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A translation of Carl Linnaeus's introduction to *Genera plantarum* (1737)

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Abstract

This paper provides a translation of the introduction, titled 'Account of the work' *Ratio operis*, to the first edition of *Genera plantarum*, published in 1737 by the Swedish botanist Carl Linnaeus (1707–1778). The text derives its significance from the fact that it is the only published text in which Linnaeus engaged in an explicit discussion of his taxonomic method. Most importantly, it shows that Linnaeus was clearly aware that a classification of what he called 'natural genera' could not be achieved by a top-down approach of logical division, but had to rely on inductive, bottom-up procedures. The translation is supplemented by explanatory notes.

Keywords: Carl Linnaeus; *Genera plantarum*; Taxonomy; Botany; Natural history; Natural system of classification; Genus concept

1. Introduction

In one of his autobiographical manuscripts, Carl Linnaeus described his *Genera plantarum* as a book that had put botany on a completely new footing 'by describing all parts of the fructification with great accuracy and setting up characters on this basis, so that a genus which has not yet been described in the Linnaean manner is entirely imperfect'.[1] This self-confident appraisal, written down about two years before Linnaeus's death in 1778, seems fully justified by the great literary success that *Genera plantarum* enjoyed. Linnaeus had put the small volume together in 1736 as a twenty-nine year old, while he curated the botanical collection of George Clifford (1685–1760), a rich Anglo-Dutch merchant banker who had established a large botanical garden on his estate at Hartekamp, near Haarlem.[2] There followed further, revised and enlarged editions in 1742, 1743, 1752, 1754, 1764 (the last, authorized edition), and 1767.[3] There were a number of posthumous editions also, the last ('ninth') one edited by the German botanist Curt Sprengel in 1830–1831.[4] *Genera plantarum* was translated into German in 1775.[5] There exist several

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[1] Linnaeus (1957), p. 137; our translation.
[2] On Linnaeus and Clifford, see S. Müller-Wille (Forthcoming).
[3] Linnaeus (1742, 1743, 1752, 1754, 1764, 1767).
[4] Linnaeus (1830–1831).
[5] Linnaeus (1775).

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eighteenth-century English translations and popular adaptations. The most reliable, based on the sixth edition (1764), was produced by 'a botanical society at Lichfield'; it is almost certain that Erasmus Darwin (1731–1802) was the translator.[6] A French translation appeared in 1804–1805.[7] Finally, there appeared countless botanical works in the eighteenth century that adapted the style and layout of *Genera plantarum* for particular purposes: describing newly discovered genera, cataloguing the flora of a specific region (national floras in particular), or providing a synopsis of a certain taxonomic group. The most important of these adaptations was Antoine Laurent de Jussieu's (1748–1836) *Genera plantarum secundum ordines naturales disposita*, which was the first to arrange the genera of plants according to their 'natural orders'.[8]

Linnaeus's *Genera plantarum* was a curious book. The first edition contained condensed descriptions of 935 plant genera on 380 octavo pages. Clearly, such a book was not to be read, but rather to be used as a reference work. The only discursive part of the first edition was an introduction, entitled *Ratio operis* ('Account of the work)', covering ten, unpaginated pages. This short methodological text is the only one, to our knowledge, in which Linnaeus positioned himself in the community of botanists by explicitly and publicly criticizing contemporaries and predecessors, especially Joseph Pitton de Tournefort (1656–1708). The introduction, which consists of thirty-two numbered paragraphs, is characterized by an extremely parsimonious style. Linnaeus prided himself on writing '*aphoristice*' and 'expressing his ideas in as few words as possible'.[9] Indeed, most of his writings, notably his *Fundamenta botanica* (1736), follow this format of short, numbered paragraphs, only loosely interconnected by cross-references. The model for this style of presentation was in all likelihood *Institutiones medicae* (1708, and later editions) by Herman Boerhaave (1668–1738), and possibly Francis Bacon's *Novum organum* (published in Latin as part of *Instauratio magna*, 1620). The first edition of *Genera plantarum* was dedicated to Boerhaave.

The aphoristic style makes Linnaeus's work rather enigmatic. Statements are usually extremely elliptical, designed to be short rather than clearly argued, memorable rather than explanatory. The resulting texts do not form linear arguments, but networks of interrelated, yet separate and relatively independent, propositions. This may explain why *Ratio operis* has so far been completely ignored by historians of biology, despite its significance for understanding Linnaeus's taxonomic philosophy, and despite the impact it must have had on contemporary naturalists.

What follows is the first translation of the introduction to the first edition of *Genera plantarum* into modern English. We have tried to preserve the characteristic style, syntax, and the typography (the original uses italics and small capitals), but have opted for a translation as close as possible to the conventions of modern English, especially with respect to punctuation and capitalization. Footnotes are restricted to providing basic bio-bibliographic information on authors and works quoted, as well as explaining some technical terms and doubtful passages. An interpretation of the text is provided in the essay by Staffan Müller-Wille in this issue (Müller-Wille, 2007).

2. Translation

|Title page|

CARL LINNAEUS'S,/ *Med[ical] Doc[tor]*,/[10] *Soc. Ac. Imp. Nat. Cur.*,/[11] GENERA/ OF PLANTS/ with Their/ NATURAL CHARACTERS/ According to the/ NUMBER, FIGURE,/ SITUATION, AND PROPORTION/ *of All the Parts of the Fructification*/ Leiden/ at Conrad Wishoff's 1737.

