

# Multiple Independent Inventions of a Non-functional Technology

Combinatorial Descriptive Names in Botany, 1640-1830

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**Abstract** Historians and sociologists of science usually discuss multiple independent inventions or discoveries in terms of priority disputes over successful inventions or discoveries. But what should we make of the multiple invention of a technology that not only gave rise to very few priority disputes, but never worked and was rejected by each inventor's contemporaries as soon as it was made public? This paper examines seven such situations in the history of botany. I devote particular attention to the inventors' cultural and educational backgrounds, focussing in particular on the scholastic education most of them shared, through which they would have become familiar with Lullian combinatorics and the mnemonic names used to distinguish syllogistic moods. I also examine their conceptions of the roles of nomenclature in botany, their assumptions about how memory works, their awareness of other similar efforts, and their contemporaries' reactions to their proposals. I suggest that an evolutionary epistemology of invention may be the middle ground between the chaos of multiple paths suggested by many microhistories and the overly deterministic view that macrohistorical studies often present. Finally, I reflect on the impacts that a consideration of multiple independent inventions of failed technologies may have on current approaches to the history and sociology of science.

Multiple discoveries of a natural phenomenon or multiple inventions of a technology are a staple of the history of science. The literature treats multiple inventions and discoveries as equivalent because it is so difficult to differentiate between common contingencies coming from a shared reality or a shared perception of reality.<sup>1</sup> Multiple discoveries or inventions—"multiples," for short—are usually explained in terms of the similarities of social experiences of the inventors and their awareness of earlier research that serves as a foundation for their work. Sociologist of science Robert Merton summarized the findings of

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<sup>1</sup> The multiple I discuss here is the reinvention of a kind of technology, following Thomas Hughes, who uses "technology" to refer to "technological or sociotechnical systems" as well as physical artifacts (1994, 102).

previous research into multiples, writing, “The innovations became virtually inevitable as certain kinds of knowledge accumulated in the cultural heritage and as social developments directed the attention of investigators to particular problems” (Merton 1961, 475). Merton was concerned with demonstrating the reality, ubiquity and importance of multiples in the sociology of science. His work and the work of others after him who wrote on multiples and their causes (such as Kuhn 1959; Simonton 1986 and 2003, Lamb and Easton 1984) therefore focus on the roles of social interactions among scientists in scientific creativity, scientific “genius,” and priority disputes concerning successful research programs. They were concerned about what multiple discoveries of natural phenomena might imply in terms of technological determinism. They were not interested in multiple independent failures.

One of the few sociologists of science who did mention failures, Augustine Brannigan, even went so far as to say that “we would find it extremely curious or bizarre to find historians and sociologists of science applying the cognitive explanation of discovery to scientific *failures*” because “a theory of discovery should not focus on how ideas came into the mind, or how they evolve as the culture matures, but how they are *defined* as discoveries.” For Brannigan, restricting analysis to the social negotiation of what counts as a discovery was a way to avoid the slippery slope of technological determinism by staying away from teleological interpretations of how and why given discoveries occurred when they did (Brannigan 1981, 40, 152).

Unlike Brannigan, I believe that multiple independent inventions dismissed as failures by the inventors’ peers reveal important things about the social aspects of science. In fact, there is nothing quite like a multiple, independent failure—reinvention of a dud—to highlight the assumptions inherent in a researcher’s cultural heritage. Multiple duds are background assumptions brought to the foreground and writ large. They illustrate attempts to solve common problems with inappropriate tools, or to combine common ideas in unsuccessful ways. Their existence testifies to an unequal distribution of knowledge among scientific practitioners, since inventors of multiple duds<sup>2</sup> are not only unaware of the invention of previous, similar approaches, but also of their failures: even those inspired by previous duds, or who plagiarize earlier duds, misjudge their proposals’ potential for success. The approach taken by the dud-makers was just one of many different tacks taken to improve specimen identification and botanical nomenclature from the mid-17<sup>th</sup> century to the mid-19<sup>th</sup> century. I have discussed many of the other methods that contemporary botanists explored in other publications (Scharf 2007; Müller-Wille and Scharf submitted 2008; Scharf 2008). My research into pre-Darwinian botanical classification and nomenclature schemes has also led me to believe, also unlike

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<sup>2</sup> I refer to failed inventions as “duds” in this paper because the word “dud” is shorter and catchier than “invention judged to have been ineffectual by the inventor’s peers,” rather than to trivialize the efforts that each inventor put into devising a solution to the technical problems faced by botanists of his time.

Brannigan, that addressing the teleological aspects of successful scientific research programs head-on may be a fruitful approach to understanding scientific discovery. The existence of multiple duds, for example, supports an evolutionary epistemology for scientific development: duds are attractive enough to be invented multiple times, but they are also repeatedly rejected as flawed. Duds can, in fact, be seen as “dead ends” in the evolution of ideas. In this case, multiple duds are inevitable by-products of the “constrained stochastic behavior” of scientific creativity, in particular, the independent actions of people trying to solve similar problems in similar ways, with similar, though inappropriate, tools (Simonton 2003 and 2004, particularly pages 91 and 184). An evolutionary epistemology of invention can account for the erratic and yet sometimes seemingly teleological development of successful scientific research programs, as well as the occurrence of multiple duds. It may well be that an evolutionary epistemology of invention is the long-sought middle ground between the chaos of many unconnected “micro” case studies and the overly deterministic slant that *longue durée* or “macro” studies tend to take (Misa 1994, 119).

In this paper I describe the multiple reinvention of a technique for referring to plants by “names” formed from combinations of letters, each of which codes for a particular plant feature. I examine in turn the common problems each of the inventors tried to solve, the common approaches or solutions they devised, the shared assumptions they held, and why these assumptions caused the proposed solutions to fail. Finally, I explore the possible implications these multiple reinventions have for typical approaches to the history of science.

