had used for previous preparatory manuscripts, for publication such as *Species plantarum* (1753). Nevertheless, the examples of *Hydrocotyle ranunculinus* and *Ixia crispa* show that the paper slips quickly began to play a vital role in Linnaeus's day-to-day work of distinguishing and naming new species.

The paper slips thus represent more than just another way of storing information. They came to play an integral part in the practical process of working out taxonomic relations between new and already known species. In the stages of Linnaeus's working process, they occupied a sort of middle ground: while the first step was to draw up a list of specimens provisionally assigned to species, the paper slips allowed Linnaeus to note down their characteristics, to compare species with each other, and to allocate names to them. They functioned in parallel with the specimens themselves: while the herbarium specimen enabled the visualization of species, the paper slip prepared the ground for their (con-)textualisation. Initially, as the information was used and printed in the 1771 *Mantissa plantarum altera*, some were discarded, as the crossed-out and re-used cards indicate. Yet increasingly, most were kept, corrected and added to, as they continued to function as a resource for collating species for a number of years even beyond Linnaeus's death.

It is tempting to read the story we have presented as a recapitulation of larger history in the lifetime of an individual. While the use of paper slips by Linnaeus was in many ways idiosyncratic, it still seems to indicate pressures at work that were beginning to change the face of natural history. On this reading, Linnaeus was at the vanguard of an inevitable development which would revolutionise the way information was stored and accessed. Against this kind of



“paper-technological” determinism it should be noted, however, that the very strict format to which Linnaeus’s paper slips adhered was prefigured on the pages of his major taxonomic works. In other words, to use paper slips in the same way as Linnaeus did, one already had to see the world with his eyes. It is for this reason that the history of the “little tools of knowledge” cannot be divorced from intellectual history.

### Acknowledgements

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### Notes

1. Zedelmaier, *Bibliotheca universalis und bibliotheca selecta*; Rhodes and Sawday, *The Renaissance Computer*; Blair, “Note Taking”; Büttner, Friedrich, and Zedelmaier *Sammeln, Ordnen, Veranschaulichen*; te Heesen, “The Notebook”; Brendecke Friedrich, and Friedrich, *Information in der frühen Neuzeit*; Scharf, “Identification Keys”; Blair, *Too Much to Know*; Soll, “From Note-Taking to Data Banks”; and Mendelsohn, “The World on a Page.”
2. Ann Blair has written extensively on information overload. See in particular Blair, “Reading Strategies”; see also Ogilvie, “The Many Books of Nature”; Müller-Wille and Charmantier, “Natural History and Information Overload”; and Strasser, “Collecting Nature”, on the continuing struggle with information overload in the nineteenth and twentieth century.
3. Blair, “Humanist Methods in Natural Philosophy”; Beal, “Notions in Garrison”; Moss, *Printed Commonplace-Books*; Dacome, “Noting the Mind”; Daston, “Taking Note(s)”; Yeo, “John Locke’s ‘New Method’ of Commonplacing”; Soll, “From Note-Taking to Data Banks”; Stolberg, “Medizinische Loci communes.”
4. Blair, “Annotating and Indexing Natural Philosophy”; Pinon, “Entre compilation et observation”; Yeo, “Between Memory and Paperbooks.”
5. See Delbourgo and Müller-Wille, “Introduction to ‘Listmania’.”
6. Malcolm, “Thomas Harrison and His ‘Ark of Studies’”; Blair, *Too Much to Know*, 93–102; Yeo, “Loose Notes and Capacious Memory.” On the significance of tailor-made furniture for the organisation of knowledge in general, see te Heesen and Michels, *Auf – Zu*.
7. For an overview of the paper technologies that Linnaeus used over his long career see Müller-Wille and Scharf, “Indexing Nature.”
8. British Society for the History of Science (16 June 2009), “Carl Linnaeus Invented the Index Card,” *ScienceDaily*, retrieved 14 November 2013, from <http://www.sciencedaily.com/releases/2009/06/090616080137.htm>.
9. Bourguet, *Déchiffrer la France*; Becker and Clark, *Little Tools of Knowledge*; Brendecke, “Tabellen und Formulare”; Ogborn, *Indian Ink*; Vismann, *Files*; Hess and Mendelsohn, “Case and Series”; Mendelsohn, “The World on a Page”; Krajewski, *Paper Machines*. For parallel developments in literature that allowed for more personalized note-taking practices see Décultot, *Lire, copier, écrire*.
10. On paper technologies as research technologies, see te Heesen, “The Notebook”; Hess and Mendelsohn, “Case and Series”; Müller-Wille and Charmantier, “Lists as Research Technologies.”
11. Blair, *Too Much to Know*, 94.
12. Malcolm, “Thomas Harrison and his ‘Ark of Studies’,” 217. Normannus’s filing system is briefly described in Placcius, *De arte excerptendi*, 122–123.
13. On the vitality of manuscript culture in early modern Europe, see Moureau, *De bonne main*; Beal, *In Praise of Scribes*; McKitterick, *Print, Manuscript and the Search for Order*; Sherman, *Used Books*. On manuscript and print in early modern Sweden, see the *LIR.journal* special issue on “Manuscript culture