[|p. 3| ACCOUNT[12] OF THE WORK]

1. All that truly can be known by us depends on a clear method by which we distinguish the similar from the dissimilar. The more natural the distinctions this method comprises, the more clearly the idea of things emerges to us. The more objects our understanding engages with, the more difficult it becomes to work out a method—and the more necessary. Nowhere has the Great Creator placed so many objects before the human senses as in the vegetable kingdom, which covers this whole globe that we inhabit. Thus, if a pure method is of use anywhere, it is here, if we shall hope to gain a clear idea of Vegetables. Thus CESALPINO: *Unless plants are reduced to orders, and distributed into their classes like the squadrons of an army, everything is bound to fluctuate*.[13]

[6] Linnaeus (1787).

[7] Linnaeus (1804–1805).

[8] Jussieu (1789). The most complete bibliography of editions, translations and adaptations of Linnaeus's works can be found in Soulsby (1933); for a detailed bibliography of the various editions of *Genera plantarum* see Bryk (1954); on the reception of Linnaeus's botanical work in general, see Stafleu (1971); on the impact of Jussieu's *Genera plantarum* see Stevens (1994).

[9] Linnaeus (1957), pp. 136–137; see aphorism 25 of *Ratio operis* also.

[10] Linnaeus had travelled to Holland in the summer of 1735 to acquire his medical degree, which he did shortly after his arrival on 18 June at the University of Harderwijk with a thesis on intermittent fevers (Linnaeus, 1735a).

[11] This abbreviation stands for 'Member of the Imperial Academy of Natural Scientists'. Linnaeus was appointed member of the German Academy of Natural Sciences Leopoldina on 3 October 1736, under the honorary name '*Dioscurides secundus*' [i.e. the second Dioscorides]. At the time, the official name of this academy was '*Sacri Romani Imperii Academia Caesareo-Leopoldina Naturae Curiosorum*'.

[12] *Ratio*, an extremely polysemic expression that can also mean plan, rationale, method, foundation.

[13] Cesalpino (1583), Dedication, p. [4]. Andrea Cesalpino (1519–1603) was an Italian philosopher and naturalist. He became professor of botany and medicine at the University of Pisa in 1560. His *De plantis* was the first modern textbook in botany, considering plant physiology, taxonomy, and development in their own right. He was physician to Cosimo I de Medici and Pope Clemens III. The latter position led to his move to the *Sapienza* in Rome in 1592.

2. Therefore vegetables are known to the one who (1)[14] knows to join the similar with the similar, and to separate the dissimilar from the dissimilar.

3. He is a *botanist* who knows (2) to call similar vegetables with similar names and distinctly different plants with distinctive names, intelligible to everyone.

4. The *names* (3) of plants are *generic* and (if there are several species) *specific*.[15] They have to be certain and well founded, not vague, slippery, or variously applicable. Before they can be so, it is necessary that they be assigned to certain, not vague genera (2, 6). For if these vacillate, the names will do so too, and by consequence the doctrine of botanists (3).

5. There are as many *species* as there were different forms produced by the Infinite Being in the beginning. Which forms afterwards produce more, but always similar forms according to inherent laws of generation; so that there are no more species now than came into being in the beginning. Hence, there are as many species as there are different forms or structures of plants occurring today, setting aside those which place or accident exhibit to be a little different (varieties).

6. There are, however, as many *genera* as there are common, proximate attributes of different species (5), as they were created in the beginning. This is confirmed by revelations, discoveries, and observations. Thus:

Genera and Species are all natural.

|p. 4| Indeed, it is not allowed to join the horse and the pig under one genus, even if both species were one-hoofed; nor is it allowed to distinguish the goat, the reindeer, and the elk by genus, even if they differed by the shape of the horns. Therefore we have to study the limits of genera with attentive and diligent observation, since it is very difficult to determine them a priori, even though this work takes effort. *For should the genera be confused, everything must be confused.* Cesalp[ino].[16]

7. That it has pleased the Infinite Wisdom to distinguish the genera by fructification[17] was discovered in a later age; and first indeed was Conrad Gesner, pride of his time, as is clear from his posthumous letters and the plates published by Camerarius.[18] Nonetheless, Andrea Cesalpino was the first to announce it publicly and put it into use.[19] It would however soon have expired, if Robert Morison had not called it into life again[20] and if Joseph Pitton de Tournefort had not raised it to pure systematic rules.[21] At length, the heroes in the art [of botany], however many there were, corroborated it.

8. As soon as this foundation was given (7), this point fixed, everyone capable of such work tried to make it useful and to build systems; all with the same inclination and with the same aim, but with unequal success. Because only a few knew the fundamental rule, which, if not observed by the builders,[22] would cause the most splendid building to be ruined with the first tempest. Boerh[aave] Inst[itutiones medicae, aphorism] 31. Teachers *are to proceed from generalities to particulars, while explaining discoveries; while* Inventors, *to the contrary, have to pass from particulars to generalities*.[23] For some have assumed various parts of fructification as a systematic principle, and with it, they have descended according to laws of division from classes to orders all the way down to species. And by these hypothetical and arbitrary principles they broke and tore apart the natural, non-arbitrary (6) genera and did violence to nature. For example, from the fruit, one denies that the Persicam [peach]

[14] Linnaeus used numbers in parentheses to cross-reference aphorisms of *Ratio operis*.

[15] *Genera plantarum* was published long before Linnaeus introduced binomial nomenclature in *Philosophia botanica* (Linnaeus, 1751). Before the introduction of binomial nomenclature, specific names consisted in adjectival phrases (*differentiae specificae*) that were added to the generic name, and listed the characters by which a species could be distinguished from its congeners. Such diagnostic phrases were superfluous, of course, in cases where a genus was represented by one species only.

[16] Cesalpino (1583), Dedication, p. [4].

[17] 'Fructification' comprises the organ systems of flower and fruit.