#### *A Common Problem: Large Numbers of Plant Species and Even Larger Numbers of Names for Them*

One problem that naturalists studying plants increasingly faced during the 17<sup>th</sup>, 18<sup>th</sup>, and 19<sup>th</sup> centuries was how to keep track of large numbers of plant species. The Bauhin brothers had described more than 6,000 kinds in the 1620s. This number ballooned to over 18,000 in the works of John Ray only 80 years later, and the rate of discovery continued to increase. Botanists recognized in the mid-17<sup>th</sup> century that there were far too many known kinds of plants to allow for the memorization of their names, let alone information about each one. And yet, there had to be some way to differentiate each plant from others. To make matters worse, multiple names—synonyms—often referred to the same plant. It was widely recognized that eliminating synonyms would do many great things for botany. It would cut down the number of plant names in circulation, clear up priority disputes, consolidate partial descriptions so that poorly known species could be understood better, and reduce the amount of time spent tracking names—something that everyone agreed was a tedious bore.

Synonyms come about for practical reasons. First, not everyone becomes aware of the existence of a given plant at once, and, second, identifications are not always precise.<sup>3</sup> One way to solve the first problem would be to somehow broadcast the name and a description of a plant around the world once it had been described and named. But during the 18<sup>th</sup> century, there was no central registry for names, and no formally codified rules about who could name what, or how complete partial specimens had to be, etc. Furthermore, the transit of books, letters and journals to the totality of the community of naturalists, then inhabiting every continent save Antarctica, was slow and erratic. Eventually, naturalists' frustration with these very issues led them to establish codified rules governing nomenclature in the 19<sup>th</sup> century, later formalized in the late 19<sup>th</sup> century as the ICBN (for plants) and the ICZN (for animals). Modified versions of these codes are in effect today. While the codes are far from perfect and will never satisfy everyone, they have brought a great deal of order to the naming of organisms. This makes the study of the state of natural history prior to the establishment of the codes particularly enjoyable. Until the Strickland rules of 1842, natural history was an especially vibrant free-for-all of interesting ideas and experiments to bring synonymy and related problems under control (McOuat 1996).

Clear communication about plants was a common need; there were also common limitations and tools.

#### *Common Tools*

Botanists in the 18<sup>th</sup> and early 19<sup>th</sup> centuries (and even earlier) found it convenient to describe plants in terms of obvious, preferably external morphological features. In practice, these were most often the numbers and positions of flower parts, as well as the general external shape of plants. These approaches had many practical benefits, since the numbers and positions of flower parts, and "life form" of plant species—tree, bush, vine, herb, and so on—are generally their most constant morphological attributes. Other plant parts vary much more from individual to individual within the same species—even within cuttings taken from the same source. This is one reason why it is much more difficult to distinguish different kinds of plants than different kinds of animals: most animals have fixed numbers of parts and are subject to less environment-induced variation (phenotypic plasticity). Botanists who wished to tell different plant kinds apart had to devote a great deal of effort to finding out which arrangements of parts are the most constant within plant groups. George Louis Leclerc, Comte de Buffon (1707-1788), attributed the contrast between the elaborate and reasoned classifications in botany and the lag in development of similar schemes in zoology to this difference between plants and animals. Echoing Buffon, the French botanist Louis-Marie-Aubert du Petit-Thouars (1758-

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<sup>3</sup> These problems of definitions varying in precision and of patchy communication among scientists are exactly the same ones that lead to multiple discoveries in science in general.

1831) wrote in 1788 that systems and methods of classification were first and most extensively developed in botany rather than zoology because there are more plants than animals, plants resemble each other more than do animals, and plants have fewer obvious body parts upon which to base classifications than animals have (Buffon 1749, tome II p. 10; du Petit-Thouars 1811, 27-30).<sup>4</sup>

Using descriptions of plants in terms of their easily visible outer parts was a matter of exigency. Other approaches to understanding plants did not develop fully during the 18<sup>th</sup> or early 19<sup>th</sup> century. Zoologists in the late 18<sup>th</sup> century, such as the comparative anatomist Georges Cuvier (1769-1832), began to use internal anatomy to characterize animal groups with great success, as well as making headway toward understanding the functions of animal organs. Comparative anatomy and physiology, however, turned out to be far less useful for studying plants. While many animal body functions are localized to particular organs that occur in particular places and in particular numbers, plant functions are more distributed throughout their bodies. Until microscopy became relatively cheap and widespread, and cell functions were better understood, plant anatomy and physiology were sufficiently alien to preclude causal explanations of plant growth, development and structure (e.g. Duméril 1806, x, and Candolle 1813, 59; Stevens 1994, 252 note 287, provides more references).

This situation made the classification of plants according to the numbers, shapes and positions of parts particularly useful as a framework of investigation. It is not necessary to know what leaves or stamens do in order to notice their shapes and modes of attachment, or to count them. It was a happy coincidence for 18<sup>th</sup> century botanists that they understood the function of stamens and pistils, which were also the most distinctive and constant flower parts in terms of shape, position and number.

Carl Linnaeus (1708-1788), the most influential botanist of the 18<sup>th</sup> century, used this situation to justify the appropriateness of his sexual system—based on stamen and pistil number and position—for classifying plants (Müller-Wille 1995, 45 and 2005, 90-91). The sexual system conveniently worked for identifying both live plants in the field and dried herbarium specimens, so long as the flowers were visible. However, flowers are not visible for all stages of a plant's life. Linnaeus, like a number of other 18<sup>th</sup>-century botanists, also strove to classify plants taking more of their features into consideration than just the flowers. His

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<sup>4</sup> The number of described plant species exceeded the number of described insect species until the last decade of the 19<sup>th</sup> century. The popular belief that there were more plants than insects persisted at least into the 1830s (e. g. Henderson 1832, 160), though the number of insect species estimated to exist by competent entomologists began to exceed the estimated number of plant species in the second quarter of the 18<sup>th</sup> century (Scharf 2007, 180). We now know that flowering plants are an evolutionarily young group composed of members much more closely related to each other and more similar in appearance to each other, on the whole, than, for instance, animals in different phyla.