- in the age of print,” notably Mattsson, “‘The Place is Swarming with Libels’,” and E. Nyström, “Permeable Boundaries.”
14. Blair, *Too Much to Know*, 94; Krajewski, *Paper Machines*, 2, 39–42.
  15. Blair, *Too Much to Know*, 94.
  16. Strout, “The Development of the Catalog and Cataloging Codes”; Hopkins, “The 1791 French Cataloging Code.”
  17. Joyce, “The Concept of Special Collections,” 21; Krajewski, *Paper Machines*, 33, chapter 5.
  18. Spieker, *The Big Archive*; Krajewski, *Paper Machines*, chapter 8; Yates, *Control through Communication*, 56–57; Thurtle, *Emergence of Genetic Rationality*, chapter 13. For accounts of more pernicious uses of card catalogues, see Allen, “The Eugenics Record Office” and Aly and Roth, *The Nazi Census*.
  19. Lindroth, *Svensk Lärdomshistoria*, vol. 2, 214–220. We have not been able to ascertain what kind of catalogue was in use at the university library during Wallin’s term there. The oldest extant catalogue, Pehr Fabian Aurivillius’s (1756–1829) *Catalogus Bibliothecae Regiae Academiae Upsaliensis* (1796) consists of bound manuscript volumes and is still in use today for older material preserved at the library; see “Early printed books and special collections at Carolina Rediviva,” <http://www.uu.se/en/Collections/Early-imprints/> (last accessed 05/02/2013).
  20. Letter from Georg Wallin to Carl Linnaeus (1 March 1749), *The Linnaean Correspondence*, linnaeus.c18.net, letter L5936 (consulted 30 November 2013). The letter mentions rune inscriptions that Wallin collected on Gotland for publication, but the copies Wallin made of these, and that accompanied the letter, have not been preserved.
  21. Wallin, *Lutetia Parisiorum Erudita*. The chapter on libraries was reproduced and translated into French in Omont, “Les bibliothèques de Paris en 1721–1722,” 62–70.
  22. Wallin, *Lutetia Parisiorum Erudita*, 129–130 (emphases in the original).
  23. Zedelmaier, “De Ratione Excerptendi,” 87; Krämer, “Wie gelangte ein Zentaur,” 274.
  24. Vismann, *Files*, chapter 3, 71–101.
  25. *Ibid.*, 105.
  26. Hess and Mendelsohn, “Case and Series.”
  27. On Bäck and medical reform, see Ihre, *Abraham Bäck*.
  28. Linnaeus, “Nosological Notes.”
  29. There are even indications that loose pieces of paper were used in school education for note taking and practical exercises; see Blair, “Student Manuscripts and the Textbook,” 40–41; Eddy, “The Shape of Knowledge,” 224–225.
  30. Blunt, *Linnaeus*, 180. Sjögren, Moberg, and Pontén, *Låt inte råttor eller mal fördärva*, 25.
  31. Charmantier, “Carl Linnaeus and the Visual Representation of Nature”; cf. Eddy, “Tools for Reordering.”
  32. Linnaeus, “Fundamenta botanica,” vol. 7 and 8. For a more detailed account of the centrality of the genus for Linnaeus note taking practices, see Müller-Wille and Charmantier, “Natural History and Information Overload.”
  33. Linnaeus, “Species plantarum,” 1746 and 1753. On this manuscript, see Hulth, “Linnés första utkast.”
  34. Müller-Wille, “Linnaeus’s Herbarium Cabinet.”
  35. Müller-Wille and Scharf, “Indexing Nature,” 59.
  36. Blair, *Too Much to Know*, 92; Brendecke, “Durchschossene Exemplare,” 50–64.
  37. Nyström, “Permeable Boundaries,” 105, 108–109.
  38. Böhme and Müller-Wille, “In der Jungferneide.”
  39. For publication dates see Stearn, “Introductory Notes.” *Mantissa* (1767) was the first supplement to the *Species plantarum*, second edition (1762–1763) and *Genera plantarum*, sixth edition (1764). It was issued at the same time, and often bound with, the twelfth edition of *Systema naturae* (1767). *Mantissa altera* was published on its own and Stearn dates its publication to October 1771, relying on a review of it (most probably by Linnaeus’s himself) dated 17 October 1771 and on a letter from Linnaeus to Burman dated 1 November 1771 (“Introductory Notes,” xi).
  40. Linnaeus the Younger, “Supplementum plantarum.”
  41. Linnaeus the Younger, *Supplementum plantarum*.
  42. From an anonymous review published in *Lärda Tidningar* (83, 1767), which was written by Linnaeus himself. Hagelin, *Herr Archiatern och Riddaren*, 360–361.
  43. Buffon, Linnaeus long-time rival, relied on a secretary and a number of amanuenses preparing excerpts from natural history literature, in preparing the volumes of his monumental *Histoire naturelle*. See Roger, *Buffon*, 113, 280.