[18] Conrad Gesner (1516–1565) was a Swiss physician, naturalist and humanist active in Lausanne and Zürich, where he served as the city's physician and lectured on physics. Gesner published extensively in natural history, and is especially known for his *Historia animalium* (Gesner, 1551–1558). Upon his death he left a large collection of botanical manuscripts and drawings, some of them already engraved in wood, to Caspar Wolf (1532–1601), who edited part of the material (Gesner, 1577) before he sold it to Joachim Camerarius jun. (1534–1598), a physician in Nürnberg. The latter used Gesner's wood blocks for some of the illustrations in his German edition of Pietro Mattioli's (1500–1577) herbal (Mattioli, 1586).

[19] Cesalpino (1583), pp. 26–28.

[20] Robert Morison (1620–1683) was a Scottish physician and botanist, who had studied medicine in Paris and was appointed gardener to Gaston d'Orleans at Blois in 1648. In 1660 he moved back to England as royal physician and became the first professor of botany at Oxford in 1669. His *Hortus regius Blesensis auctus* (Morison, 1669; also known as *Praeludia botanica*) contained a dialogue arguing that classification should be based on fruit and seed characters. He later applied this principle in his *Plantarum umbelliferarum distributio nova per tabulas cognationis & affinitatis ex libro naturae observata & detecta* (Morison, 1672) and his *Plantarum historiae universalis oxoniensis* (Morison, 1680–1699).

[21] Joseph Pitton de Tournefort (1656–1708) received his education from the Jesuit college in Aix, and studied medicine at the University of Montpellier. In 1683 he was appointed *demonstrateur de botanique* at the *Jardin du Roi* in Paris. In this function he undertook botanical travels to the Netherlands, Spain, and the Eastern Mediterranean (1700–1702). In 1694 he published his *Élemens de botanique, ou méthode pour connoître les plantes* (Tournefort, 1694), a general textbook in systematic botany, which was translated into Latin (Tournefort, 1700). The first chapter of this edition, on which Linnaeus certainly relied, applies the 'art of combination' (*ars combinandi*) to identify calyx and fruit as the parts by which plants can best be classified. It also provides the first history of systematic principles.

[22] *Aediles*, that is, officers responsible for the building and maintenance of public buildings in ancient Rome.

[23] Boerhaave (1720), aph. 31, p. 10. Herman Boerhaave (1686–1738) became professor of botany and medicine at Leiden in 1609. He was one of the most renowned physicians in the early eighteenth century. He introduced clinical instruction, taught on the relation of symptoms and lesions, and greatly improved the collection of the botanical garden at Leiden through widespread correspondence and close contacts with the Dutch East India Company. Linnaeus met him during his stay in the Netherlands in 1735–1738 and dedicated *Genera plantarum* to him.

and the Amygdalum [almond] can be joined together in the same genus;[24] from the regularity of the petals, someone else denies it for the *Capraria* [goatweed] of Boerhaave and of Feuillée;[25] from their number, another denies it for Linum [flax] and Radiola of Dill[en];[26] from the chambers, another denies it for Agrifolium [holly] T[ournefort] and Dodonaea Pl[umier];[27] from their sex, another denies that the androgynous Urtica [nettle] and the one with distinct sex etc. can be combined in one genus.[28] Because, as they say, if these cannot be joined by class, |p. 5| they can be joined still less by genus. But they do not observe that they themselves constructed the classes, but the Creator himself made the genera. Hence so many false genera! So many controversies among authors! So many bad names! So much confusion! Indeed such was the state of things that, as often as a new systematist[29] arose, the whole botanical world was thrown into panic. And I truly do not know if these systematists produced more evil than good. Surely, if the unlearned are compared with the learned, the former produced much more [evil]. Physicians, pharmacists, and gardeners have suffered this fate,[30] and not without reason. I confess that their theory would have been the best, if it had only pleased the Great Creator to make all the fructifications of the same genus as similar among themselves as the individuals of one species are. But since it was not done that way, there remains no other recourse, than this: we, who cannot be the masters of nature and cannot create all plants again according to our own understanding, must submit ourselves to the laws of nature and, with diligent study, learn to read the features[31] inscribed in plants. Yet, if every different feature of the fructification were judged sufficient to distinguish by genus, why should we hesitate to proclaim immediately that there are almost as many genera as species? Indeed, we are hardly acquainted with any two species of flowers so similar, that no difference would intercede. I also once tried to determine all the specific differences from the flower alone, but it was not a fruitful endeavor since there was an easier way.[32] I therefore urge all sound botanists, if certainty in the art is to be hoped for, to acknowledge that *genera and species are all natural*. Without assuming this principle, nothing good can be obtained in the art. F[undamenta] B[otanica, aphorisms] 132 and 157. S[ystema] N[aturae], p. 1., [aphorisms] 1 to 4.[33]

9. Having assumed this postulate (8), everyone proceeded according to his own method and divided those genera into orders and classes: Cesalpino, Hermann,[34] Ray,[35] Knauth the elder[36] according to the *fruit*; Tournefort

[24] Cesalpino (1583), Lib. ii, Cap. xiv and xvii, reports that 'the ancients' considered almonds as nuts, and that it should figure among plants 'without a pericarp'. He was aware, however, that flowers and leaves of almond and peach trees were very similar and that peach branches that were grafted onto almond trees developed fruits with a rudimentary pericarp only. He therefore treated the almond under the same systematic heading as the peach, considering the former as a 'middle tree' (*arbor mediocris*).