“fragments of a natural method,” first published in *Classes plantarum* (1738), kept species he saw as related to each other together in natural genera. Because these genera were accepted as natural and relatively stable, Linnaeus referred to them as the “common currency” of botany. Full descriptions of natural groups of plants, what Linnaeus called their “natural character,” could work in any botanical system, regardless of whether the overall classification or nomenclatural schemes were completely different from each other (Linnaeus 2003, 142 § 189). Linnaeus clearly understood the value of keeping classification and nomenclature separate (e.g. Müller-Wille 2007, 542, discussing, in particular, a passage from the introduction to the first edition of *Genera plantarum* [Linnaeus 1737, lectori 2003, 141-143]). Keeping description separate from nomenclature allowed Linnaeus to use short and convenient binomial nomenclature and to avoid and advise against “generic names 1 ½ feet long, those that are difficult to pronounce” and, in particular, “words that contain more than 12 letters” (Linnaeus 2003, 214). Linnaeus’s suggested naming conventions were practical. Botanists all over Europe began adopting them in the 1750s, and by the 1780s, they were commonplace. Linnaeus’s separation of nomenclature from the descriptions used in plant classification is one reason why the binomial nomenclature he helped popularize is still standard, centuries after his sexual system of classification became obsolete.

Separating description from prescription and from naming, however, has always been tricky. Many 17<sup>th</sup>-, 18<sup>th</sup>-, and 19<sup>th</sup>-century botanists found the concept of descriptive names particularly attractive. At least seven different men living in six different countries and writing in four different languages independently invented—or claimed to have independently invented—variations on a technique for generating plant names using descriptions of the plants themselves. These descriptive naming schemes were meant to prevent synonyms from being formed in the first place. With this kind of system of nomenclature, a plant would get only one name, regardless of who was naming it. Descriptive names would also make botanical nomenclature less arbitrary than it had ever been.

As to be expected, the particulars of these descriptive naming schemes varied from inventor to inventor and bore the imprints of trends popular at different times in the history of botany. These differences, along with biographical details, lend credence to the likelihood that their inventions were independent. Still, there were sufficient similarities among the inventions to merit grouping them together as expressions of the same idea.

#### *Common Technology: Algorithms for Generating Names from Coded Descriptions of Their Features*

All of the schemes discussed in this paper were supposed to make botany easier to learn and communicate than ever before. Each involved a highly structured algorithm—a set of rules—for giving plants names embodying their descriptions. The rule sets were usually short and easy to remember:

1. Different plant features were each to be assigned a different letter:
2. A consonant came first,  
then a vowel,  
then a consonant,  
then a vowel, and so on.
3. Each letter had place value so that if it appeared more than once in the word, it would have a different meaning each time.
4. The combinations of letters that the technique generated were therefore pronounceable, compact descriptive names of plants.

The rules were simple to use. Botanists needed remember only a few traits of plants. Better yet, the meaningful names would be brief and memorable, far more so than the long Latin descriptions current before the 1750s. They would be superior to Linnaean names as well. With both long Latin descriptions and Linnaean binomials, botanists have to search through books to determine what to call a specimen. The use of naming algorithms would instead allow anyone who knew the rules about which letters stood for which properties and the order in which plant features should be named, anywhere in the world, to name a plant in exactly the same way, whether or not he had seen it before. These new systems of naming would eliminate the nomenclatural mess caused by both synonyms and the giving of the same name to different plants. Botanists would finally be freed from the need to buy and pore over expensive Latin tomes to identify specimens.

The benefits that these schemes would have brought to botany, had they functioned as their promoters described them, would have been great indeed. Yet, not one of these techniques became popular among botanists at large, and some were downright ridiculed. But clearly this kind of dud was attractive enough to inspire many different men to invent or claim to have invented it. How did they end up travelling down the same blind alley, and what can their misadventures tell us?

I will start with a brief discussion of each of the schemes in question, the circumstances under which it was produced, and how the botanical public received it.

### *The Schemes Themselves*

The first algorithmic plant naming schemes appear to have originated in the 1640s and 1650s amid a group of corresponding intellectuals who wanted to develop a universal language. Many of the men experimented with and made suggestions concerning both language reform and botanical classification. They included Marin Mersenne (1588-1648) (Salmon 1966, 392), Cyprian Kinner (?-

1649) (DeMott 1958, 6; Schulte-Albert 1979, 47-52), William Petty (1623-1687) (Slaughter 1982, 134; Lewis 2007, 66-67), Seth Ward (1617-1689) (Slaughter 1982, 133, 179), and John Wilkins (1614-1672) (Slaughter 1982, 160). Details of most of these schemes are scarce; however, Cyprian Kinner laid out his plan in a letter dated June 27th, 1647 to Samuel Hartlib (?-1662), the chief disseminator of scientific ideas of his age.

#### *Cyprian Kinner's Scheme (1645)*

Kinner was a Silesian lawyer and physician. He lived most of his life during the Thirty Years' War. Few details of his life are available, though he is known to have come from a wealthy noble family from the Silesian town of Brieg, where he studied at the same school as Samuel Hartlib. He travelled extensively, and had many intellectual correspondents. He was long interested in education and language reform, and had worked for a time in Transylvania with Johann Heinrich Alsted (1588-1638), an encyclopaedist. After he lost his family and fortune when the Imperial army invaded Silesia, "he offered his service in 1644 to the Czech reformer-in-exile Jan Amos Comenius (Komenský)" (1592-1670), Bishop of Brethren and a student of Alsted's, who hired him 1645 as collaborator on the revision of a language textbook.<sup>5</sup> It was around this time that he developed his scheme for naming plants (DeMott 1958).