44. Müller-Wille and Charmantier, “Natural History and Information Overload.” For characteristic complaints, see Carl Linnaeus to Abraham Bäck, 4 March 1752, *The Linnaean Correspondence*, linnaeus.c18.net, letter L1371 (consulted 22 May 2012); Carl Linnaeus to Nicolas von Jacquin, 20 March 1761, *The Linnaean Correspondence*, linnaeus.c18.net, letter L2889 (consulted 22 May 2012); Carl Linnaeus to Count Carl Gustaf Tessin, 10 October 1753, *The Linnaean Correspondence*, linnaeus.c18.net, letter L1657 (consulted 22 May 2012). See also Blunt, *Linnaeus*, 232.
45. Stearn, “Introductory Notes,” vii–viii.
46. See for example Carl Linnaeus to Abraham Bäck, 19 September 1769, *The Linnaean Correspondence*, linnaeus.c18.net, letter L4257 (consulted 1 May 2013); Carl Linnaeus to Nicolaus Joseph, baron von Jacquin, 18 October 1770, *The Linnaean Correspondence*, linnaeus.c18.net, letter L4417 (consulted 22 May 2012); Carl Linnaeus to Carl Fredrik Mennander, 28 October 1770, *The Linnaean Correspondence*, linnaeus.c18.net, letter L4417 (consulted 22 May 2012).
47. Stearn, “Introductory Notes,” xvii.
48. Blair, “Note Taking,” 87.
49. Linnaeus, “Botanical Paper Slips.” The manuscript collection at the Linnean Society is not properly catalogued, and we will refer to manuscripts, including the paper slips, by the titles found in a typescript list of manuscripts compiled by Swedish scholars in the 1950s, and the inscriptions found on the boxes in which the manuscripts are housed. In referring to individual slips, we will use the genus and species names that head them, since they are not numbered.
50. A note on a paper slip accompanying the collection of Linnaeus’s paper slips states that the cards were rearranged by T.T. Barnard in July 1966 without providing any information on how they were arranged before. We have tried to identify traces of the original order, e.g. burn marks (Linnaeus was a smoker) or ink blots joining individual slips, but this gave only some weak indications that cards on species of the same genus were originally kept together.
51. Linnaeus, “Botanical Paper Slips,” *Drupina cristata*.
52. T.T. Barnard has left a handwritten list with the Linnaean paper slips collection that correlates the crossed-out descriptions with their published version in *Mantissa plantarum altera*.
53. Pallas, *Reise*.
54. The abbreviated references correspond in their majority to the ones which are listed in Stearn, “An Introduction to the *Species plantarum*,” 99–102 and J.L. Heller, “Index auctorum et librorum,” 1–60, 10–60.
55. The herbarium is kept at the Linnean Society of London and is available online: <http://www.linnean-online.org/>.
56. Linnaeus, *Hypericum*.
57. Linnaeus, “Cycas.”
58. Jarvis, *Order Out of Chaos*, 204.
59. Gabriel to Carl Linnaeus, 25 August 1767, *The Linnaean Correspondence*, linnaeus.c18.net, letter L3943 (consulted 13 June 2012).
60. The corresponding specimen in the Linnean herbarium for *Polypodium fragrans* bears the Savage catalogue number LINN 1251.34.
61. On König, see Jensen, “Medical Skills,” 497–498.
62. This specimen also survives in the herbarium: LINN 1251.33. On the herbarium sheet next to the specimen is glued König’s description of the specimen, which Linnaeus mostly copied at the top of corresponding paper slip, before providing his own species description.
63. Linnaeus, *Mantissa Plantarum Altera*, 307. Information on the roots of *Polypodium fragrans* was drawn from Friar Gabriel’s specimen.
64. Andreas Berlin left for Africa in 1773. Only one letter was sent from Sierra Leone to Linnaeus: Andreas Berlin to Carl Linnaeus, 15 April 1773, *The Linnaean Correspondence*, linnaeus.c18.net, letter L4829 (consulted 19 July 2012). An undated list of four species descriptions in Berlin’s hand is amongst the Sparrmann correspondence at the Linnean Society (LS, vol. XIV, fol. 275). *Hypericum guinense* is one of the species described, and its text was the basis for Linnaeus’s paper slip.
65. Linnaeus, “Mutis.” The related herbarium specimen is LINN 943.31. On Mutis’s contacts with Linnaeus, see Bleichmar, “Geography of Observation,” 374–375.
66. Linnaeus, *Hypericum*.
67. Linnaeus the Younger, *Supplementum plantarum*, 343–345.
68. Linnaeus, “Sparrmanni Capenses,” 271–272. There are five extant letters written to Linnaeus by Sparrman in 1772, only the last of which, dated 21 November, speaks of a significant batch of plants, insects, and other animals sent (“ett pacquet örter, en insect låda, och en liten flaska med diur i”).