[25] *Capraria bifolia* (goat-weed, wild tea) is a plant native to South America. In 1738 Linnaeus gave out a digest of the botanical systems published up to that point, his *Classes plantarum*. In this book, *Capraria* is found among the *Regulares Monopetali* in Christian Gottlieb Ludwig's (1709–1773) system. In Linnaeus's own *Methodus a Calycis Speciebus*—a system based on the morphology of the calyx and presented as an alternative to the Sexual System in *Classes plantarum*—it is found in the class *Inaequales Monopetali*. *Capraria* thus seems to comprise species with regular and irregular calyces; see Linnaeus (1738), pp. 266, 430. Louis Éconches Feuillée (1660–1732) was a member of the Order of the Minims, explorer, astronomer, geographer, and botanist. He travelled through South America in 1707–1711 and published a *Journal des observations physiques, mathématiques, et botaniques* (Feuillée, 1714).

[26] *Radiola* is a monospecific genus that some twentieth-century botany text books still distinguish from *Linum* with over 200 species on the basis of its quadriradial symmetry (*Linum* flowers are quinqueradial); see, for example, Cronquist (1981), p. 760. In Linnaeus's sexual system *Linum* and *Radiola* Dill. were listed separately under the *Tetrandria* and *Pentandria* respectively, but linked again by cross-references (see Linnaeus, 1735b, *Regnum vegetabile*). On Dillen see n. 61.

[27] Linnaeus considered *Agrifolium* as a synonym of *Ilex*, and also referred *Dodonaea* to this genus, retaining the name for a wholly different plant genus (Linnaeus, 1737d, p. 144). On Plumier see n. 63.

[28] Linnaeus's sexual system distinguished between monoecious and dioecious plants in the terms employed here (*androgyna* and *sexu distincta*). Thus *Urtica* is found in two classes, the *Dioecia* and the *Monoecia*, although again linked by cross-references (see Linnaeus, 1735b, *Regnum vegetabile*).

[29] *Systematicus*, a technical term Linnaeus used to designate botanists who had proposed taxonomic systems; see Linnaeus (1736), aph. 24.

[30] The expression *dolent haec fata* is ambivalent, as it can both mean 'lamented this fate' and 'suffered this fate'. Eighteenth-century translations usually opt for the first version, wrongly assuming that the preceding sentence refers to 'systems' rather than 'systematists'. Linnaeus opposed 'true' botanists and 'amateurs' (*botanophili*), the latter category including physicians, pharmacologists, and gardeners; see Linnaeus (1736), aph. 24.

[31] *Nota*; this expression refers to single characters or marks of plants, in contrast to the expression *character*, which Linnaeus used synonymously with definition, and which can refer to a complex set of characters. In order to avoid confusion, we will render *nota* as 'feature', and *character* as 'character'.

[32] This is probably a reference to Linnaeus's *Methodus a Calycis Speciebus* (see n. 25).

[33] These references point to two aphorisms in Linnaeus (1736), and the first four aphorisms under the heading *Observationes in regna III naturae* in Linnaeus (1735b). The aphorisms contain Linnaeus's theory of plant reproduction and his version of the history of creation.

[34] Paul Hermann (1646–1695) travelled to Ceylon as a Medical Officer of the Dutch East India Company between 1672 and 1677. In 1679 he took up the Chair of Botany at the University of Leiden and prepared a catalogue of the university garden (Herman, 1705). His *Musaeum Zeylanicum* (Herman, 1717), a flora of Ceylon, was put together posthumously from notes and collections by W. Sherard (n. 61).

[35] John Ray (1727–1605) was one of the most innovative naturalists before Linnaeus. He experimented with a number of literary formats in natural history, and proposed a similar species concept to that of Linnaeus. His most famous work in botany was *Historia plantarum: Species hactenus editas aliasque insuper multas noviter inventas & descriptas complectens* (Ray, 1686). Ray was educated at Cambridge University where he held various college offices until 1662, when he left Cambridge unable to subscribe to the Act of Uniformity. He travelled extensively through Britain and Europe with his student Francis Willughby, and became a member of the Royal Society in 1667. Ray became involved in a debate about proper botanical method with Tournefort (n. 21) and Rivinus (n. 37) around 1700.

[36] Christian Knauth (1654–1716) was a German physician, based at Halle, who published a *Methodus plantarum* (Knauth, 1716) that arranged 1500 species in a consecutive branching diagram.

according to the *shape of the corolla*; Rivinus[37] according to the *number and equality of the petals*; Magnol[38] according to the *calyx*. And none of these methods did any harm. On the contrary, if worked out well, they are of utmost utility, as they let us see how much this or that part of the fructification under consideration is worth in this or that natural class. If you take the easiest path to arrive at genera, then the method hardly matters. Instead, the method that is to be preferred over the rest is the one that leads to the genera by the more certain and trouble-free path, and the one that is the most universal. For I believe there is hardly anyone |p. 6| born with such a memory that he could retain the genera without a system. The method must therefore lead the way; for orders are subaltern classes. And no one will deny that it is easier to distinguish a few genera than all at once. I do not deny, however, that natural classes can be given as well as natural genera. And I do not deny that a natural method will be much preferred to ours and all methods invented. But I laugh at all natural methods hitherto proclaimed. And provoked to my defence, I venture to affirm that not a single class given so far, in any system, is natural, as long as such genera and such characters that are currently used are serving under them. It is easy to refer the greatest part of known genera to their natural classes, but the more difficult to do this for the rest. And it is not possible to hope that our age will be able to see any natural system, nor perhaps will posterity. Nevertheless, we are striving to know the plants; so meanwhile artificial and substitute classes have to be assumed.