Kinner's letter outlining his idea is paraphrased in a 1958 article by Benjamin DeMott. A few years before he wrote the letter, Kinner had explained,

in a period when he was considering ways of helping students of botany, he, too, had thought of devising technical words (*voculas technicas*). His notion was to fashion them so that every letter or syllable in them would have a specific meaning. Consonants in the first syllable would denote primary and secondary qualities ... vowels would denote the degree of qualities. The second syllable would express the peculiar power of the plant—curative, preservative, nutritive, or the like. The third syllable would signify even more particular details, as for example when and where the plant grows and how it is gathered. Some letters would necessarily be repeated in different syllables (the Latin alphabet not providing enough letters for all the information that would be expressed in the word), but the repeated letters could be arranged so that they would have different signification according to the syllable in which they appeared. And the syllables might be made to vary in length from one to three letters, so that the meaning of letters would then depend upon their place within the syllable: by such techniques the problem of repetition could be solved.

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<sup>5</sup> Quotation and biographical details of Kinner from Schulte-Albert 1979, 42, 47. Extra details about Alsted and Comenius from Lewis 2007, 131-132.



Kinner observes that a symbol made on this plan would be more than merely a new name for a plant, for to remember such a term would be to possess a compendium of the plant's powers and uses. And he contends that similar terms could be made for other classes of existing things [such as] elements [and] astronomical bodies (DeMott 1958, 6. Lewis 2007, 55-56, also discusses Kinner's botanical scheme).

Kinner gave a few tentative examples but did not expand on the scheme any further. His scheme may have influenced many people, though, care of Hartlib—including Bishop John Wilkins, author of the famous, Royal Society-sponsored *Essay towards a real character and a philosophical language* (1668).

#### *John Ray's Contribution to John Wilkins' Scheme (1668)*

John Wilkins' *Essay* was the largest and best-financed attempt at a universal language put forward during the last half of the 17th century. In many respects, it is a test case for what happens when a dud has strong institutional backing.

Wilkins was a powerful man. He was friendly, somewhat dogmatic, bright, and he had very influential friends—for instance, he was married to Oliver Cromwell's sister (Maat 2004, 136). He was a founding member and the first secretary of the Royal Society, and he became the Bishop of Chester by 1668 (McMahon 2001, 240). He had been working on his own universal language based on Hebrew in the 1640s, but he neglected that sort of research until after he met Scottish language reformer George Dalgarno (1616?-1687) and collaborated on his project (Maat 2004, 137-138). Although both men had similar ideas of how to come up with the individual words for things, they made different assumptions about how memory works and how much it can retain. These assumptions affected the degree to which they expected the vocabularies of their languages to reflect their classifications and how they thought their languages would best be employed. By the end of 1657, Dalgarno and Wilkins had a falling out about these issues and went their separate ways (Maat 2004, 50-55; Lewis 2007, 88-99).

Wilkins had originally completed his *Essay* in 1666. In September of that year, the printer had almost finished with it when most of the printed sheets and a good part of the manuscript were destroyed in the Great Fire of London (Maat 2004, 135).

After the fire, Wilkins resolved to put the book together again, bigger and better than before. He enlisted his friends to help with different sections. The naturalist John Ray (1627-1705) worked on the tables of plants.

Many historians, linguists, cryptographers and the like have written on Wilkins' scheme, so I will keep this commentary short. (See Maat 2004, and Lewis 2007, for a thorough treatment). Wilkins assembled words for concepts into tables in groups according to a hierarchy of kinds of his devising. There were

four levels in the hierarchy: genus, difference, species and numerical position. Within each species, items were mostly grouped in nines. Each had a particular place in the table. It could be expressed using numerical notation, for instance:

‘elephant’ occurs under the genus ‘beast’, and under the first difference, that is, ‘whole footed’, as the fourth species. To locate ‘elephant’ on the tables, one could write ‘18.1.4’, since ‘beast’ is the 18th genus on the list of genera, ‘whole footed’ the 1st difference under that genus, and ‘elephant’ the 4th species under that difference (Maat 2004, 167).

Wilkins had also provided for each of these location indicators to be expressed in words. Each genus was represented by a two-letter word. Each difference was indicated by adding a different consonant, and species were distinguished by the use of different vowels at the end. Using this notation, “18.1.4,” equivalent to “elephant,” could also be spelled “zibi” (Maat 2004, 158). The names for plants were to be formed in an analogous way.

Wilkins knew that his plan was flawed, though he believed it to be achievable in principle (Maat 2004, 142). John Ray thought otherwise, writing in a letter to a close friend that he thought Wilkins’ arrangement to be “most imperfect and absurd” (Ray 1848, 41-42—Ray to Martin Lister, May 7, 1669). A major complaint of his was that there were far too many plants to describe using such a scheme (Maat 2004, 207). Even by including only major groups of plants, and modifying the tables in the plant section to permit groups of up to 18 per “species”, rather than the usual limit of 9, the “Real Character” could distinguish among only one-eighth of plants known and described at the time it was published (Maat 2004, 208; Wilkins 1668, 67). It is likely that Ray’s frustration with Wilkins’ scheme for plant identification purposes played a large part in spurring him to develop what grew into his own “natural” method for classifying plants. And despite the Royal Society’s backing and some friends’ of Wilkins using it in their correspondence for a few years, Wilkins’ real character and philosophical language never caught on with the public. For instance, after Wilkins died, some of his friends tried to reform his scheme to make it more philosophically consistent, but most of their contemporaries did not think it merited any more attention (Lewis 2007, 198, 216). Historian Jaap Maat also describes several examples of the general disdain for the real character and schemes like it by the 1680s (2004, 265). Wilkins’ scheme was, in effect, a dud.

This dud was, of course, reinvented. A similar scheme specifically designed for use with plants came to light nearly three-quarters of a century later, in Sweden. But its inventor was not who might first come to mind.

*Christopher Polhem's Schemes (1739, 1741)*

Christopher Polhem (d. 1751) was born in December 1661 on the island of Götland, just east of the Swedish mainland in the Baltic Sea.<sup>6</sup> He was born to a merchant's family, but, orphaned at a young age and penniless, he had to work as a farm hand to support himself. Friendly priests who spotted his talents helped educate him and got him admitted to the University of Uppsala in 1687 at the age of 25. For much of his life, he was the leading mathematician in Sweden, and he was also one of the founders of the Swedish Royal Academy of Sciences in the late 1730s. A painting of Polhem, made by Johan Henrik Scheffel in 1741, now seen by Swedes on the back of their 500-kronor note, shows him wearing the Order of the North Star. He later shared this honour with Linnaeus.