69. Linnaeus, "Mutis." There is also a 1777 list written up by Mutis himself, in his letter dated 8 February 1777 (Library of the Linnean Society of London, Linnaeus Correspondence, vol. 11, fol. 97–100). See Jarvis, *Order Out of Chaos*, 220, 188, 229, 223.
70. The herbarium specimen of *Hydrocotyle ranunculinus* is LINN 332.15.
71. Linnaeus the Younger, "Supplementum plantarum," fol. 43 v.; Linnaeus the Younger, *Supplementum plantarum*, 157.
72. Linnaeus the Younger, *Supplementum plantarum*, "Praefatio" [unpag.]: "Impendam subseciva mea tempora ad perficienda illa opera, quae pater meus carissimus, dum in vivis erat, suscepit, mihiq[ue] hereditarii in loco reliquit."
73. T.T. Barnard worked on the paper slips in 1966, and has left notes correlating the paper slips with species entries in Linnaeus the Younger's *Supplementum plantarum* (1781), in a reprint of the *Supplementum* kept at the Linnean Society of London (L.IV.737).
74. The herbarium specimen is LINN 59.18, and carries the inscription "Sp[arman]. 123." On Sparman, and other Linnaean "apostles," see Sörlin, "Scientific Travel."
75. Carl Peter Thunberg to Carl Linnaeus, 5 March 1773, *The Linnaean Correspondence*, linnaeus.c18.net, letter L4822 (consulted 28 June 2011). The corresponding herbarium specimen is LINN 58.10, and was annotated "T[hunberg] 313."
76. Fries, *Bref och Skrifvelser*, 207.
77. Linnaeus the Younger, "Supplementum plantarum," 20.
78. Linnaeus the Younger, *Supplementum plantarum*, 91.
79. *Ibid.*, 94.
80. Burman, *Flora Indica*, in *Prodromus florum Capensis*, 1.
81. Linnaeus the Younger, "Diagnoses of Mammals."
82. Solander, *Collected Correspondence*, 15–16. Drottningholm and Ulriksdal were both royal palaces.
83. Linnaeus, "Museum Ludovicae Ulricaе." The cards are dated c. 1760 but we can accurately date them to 1752 if we follow Solander's letter. In fact, by 1760, Solander was already in England, and it is therefore likely that the dating refers to the use of the manuscript for the publication of the catalogue in 1764. As in the case of Linnaeus's later paper slips, it is impossible to establish the original order of the manuscript. It is now organized by bundles wrapped in paper inscribed with the names of insect orders in the hand of the Swedish entomologist Per Olof Christopher Aurivillius (1843–1928), who wrote a taxonomic review of Linnaeus's work on the Queen's collection in 1882; see Aurivillius, "Recensio critica lepidopterum."
84. Honey and Scoble, "Linnaeus's Butterflies," 285.
85. Duyker, *Nature's Argonaut*, 18.
86. Linnaeus, *Philosophia botanica*.
87. Linnaeus, *Museum Ludovicae Ulricaе*, Praefatio [unpag.].
88. Solander's slips from this period are annotated with "MB HS." It is disputed whether this refers to Sloane's collection or another collection of plants present in the British Museum; see Diment and Wheeler, "Catalogue," 470, and Marshall, *Handwriting of Joseph Banks*, 2–3.
89. Daniel Solander to William Watson, 26 January 1763, in Solander, *Collected Correspondence*, 254.
90. Marshall, *Handwriting of Joseph Banks*; Diment and Wheeler, "Catalogue"; Marshall, "Daniel Carl Solander," 451–456.
91. Solander, "Manuscript Descriptions of Plants."
92. On Dryander and Brown, see Marshall, *The Handwriting of Joseph Banks*, 3, 5, 16–18.

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