10. Having assumed natural Genera (6, 7), two things are required to keep them pure and well inculcated, namely that true species, not others, are reduced to their genera (about which elsewhere); and that each Genus is circumscribed by true limits and terms, which we call *generic characters*.[39]

11. Such *characters* (10), while I read over the authors, I do not find certain and fixed before *Tournefort*, so that to him therefore we ought to concede the honour of invention in regard to genera. There were also other botanists of other schools, but I understand no other [characters] than his, and the ones by those who put on his clothes, like *Plumier*, *Petit*,[40] *Boerhaave*, *Vaillant*,[41] *Dillen*, *Rupp*,[42] *Pontedera*,[43] *Buxbaum*,[44] *Micheli*,[45] and a few others. For the most part, they followed Tournefort in the genera, although they stepped back from his classes and orders, or method. Tournefort assumed *petals and fruit* as the diagnostic features of plants, not other parts; and so did almost all his followers. But the more recent [botanists], overwhelmed by the quantity of new and lately detected genera, understood that those parts alone were not sufficient to distinguish all genera. And therefore they believed themselves forced to take recourse to the habit and appearance of the plant, namely to the leaves, the situation of the flower, the stem, |p. 7| the root etc.; that is, they chose to recede from the foundation of the fructification (7) and to step back to the former barbarism. It would be easy to show—if time and place did not prohibit it at present—with what ill omen this was done. However that may be at last, I do acknowledge that these parts [petals and fruit] are not sufficient, and the same has so clearly been demonstrated by Heister[46]

[37] Augustus Quirinus Rivinus (also called Bachman, 1652–1723) was a German physician, botanist and astronomer, who practised and lectured in Leipzig. His *Introductio generalis in rem herbariam* (Rivinus, 1690) was remarkable, because it ignored the traditional distinction of trees and herbs.

[38] Pierre Magnol (1638–1715) was the son of an apothecary and studied medicine at Montpellier. He had close connections with Tournefort (n. 21) and became professor of botany at Montpellier University in 1694. He produced floras of the surrounding areas of Montpellier, the Alps, and the Pyrenees and presented his system as a *Prodromus historiæ generalis plantarum* (Magnol, 1689).

[39] *Characteres genericos*; *character* derives from the Greek word for a tool to brand animals or stamp coins with, metonymically also designating the signs thus produced. It was used as the title for an ethico-psychological treatise by Theophrastos of Eresos (390/371?–287? BC), a student of Aristotle who authored the important botanical works *Historia plantarum* and *De causis plantarum* (Theophrastos, 1968, 1976–1990). Linnaeus used it as a synonym for 'definition' (*definitio*); see Linnaeus (1736). The expression was used in this sense already in Tournefort's *Institutiones* (Tournefort, 1700).

[40] François Pourfour du Petit (1664–1741), military physician and anatomist at the *Académie des Sciences*, who published *Lèttres ... La troisième lettre contient une critique sur les trois espèces de Chrysosplenium des Instituts de Mr. de Tournefort* (Pourfour du Petit, 1710).

[41] Sébastien Vaillant (1669–1722), successor of Tournefort (n. 21) at the *Jardin du Roi*. Vaillant's *Discours sur la structure de fleurs* (Vaillant, 1718), arguing for the sexuality of plants and containing descriptions of a few new genera, one of them named *Boerhaavia*, had a huge influence on the young Linnaeus.

[42] Heinrich Bernhard Rupp (1688–1719) studied medicine at Jena, Leiden and Gießen, where he met Dillen (n. 61). He botanized extensively in the German countries, and authored *Flora Jenensis sive enumeratio plantarum* (Rupp, 1718).

[43] Giulio Pontedera (1688–1757) was professor of botany and director of the botanical garden at Padua. In 1720 he published his major botanical work, *Anthologia, sive de floris naturae libri tres* (Pontedera, 1720), in which he argued for the sexuality of plants, using figures from Tournefort's *Élemens* (n. 21) for illustration. Pontedera corresponded with Linnaeus and wrote important commentaries on ancient agricultural works (Pontedera, 1740).

[44] Johann Christian Buxbaum (1693–1730) studied medicine in Leipzig, Wittenberg, Jena, and Leiden, and published a flora of Halle (Buxbaum, 1721). In 1722 he was invited by Peter I (1672–1725) to arrange a pharmacological garden for the medical college in St. Petersburg. Buxbaum accompanied a diplomatic mission to Constantinople in 1724, and afterwards published a series of accounts of plants collected in Greece, Asia minor, and Armenia (Buxbaum, 1728–1740).

[45] Pierantonio Micheli (1679–1737) was a gardner and self-taught botanist, who was appointed director of the Florence gardens in 1706 by Cosimo III de Medici (1642–1723). Micheli is especially known for his discoveries relating to the reproduction of mushrooms. In 1729 he published his *Nova plantarum genera juxta Tournefortii methodum disposita quibus plantæ MDCCCC recensentur* (Micheli, 1729).

[46] Lorenz Heister (1683–1758) was a well known surgeon and anatomist at the University of Helmstedt. The argument Linnaeus refers to here was laid out in *Dissertatio botanica de foliorum utilitate in constituendis plantarum generibus iisdemque facile cognoscendis* (Heister, 1732). Heister later also wrote a polemic against Linnaeus's sexual system (Heister, 1741), and a preface to a text by Johann Heinrich Burckhard (1676–1738), which disputed Linnaeus's claims to priority (Heister, 1750).