Some time after 1739, his seventy-eighth year, Polhem approached the Swedish Royal Academy of Science with a manuscript on "Suggestions for Botanical Names." He wrote that he had been inspired by reading one of Linnaeus's works—possibly *Classes plantarum* (1738)—to devote time to his own old idea for a universal language to describe plants. The system he proposed had different consonants at the beginning of words to indicate different kinds of substances. "K" in particular was to stand for trees and "G" for grasses and other herbaceous plants. The initial consonant designating the size and rigidity of the plant was to be followed by a vowel. Each vowel was to signify a different sense that the plant affected in the human observer: "A" would stand for sight, "E" for hearing, "I" for smell, "O" for taste and "U" for touch. The letters of these names could be written in different typefaces, "[s]o that if *ga* should exist, it necessarily signifies an herb which sight alone can indicate or please, such as a beautiful flower, according to the approximate size that the size of the consonant will express" (Polhem, 1954, 346-347). Along these lines,

*ge* can indicate an herb which man has heard about but not yet gained knowledge of its actual properties; *gi* indicates an herb that smells pleasant or appalling; *go* an herb that according to taste is good enough to eat; and *gu* [a herb] which has a soft or sharp feel etc. However, if a man wants to describe any herb's figure as follows, then the first syllable must be *gå*, because å is a composite of a and u [such] as the French write, and according to a and u, vision and feel give the most reliable knowledge about everything. . .

It happens sometimes that that one needs two vowels together, such as when an herb both smells and tastes good, which or consequently is written *gio* and their size as the situation requires (Polhem 1954, 348).

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<sup>6</sup> Biographical details from Lindroth 1997, vol. 2, 534-552 and Frängsmyr 2000, 178-182.

To the third position was to be assigned one of the “semi-vowels,”

such as *s* for the intellect, *l* for all operations by the tongue in general living, *n* for hands, *m* for feet or *Modus localis* and *r* for the whole body’s labour of internal and external nature. To follow up this with examples becomes too extensive, therefore only one example here and there is included which can demonstrate the method for everything else; e.g.: *gas* denotes a flower which the intellect has much to reason about, *gal* represents a flower which has much to be talked about; *ges* represents a flower which much is heard about and much talked about; *gan* a flower which can be used for manufacturing and yarn colouring and which has been transported from another place; and *gar* a flower which serves our body as medicine or poison. The entry *gis* marks a sensible chemical mixture which causes good odours, etc., *gil* an herb which a charlatan can talk about for his own profit, *gin* an herb of good or nasty smell which, however, serves for some preparations or manufacture, *gim* an herb that smells and which can serve to promote speed, such as hemp for ropes for riding, horse tackle, and rigging and sails, etc., *gir* an aromatic herb for medicinal purposes. The rest is easy to work out from this (Polhem 1954, 348-349).

Other intellectuals were not as confident of the scheme’s success as Polhem was. This particular manuscript was not mentioned in the *Academy’s Handlingar*, its monthly publication, or in its minutes (Polhem 1954, 346).

But Polhem did not give up. Two years later, in 1741, he felt the need to revise his older manuscript after he saw that the *Handlingar* published a description of a collection of 100 plants that Linnaeus had discovered in Gothland, Öland and Småland. This new version of Polhem’s was called “Suggestions for such Names for Herbs and Grasses that will in a Concise Way Point out their Virtues and Qualities in General.” The main ideas of how alternating consonants and vowels assigned place value were to represent qualities that observers note in plants remained the same. He also added some comments on how the use of three different fonts and five different font sizes could increase the number of plants it would be possible to describe with the system. For instance,

*bu* points out an externally recognizable herb, and can be ranked for better or worse with the largest vowel for cotton, followed by linen, and so hemp, thistle and nettle.

These two letters, such as one consonant and one vowel, should satisfy the common goal as they can, with their 3 kinds and 5 sizes, make 15,625 variations. But to entertain the inquisitive, one will add the 6 semi-vowels for how each branch conducts itself, such

as the top or the crown which is characterized by l, seed or fruit by n, leaves with m, the trunk or stem with s and the root by r.

When these are divided into 3 kinds and each kind into 5 sizes, [there] appear 90 variations, and when the aforementioned 15,625 are multiplied with this, [there] occur 1,406,250. More differences should not exist.<sup>7</sup> Nevertheless, so that nothing is omitted, a vowel then follows so each name will consist of 4 letters in total. . .

I should perhaps continue with examples, but as I am neither a botanist nor an apothecary, I can not support to go further outside my field (Polhem 1954, 350-351).

Polhem's successors seemed to agree. His ideas on this matter were neglected.

#### *Nathaniel Matthaeus von Wolf's Scheme (1776, 1782)*

The next person to have published on this topic was Nathaniel Matthaeus von Wolf (1724-1784).<sup>8</sup> Von Wolf was born in Konitz, a town in western Prussia, on January 24, of 1724, the son of an apothecary.<sup>9</sup> He earned his medical degree in 1748 in Erfurt and built up a good reputation as a physician and as an astronomer. In 1766, he was elected to the Polish nobility. Von Wolf visited England from November 1759 to July 1760 in order to pass the six months on English soil required at that time to allow him to qualify as a Fellow of the Royal Society of London (Royal Society of London 2006). He was elected as a Fellow on April 10, 1777. In 1776, von Wolf came out with *Genera plantarum vocabulis characteristicis definita*, a Latin publication expanding on ideas of plant classification he had been working on for several years.