for both, that it would be superfluous to add more. And indeed, if it were only the petals and fruit that counted, I would completely deny and reject the mystery of fructification. But I ask, what reason should ever have taught that only those features should be taken? What observation by one's own eyes taught it? What revelation? What argument derived a priori or a posteriori? Certainly none of these, if not mere authority. We do not accept any authority in botany but autopsy [i.e. observation with one's own eyes]. And are there not manifest to us many more parts in fructification? Why are these acknowledged, but not the others? Did not he, who created those, also create the others? Are not those parts just as necessary in fructification as any of the others? The [parts] of the CALYX manifest to us are: 1. *involucrum*, 2. *spatha*, 3. *perianthium*, 4. *amentum*, 5. *gluma*, 6. *calyptra*; of the COROLLA, 7. *tubus* or clawed petals, 8. *limbus*, 9. *nectarium*; of the STAMENS, 10. *filamenta*, 11. *antherae*; of the PISTIL, 12. *germen*, 13. *stylus*, 14. *stigma*; of the PERICARPIUM, 15. CAPSULA, 16. SILIQUA, 17. *legumen*, 18. *nux*, 19. *drupa*, 20. *bacca*, 21. *pomum*; the SEMEN 22. and its 23. *corona*; the RECEPTACULUM 24. *of the fructification*, 25. *of the flower*, 26. *of the fruit*.[47] Truly, there are more parts, more letters here, than letters of languages, or alphabets. All these features are to us the letters of plants, and once read, they will teach us the characters (10) of plants. These were inscribed by the Creator. It will be our duty to read them.

12. Without detracting from *Tournefort's* great merits, I nevertheless deny that his *characters* are perfect. I deny that one can distinguish genera by them. And I would not prefer his characters to others, if he had not added figures or drawings of the fructifications, which render his genera much more intelligible. And if the illustrator had not discovered more things than the author had in the definition, the author would have had far fewer followers. Most of the illustrator's figures elucidate more parts, more features, the shape of the flower etc., than the description.

13. I do not recommend drawings (12) for determining genera—in fact, I absolutely reject them, although I confess that they are of great importance to boys, |p. 8| and to those who have more brain-pan than brain.[48] I confess that they convey something to the unlearned. Before the use of letters came to be known by mortals, wherever the sound of the mouth could not be heard, everything had to be expressed by pictures. But as soon as letters were invented, there was an easier and surer way to communicate ideas by writing. So too in botany, figures afforded great assistance before the letters (11) were discovered. But once those were given, there was a shortcut. We have twenty-six letters (11) with which we will write down our ideas.

α. Who could ever deduce a firm argument from a drawing? But from written words, it is easy.

β. If one wants to use or review a generic character in some book, one cannot always easily paint, engrave, print, and publish a picture; however, it is easy with a description.

γ. If in one and the same genus, as in most genera, parts differ by number and shape among distinct species, I would nevertheless be obliged to note the situation and proportion of the parts. I cannot express this in any way in a drawing unless I give as many figures. Therefore, if there were 50 species, and just as many different ones, I would have to deliver just as many pictures. Who would be able to extract any certainty from such a multitude? But to omit the differing parts from a description and to describe those agreeing is a much easier task, and easiest for the intellect.

14. We will therefore try to express by words all features just as clearly—if not more clearly—as others with their splendid drawings. The first to urge this path was the *incomparable* BOERHAAVE.[49] But no one has yet tried to travel with him down the road he opened. How wonderful is the understanding of man! How wonderfully the eyes are blinded by the noonday sun!

15. Generic characters (11) are obtained in a three-fold manner, to wit, *artificial*, *essential*, and *natural*; F[undamenta] B[otanica, aphorisms] 186–302.[50]

16. The *artificial* (15) character imposes a unique feature on a genus, by which that genus is distinguished from the rest of the genera displayed under the same order[51] (but not from genera in other orders). This kind of character is the easiest for the intellect, and it is provided in dichotomous or synoptic tables, as done by Ray (in the editions preceding the Synopsis),[52] Knauth,[53] and Kramer.[54] If indeed there never were any doubts about the class[55] or

[47] All of these terms, designating the elements of Linnaeus's morphology, are technical terms, so we have left them in their Latin original; for explanations see Linnaeus (1736), Ch. 4.

[48] This was one of Linnaeus's favourite formulations; he obviously thought it was funny.

[49] This concession of priority to Boerhaave, repeated in aphorism 18, seems to have been a strategic one. It is true that the latter's *Historia plantarum* (Boerhaave, 1727) contains generic descriptions. But these descriptions were much more unsystematic than Linnaeus's 'natural characters' of genera, containing, for example, a lot of pharmacological information. Linnaeus deleted these references to Boerhaave in the sixth edition of *Genera plantarum* (1764).

[50] Linnaeus (1736), aph. 186–302. This section from *Fundamenta botanica* is part of a chapter titled *Characteres* and contains Linnaeus's theory of generic definition.

[51] '*Ordo*', a term Linnaeus reserved for the level above genera in his hierarchy of taxonomic ranks; see ibid., aph. 155.

[52] Ray (1690). Ray made use of dichotomous diagrams in his *Historia plantarum* (Ray, 1686).

[53] Knauth (1716).

[54] Kramer (1728). Kramer (d. 1744) was a military physician. A second edition of his *Tentamen* appeared in 1744 in Vienna.

[55] *Classis*, the highest rank in the Linnaean hierarchy.

order, and if all the genera existing in natural things |p. 9| were discovered, this would be easier than the other two [kinds of characters]. But since they have not been discovered, nor ever could be, the character is erroneous and leads into error. For whenever someone discovers some new genus, its neighbouring genera become wrong and all the characters, which spring from the branch, to which it has to be connected.

17. The *essential* (15) character supplies the genus, to which it is applied, with a single and most characteristic feature. It recommends itself through succinctness and certainty—Parnassia [grass-of-parnassus, bog-star], Nigella [black cumin, kalonji], Helleborus [hellebore], Ranunculus [buttercup, spearwort], Aconitum [monkshood] are easily recognised by the nectaries alone. But I doubt very much that this can ever be obtained in all genera. Indeed, I would much like to see essential characters in umbellifers and elsewhere.