He began his treatise by describing the sounds that each of the letters he was about to employ should indicate, and stating that notions could be either numerical or comparative. For the numerical notions, he assigned "A" to mean "first," "Æ" to mean "second," "Y" to mean "third," and so on. A long vowel, designated by a circumflex (^) above it, was to indicate quantity. For instance "Â" was to mean "one" and "Û" was to mean "three." Comparative notions included

<sup>7</sup> Linnaeus used this style of reasoning in his 1751 work, *Philosophia botanica* (2003, pp. 98, 99, and 101), to explain that 10 classes of 10 orders of 10 genera with 10 species in each would be enough to encompass all existing plants (Stevens 2006 and 2002, 13) whereas in *Classes plantarum* (1738), he simply stated that he thought there were no more than 10,000 plants in existence (Linnaeus 1738, first page). It is possible that Linnaeus developed his mathematical accounting for this number after talking with Polhem.

<sup>8</sup> Wolf also appears in the literature as Matthaeus Nathanael Wolf, Nataniel Mateusz Wolf, Nathaniel Matthew Wolf, Nathanäel Matthäus von Wolf, and all variations upon these names.

<sup>9</sup> Most of the biographical details are from Poggendorff 1863, vol. 2, 1356, and Kasia, 2004.

substance, superficial qualities, location, shape, smell and flavour. Each manifestation of these notions was to be represented by a letter. For instance, for the different kinds of substance that plant parts could manifest, von Wolf assigned the following letters:

<b>Substance type</b>	<b>Letter</b>
Hard	R
Somewhat hard	V
Elastic	F
Soft	P
Sticky	W
Liquid	B

Figure 1

The ensemble of his technique was likewise displayed as a chart (Figure 1).

Instead of using uninomials, as did the other inventors of similar schemes, von Wolf split his plant names into two parts so that they were a kind of binomial. One name stood for the plant's family and the other for the genus, though in other respects the generation of the names was the same. He suggested that plant family names should be two letters long, the first indicating the number of pistils (or pistilliform stamens), the second, the number of stamens. Adding a prefix "h" would indicate an unequal number of stamens, while adding "z" would indicate an absence of stamens. For generic names, the first syllable described the fruit. The next syllable was to describe the number of involucre, the next the corolla, and so on. He provides the example of a plant with one naked seed: according to his system, the botanist would first write "A" and "ñ." Noticing that this particular flower has five simple petals in a tube, he would add "f" and "i" to make the generic name, Añfi. The flower has one pistil and five stamens, making the next syllable, or family name, Aî. The botanist could then look up a more detailed description for the plant under its family and genus (Aî Añfi), where he would also find its Latin generic name, *Calligonum* (von Wolf 1776, 7).

Generis: Syllaba prima, fructum determinans.												Syllabae sequentes, Corollam, Calicem, et Involucrum extimum determinantes.							Familiae Syll. duae, Pifilla et Stamina determ.				
Confirma	Confirma	Vocals	Confirma	Vocals	Vocalis Numerus et Divifio.	Confirma	Vocals	Confirma	Vocals	Confirma	Vocals	Confirma	Vocals	Confirma	Vocals	Confirma	Vocals	Confirma	Vocals	Confirma	Vocals		
	Conf. ante Subfidentia et Situs.		Conf. ante Voc.			Conf. post Voc.		Conf. vtrisque Fig. et Superf.			Conf. vtrisque Fig. et Superf.			Conf. vtrisque Fig. et Superf.									
	Fructus.		Fructus.		Samen.	Fructus.		Corolla, Calix, Involucr.			Corolla, Calix, Involucr.			Corolla, Calix, Involucr.			Petal. vel falium vnum.			Syll. prima, Pifillum			
B.	-	Bacca.	-	a	Sem. 1.	-	b	rotundus fere	b	-	b	-	a	Petal. vel falium vnum.						A	-	a	vnum.
P.	-	Pomum.	-	a	- multa in loc. 1.	-	p	onatus	p	-	p	-	a	- multa, plus 15.	Â	-	a			Â	-	a	multa plus 15.
V.	-	Cortex. Drupa.	-	e	- duo	-	v	conicus	v	-	v	-	e	- bifidum	Æ	-	æ			Æ	-	æ	bifidum, vel duo connata.
F.	-	Siliqua.	-	e	- multa in loc. 2.	-	f	cilindricus	f	-	f	-	e	- duo distincta	Ë	-	ë			Ë	-	ë	duo distincta.
W.	-	Capfula.	-	y	- tria	-	w	femirotondus	w	-	w	-	y	- trifidum	Ï	-	ï			Ï	-	ï	trifidum, 3. connexa.
R.	-	Nux.	-	y	- multa in loc. 3.	-	m	arcuatus	m	-	m	-	o	- tria	Ï	-	ï			Ï	-	ï	tria, 3. distincta.
S.	-	Inferus.	-	e	- quatuor	-	d	bifarius, 2. valv.	d	-	d	-	e	- quadrifidum	E	-	e			E	-	e	quadrifidum, 4. connata.
				e	- multa in loc. 4.	-	t	trifarius	t	-	t	-	e	- quatuor	Ê	-	ê			Ê	-	ê	quatuor distincta.
				i	- quinque	-	g	quadrifarius	g	-	g	-	i	- quinquefidum	I	-	i			I	-	i	quinque connata.
				i	- multa in loc. 5.	-	l	quinquefarius	l	-	l	-	i	- quinque	Î	-	î			Î	-	î	quinque distincta.
				o	- sex	-	j	sex et multifarius	j	-	j	-	o	- sexfidum	O	-	o			O	-	o	sex fidum, 6. connata.
				o	- multa in loc. 6.	-	n	linearis	n	-	n	-	o	- sex	Ô	-	ô			Ô	-	ô	sex distincta.
				o	- septem	-	fi	planus	fi	-	fi	-	o	- septemfidum	Ï	-	ï			Ï	-	ï	septemfidum.
				o	- multa in loc. 7.	-	k	imbricatus	k	-	k	-	o	- septem	Ï	-	ï			Ï	-	ï	septem.
				u	- octo	-	x	articulatus	r	-	r	-	u	- octofidum	Û	-	û			Û	-	û	octofidum.
				u	- multa in loc. 8.	-	r	dentatus	s	-	s	-	u	- octo	Û	-	û			Û	-	û	octo.
				q	- 9 ad 15.	-	s	spinofus arifatus	z	-	z	-	q	- 9 ad 15. fidum	Q	-	q			Q	-	q	9 ad 15. fidum.
				q	- multa in loc. 9-15.	-	e	glaber	c	-	c	-	q	- 9 ad 15.	Q	-	q			Q	-	q	9 ad 15. distincta.
							c	villofus pappofus	o	-	o	-			-	-	-			-	-	-	inaequalia Stam.
							o	faber	h	-	h	-			-	-	-			-	-	-	Stamen deficienti intra, in eadem planta, Monoica.
							o	faber	h	-	h	-			-	-	-			-	-	-	Stamen deficienti extra, in alia planta, Dioica.