18. I therefore propose *natural* (15) characters here, which exhibit all obvious and common features in fructification. Nobody, as far as I know, has given such characters, though, as we said (14), the *incomparable* BOERHAAVE has envisioned them.

The uses and advantages of natural characters are:

α. This kind of character is applicable to all methods proposed or to be proposed, as long as the system is built on the indestructible foundation of fructification. Let any one take his method from the calyx, the corolla, the stamens, the pistils, or the fruit: still our character will remain the same, as long as the genus is the same. Formerly, it was necessary to compose as many characters of all genera as there were systems produced. But given these natural characters, that is no longer the case.

β. Even if a thousand new genera were discovered, it would not be necessary to add or remove a single feature because of a neighbouring natural genus, whereas this was inevitable in all other systems.

γ. It is possible to provide this character or this genus definition without a method, in whatever book you please, and it can be kept in mind and understood [on its own] as perfectly as when it is ranged under its class.

δ. It expresses the same idea, even if the names should change a thousand times.

ε. You see more features than are necessary to distinguish the genus in question from others. This confirms that you have this genus for certain, not another. Should any features be superfluous, |p. 10| that must be determined by posterity once all genera are discovered.

19. I have selected certain and real, not vague and shaky features while describing the various parts of fructification. Others often assume taste, smell, colour, magnitude (without [paying] attention to proportion). Such you will never see adduced by me, but only those four certain and firm mechanical principles: *number*, *shape*, *situation*,[56] and *proportion*.[57] These four attributes, together with those twenty-six letters (11) distinguish the genera so certainly from each other, that nothing more is wanted. Beyond considering these features on their own, there is no lack of features for determining genera; but these features become superfluous. Nor is there any necessity to take recourse to the habit[58] of plants.

20. In setting up such a character, all species discovered so far have to be considered. The four features (19) have to be described properly for each of the obvious parts of fructification. Those which do not come together in all species have to be excluded—only those that do come together should be retained. And as there is no one man who sees all species, it is the duty of the one who sees the most and observes the differing features among them to exclude these from the character, so that posterity may see the labours completed.

21. I foresee that many will find it difficult to study the very small parts of fructification, certainly those who want a doctrine without labour. Nevertheless I do not see that there is a more certain way. For example, no one would deny that all animals, even the insects, should be distinguished by inscribed features or the structure. Therefore, if an insect was so small that it could hardly be seen by the eye, you must nevertheless go through its features before you can know if it is a Monoculus [a copepod] or an Acarus [a mite]. And so it is also in plants. All that I have described, I have seen with the naked, unarmed eye. Nor will this work be harder for us than any other, but instead it will be pleasant and congenial.

22. I have understood that the flower must by far be preferred to the fruit in determining genera, even if others have long felt otherwise;[59] and that the nectaries deserve greater attention for determining genera than any other part, though they were completely neglected and held for nothing by others—so much so that they did not even have a distinct name.

23. Nobody should fear new names; you may invent new ones, if they do not please, or keep the mentioned synonyms, if they please |p. 11| better. The reasons why I have changed names, I shall give in CRITICA BOTANICA, which now goes into press,[60] and my arguments will have greater weight than you might at first divine.

[56] *Situs*, that is, relative position of a part with respect to other parts.
[57] *Proportio*, that is, relative size of a part with respect to other parts.
[58] *Habitus*, that is, the overall appearance, or *gestalt*, of a plant; see Linnaeus (1736), aph. 168.
[59] Cesalpino (1583), pp. 27–28, suggested dividing plants by characters of the fruit first.
[60] Linnaeus (1737a). This was an extended version of Chapters 7 to 9 of Linnaeus (1736).

24. I did not trust any authors with the exception of the famous *Dillen* in his Hortus Elthamensi,[61] *Rheede* in his Hortus Malabaricus,[62] whom I have observed to be most accurate; and *Plumier* on American [plants],[63] who, though I trust him less, was still necessary, where no other authors were available. I have, therefore, made careful distinctions: I put an *asterisk* * where I was allowed to examine living plants; a *cross* † where I only could get dried plants; and no sign, where I have seen nothing, but had to trust authors and their good drawings.

25. I have expressed my ideas *with as few words as possible*, caring more for weighty words than pompous and eloquent Latin phrases.

26. I have used few *technical terms*, and hardly any that are not well known to everybody; I have never adduced *magnitude* as a feature except in relation to other parts. Where doubts occurred, I have been more anxious to escape from vain disputes than to enter into them, as, for example, where there was doubt about calyx and corolla. The flower bends according to the *course of the sun*, or against it, as I have called it from common understanding; what others call to the left is to the right, or the other way round.

27. I do not treat *species* here. They will be recognised easily by the botanist from the characters given. Anyone who wants them from my principles may in part look for them in FLORA LAPPONICA,[64] but the greatest part he may take from HORTUS CLIFFORTIANUS,[65] which the splendid owner of this splendid garden[66] will not hesitate to publish very soon.

28. Striving for brevity, I refrain from giving the definitions of the parts of fructification, as they will easily become clear to everyone who studies this or that flower, or simply from the schema published in the *Systema Naturae*.[67]

29. The *use* of some botanical system I do not have to recommend even to the beginner, as without it there would be no certainty in botany. Two learned persons, one a taxonomist, the other an empiricist, may enter a garden stuffed with exotic and unknown plants |p. 12| and equipped with the best botanical library. The taxonomist will, by reading the letters of fructification (11), easily track the plants back to their class, order and genus; and once that is done, only a few species will be left to distinguish. The empiricist will persist in turning over all the books, reading all the descriptions, and looking at all the drawings with unceasing toil; and still he will not be sure about the plant, except by accident.