Figure 1. N. M. von Wolf’s chart explaining which letters stand for which plant properties. Image © and courtesy of Hunt Institute for Botanical Documentation, Carnegie Mellon University, Pittsburgh, PA.

Under his system, samphire (*Salicornia*) would be Aæ Ańga, and pipewort (*Eriocaulon*) would likewise be Yŷ Apvye.

Von Wolf used his technique to briefly describe and name new “families” and to provide new “generic” names for hundreds of plants. Still, his dedication to the botanical cause seems ambiguous. The *Genera plantarum* was initially published anonymously, and on very bad quality paper. The index—published separately in 1780—is a marvel of disorder, lacking alphabetization beyond the first letter and missing many entries. It shows at a glance that some plants have multiple names and other plants share one name. Von Wolf nevertheless made a gift of his book to the Royal Society on November 9, 1780.<sup>10</sup> The Abbé des Houssayes (1727-1783) also, quite astonishingly, did not mention anything unusual about the index in his scathing review of von Wolf’s work in 1781—though he called von Wolf’s nomenclature “hieroglyphics,” “barbarous,” and “unintelligible” (Deshoussayes 1781, 405).

Despite these drawbacks, von Wolf’s work was popular enough to merit a second, expanded edition published in 1782 and titled *Genera et species*

<sup>10</sup> Presents Made to the Royal Society, 1781. “N. M. de Wolff, M. D., F.R.S.” also personally gave an octavo copy of the second edition of his work to the Royal Society on November 13, 1783 (Presents Made to the Royal Society, 1784).

*plantarum vocabulis characteristicis definita* (von Wolf 1781).<sup>11</sup> This work was like the first edition except that von Wolf also introduced three-syllable names for plant species. The first syllable was to describe the plant's overall appearance, the second, its leaves, stipules, bracts, etc. and the third, the arrangement of flowers in its inflorescence. These syllables were likewise to be generated by combinations of letters, each standing for a particular plant property. For instance, for the genus *Equisetum* (horsetails or scouring rushes), von Wolf proposed the genus name *Åńu*. The various species to be found in *Åńu* were *Vyljaffe*, *Væxfe*, *Vyxjafzi*, *Svyxjafpu* or *Svæxjapû* (one species with two names), *Svexjaffu*, *Svexzpu*, *Vyxɔpu* and *Viljaffê* (von Wolf 1781, 337). I suspect that these names were tongue-twisters even to multilingual mitteleuropeans.

Doctor Jonathan Stokes, compiler of references to figures in the English botanist William Withering's very popular *Botanical Arrangement of British Plants* (1787), was familiar with von Wolf's 1776 edition. Of "Wulff," he wrote in an aside that he had

once formed a botanical language on a plan somewhat similar, but I soon discovered that in proportion as plants resembled each other, the difficulty of distinguishing the sounds or combinations of letters expressive of them, must proportionately increase. Languages formed on plans of this kind, must be full of such ambiguous names as *Clutia*, and *Clusia* (Withering and Stokes, 1787, xlvj).

Von Wolf had also sent French botanical reformer Michel Adanson (1707-1806) a copy of his 1776 publication in 1780 (Hunt Institute of Botanical Documentation 1963, 307) but it does not appear from existing records that Adanson corresponded with anyone about it. Adanson may, however, have lent or given his copy to Antoine-Laurent de Jussieu (1748-1836), a highly respected Parisian botanist, since both of them discussed it with another botanist, the Abbé de Las, in early 1783 (de Las 1783, 58).

Von Wolf's work remains a bane to systematic botanists to this day. It is as rare as its quality is poor, yet even des Houssayes conceded that it could have "some utility" (Deshoussayes 1781, 406). Modern botanists must still occasionally consult it since it contains the original description of the genus *Eragrostis*, the ornamental plant popularly known as "love grass."

#### *Jean-Pierre Bergeret's Scheme (1783)*

The most famous—or, should I say, notorious—botanical scheme of this type was produced by Jean-Pierre Bergeret (d. 1813). There are several different versions of the details of Bergeret's early life. According to Weiss, he was born on November 25, 1751, in Lasseube, Auch, in the southwest of France near Pau

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<sup>11</sup> According to WorldCat, though the date given on the title page is 1781, it was published in 1782.



(Weiss 1854). He took courses in surgery, anatomy and natural history at Bordeaux, then moved to Paris. Benoît Dayrat indicates that he was born in 1752, in Oléron, in the Béarn district, slightly south of Lasseube, though his parents moved to Paris when he was young. After they died, he decided not to return to his birthplace with his relatives but instead to stay in Paris to study surgery and take courses in botany with Bernard de Jussieu. He was never enrolled in a school or faculty of medicine (Dayrat 2003, 160). Either way, in 1776 he undertook a description of the plants of the Paris region, but set aside this work to prepare and then teach a botanical course he started.