30. To say more by way of preface, I find superfluous. Whoever wishes, can find the reasons and laws of our theory in our *Fundamenta Botanica*.[68] Whoever wants more about our sexual method may read over our *Systema Naturae*, published in Leiden, 1735, in which we explicated our classes in three ways and demonstrated a priori the value of our method through the sex of plants, along with the general use of natural classes.[69]

31. Accept therefore these our [results from a] decade of hard work; and, as an upright judge of these matters, consider them fair and good. You will know that these really should not be the work of someone my age, but of elders a hundred years old. We ourselves knew this too and therefore intended them for those later years. But exhausted by the labour, persuaded by the advice of friends, and instructed by the often unexpected fates of long efforts, we finally seized the opportunity to publish: for our great patron, the most noble and generous GEORGE CLIFFORD, Doctor of Laws, who deserves eternal veneration, offered a museum, a garden, travel expenses, and the best and happiest life.

32. Finally, the only thing left to do is to thank those, who communicated rare plants for examination. These

[61] Johan Jacob Dillen (1687–1747) was a German who published a catalogue of plants growing around Gießen (Dillen, 1719). In 1721 he went to England on the invitation of William Sherard (1659–1728) and published a famous catalogue of the garden owned by the Sherard family, *Hortus Elthamensis* (Dillen, 1732). Linnaeus met Dillen when he visited Oxford in August 1736.

[62] Rheede tot Draakenstein (1678–1693). Hendrik Adriaan van Rheede tot Drakenstein (1636–1691) was a nobleman who collected plants in South Africa and the Malabar region (Southern India) for the Dutch East India Company. As the Dutch Governor of Cochin he began to collect on a grand scale, building up an enormous network of local informants and collaborators. The later volumes of *Hortus Indicus Malabaricus* were edited by Jan Commelin (1636–1693), professor of botany in Amsterdam.

[63] Charles Plumier (1646–1704) was a French botanist and, like his student Feuillée (see n. 25), a member of the Order of the Minims. Plumier explored the Antilles and Central America. In 1703–1704 he published *Nova plantarum Americanarum genera* (Plumier, 1703–1704), a work on which Linnaeus much relied.

[64] Linnaeus (1737b). This publication reports botanical observations that Linnaeus made during his journey to Lapland in 1732.

[65] Linnaeus (1737d, actually published in 1738). This was a catalogue of George Clifford's botanical collection (see note 66).

[66] George Clifford (1685–1760). Clifford belonged to a family of bankers and merchants of English origin and was enormously rich. He engaged Linnaeus in 1735 to catalogue his botanical collection, housed on his estate in Hartekamp near Haarlem. He also financed Linnaeu's trip to England in the summer of 1736, to acquire seeds and plants from botanists there.

[67] This probably refers to the one-page representation of the twenty-four classes of the sexual system that the famous plant illustrator Georg Dionysus Ehret (1708–1770) produced in 1736. The illustration was integrated into later editions of *Genera plantarum*. It shows stamen and pistils of representative genera of the classes, not really all the 'parts of fructification'.

[68] Linnaeus (1736).

[69] Linnaeus (1735b). Aphorism 12 under the heading *Observationes in regnum vegetabile* distinguishes between artificial and natural systems, and claims that the former are 'substitutes' for the latter. Linnaeus referred to his sexual system as 'artificial' in this context.

were: O[lof] Rudbeck,[70] Professor of Botany at Uppsala; O[lof] Celsius, Prof. of Theology at Uppsala;[71] K[ilian] Stobaeus, Professor of History at Lund;[72] J[ohann] H[einrich] Spreckelsen, Doctor of Law, Hamburg;[73] G[eorge] Clifford, Doctor of Law; J[ohann] F[riedrich] Gronovius, Doctor of Medicine, Leiden;[74] J[ohannes] Burman, Professor of Botany at Amsterdam;[75] A[driaan] v[an] Royen, Professor of Botany at Leiden;[76] J[ohann] J[acob] Dillen, Professor of Botany at Oxford; H[ans] Sloane, President of the Royal Society, England; Ph. Miller, Head of the Chelsea Garden.[77]

Farewell, reader, and enjoy good health. I wrote this in the Cliffortian Museum on 20. November 1736.

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[70] Olof Rudbeck jun. (1660–1740) was professor of medicine at Uppsala University while Linnaeus was studying there 1728–1731. Rudbeck did not lecture, however, being occupied with the compilation of a *Thesaurus* of all European and Asiatic languages. He had made a scientific expedition to Lapland as well in 1695, and returned with a huge number of drawings of birds and plants.

[71] Celsius (1670–1756) was professor of theology at the University of Uppsala. Working on a book dealing with the plants mentioned in the bible (*Hierobotanicon*), he offered Linnaeus free lodging and the use of his library during the latter's student years.

[72] Stobaeus (1690–1742) was professor of medicine at Lund University, which Linnaeus visited in 1727–1728. Like Celsius, he was a keen amateur botanist, and offered Linnaeus free lodging.

[73] Spreckelsen was a lawyer in Hamburg who owned a botanical garden. Linnaeus met him in 1735 when passing through Hamburg on his way to Holland.

[74] Gronovius (1686–1762) had helped Linnaeus financially in publishing *Systema naturae*, together with Isaac Lawson, a Scottish doctor.

[75] Burman (1707–1779) had invited Linnaeus to stay at his house in the summer of 1735, to assist him in the publication of his *Thesaurus Zeylanicus.*

[76] Van Royen (1704–1779) was the successor of Boerhaave as head of the botanical garden, and tried to entice Linnaeus to stay in Leiden in order to reorder the garden according to the sexual system.

[77] Linnaeus had met Sloane and Miller during his short stay in England in the summer of 1736.

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