It was during this time that he started to compile the material that would grow into his masterpiece, *“Phytonomatotechnie universelle* [a universal technique for naming plants], or, the art of giving plants names taken from their characters; a new system by the means of which one can, by oneself, without the help of any book, name all the plants that grow on the surface of the earth” (Bergeret 1783, 157). Bergeret tested his system on his students before having it published. “On different field trips,” he wrote in the prospectus to his book,

having put the principles of my system into their [i.e. students’] hands, I had the sweet satisfaction of seeing them grasp it, and I saw with pleasure that, by the means of these very principles, they were brought without trouble to name to me phytonomatotechnically all the plants that they found at their feet. The displays of joy on their part were not at all equivocal; they saw themselves, so to speak, as the creators of names, and this joy became even more evident when they recognized the appropriateness of the application of the letters to the different characters, according to the conformity of these names with those that I had already laid down (Bergeret 1783, 157-158).

A major selling point for this kind of nomenclature, according to Bergeret, was that the principles of it were simple enough to memorize easily. In fact, the rules for naming genera, he wrote, “can be written on fewer than twelve playing cards” (Bergeret 1783, 158). But though the principles were few enough to allow botanists to name plants the field without lugging books around, Bergeret did not take that to mean that his work had to be pocket-sized.

*Phytonomatotechnie universelle* was published in three volumes in-folio from 1783-1785. It is a sumptuous work of which only 200 copies were printed. The most complete versions contain 328 plates, some in colour. Bergeret drew them all himself. It was to be issued in 30 livraisons, but the last two and the twenty-first were never produced. The twenty-first was to have contained an explanation of Bergeret’s botanical system, which Dayrat characterized as “unique in the entire history of botany” (Dayrat 2003, 160). Figure 2 shows the first chart from the book, explaining how the system works.

Bergeret explained that he had gone over

all the principal states (*manières d'être*) of the corolla, the stamens, the nectaries, the pistils, the floral envelope, the calyx, the pericarp and the seeds. To each of these different states, we attributed a consonant; this yielded eight large alphabetical charts. We then saw that the majority of these different states could also be subjected to closer examination. This new consideration produced seven other small charts for us, in which there is nothing but vowels.

All these charts are put together in a manner such that each one gives a letter to the plant, according to its characters [i.e. the plant's features]; the resulting name can be spelled easily (Bergeret 1783-1784, i [unnumbered]).

Each name was to be 15 letters long. Unlike all the other schemes discussed here, his did not involve strict alternation of vowels and consonants. Names containing several of the same letters in a row—such as those in which many parts were assigned “A” for “absent”—could be condensed by adding a superscript number over the first repeating letter. This was to indicate how many of the same letters were to follow. For instance, the phytonomatotechnical name for the fly agaric mushroom, AAAAAAAAAALAAAYZ, could be spelled A<sup>8</sup>LA<sup>4</sup>YZ for short (Bergeret 1783-1784, i [not numbered]). He then ran through how to generate these names, using the example of *Belladonna officinalis* (deadly nightshade):

**PREMIER TABLEAU.**  
**LA COROLLE.**  
PREMIÈRE LETTRE DES NOMS.

PLANTES,	}	Sans aucune Corolle . . . . .	A			
		}	Fleurs simples.	}	Corolle d'une pièce très-entière,	B
					— découpée (Divisions égales,	C
						en deux { — inégales,
					— en trois { — égales,	E
						— inégales,
					— en quatre { — égales,	G
						— inégales,
					— en cinq { — égales,	J
						— inégales,
— en plus de cinq { — égales,	L					
	— inégales,	M				
}	Fleurs labiées.	}	Une lèvre entière. { L'autre lèvre fendue en deux	N		
			— en trois	O		
			— en plus de trois	P		
			Les deux { Une fend. { La sec. en trois . . . . .	Q		
				lèvres dé- en deux. { La sec. en plus de trois . .	R	
			coupées. { Les deux lèvres fendues en trois & plus	S		
				de trois. . . . .	S	
			Fleurs composées. . . . .	}	Flofculeufe { moins de douze fleurons	T
					— plus de douze fleurons égaux	V
					— inégaux	U
Radiées {	}	moins de douze $\frac{1}{2}$ fleurons	W			
		plus de douze $\frac{1}{2}$ —	X			
		moins de vingt fleurons.	Y			
		plus de vingt —	Z			

Nous aurions désiré pouvoir joindre ici quelque autre Tableau, pour plus d'éclaircissement; mais on les trouvera tous dans l'Introduction à cet Ouvrage, qui paroitra incessamment.

Figure 2. Bergeret's first table, "the corolla," from his *Phytonomatotechnie* (1783). Each variation of the corolla is assigned a different letter, with no regard for the pronounceability of the resultant plant name. This table was to be followed by 14 more like it, one for each of the subsequent parts of the plant examined. Image © and courtesy of Hunt Institute for Botanical Documentation, Carnegie Mellon University, Pittsburgh, PA.

We compare the corolla with the characters of the first table; we see that the letter J indicates a corolla in five sections. We write J and move on to the second table, which gives the vowel E because the sections of the corolla are not cut very deep. We put the E next to the J, and so we have JE. We go to the third table, and find that the letter Q indicates the insertion of the stamens under the germ, by means of the corolla. We write Q, and have JEQ. The number of stamens is five, so we find in the fourth table that the letter L indicates those for this plant. We write it and we have JEQL. The side opening of the anthers is expressed by the letter Y in the fifth table; we write it down and have JEQLY. Finally, by this method, we travel through the five tables in turn, each furnishing a letter; we write them down, and obtain the name JEQLYABIAJISBEV, which is equivalent to the entire description that Linnaeus gives us of the genus of deadly nightshade, since

each of these letters expresses, as we will see, a character of the plant (Bergeret 1783-1784, ii [not numbered]).

Although Bergeret paid attention to the pronunciation and ordering of individual letters, he was apparently not as concerned with the pronounceability of phytomatotechnical names as he could have been. This was a source of consternation to his readers, including Erasmus Darwin, writing on behalf of the members of the Lichfield Botanical Society in England.<sup>12</sup> “Thus,” Darwin wrote in 1787,

*leqlyabiajisbey* [sic] expresses the description of *Belladonna* .. In like manner *Gypmyabeahuftez* is both the name and description of *Draba* [a weed in the mustard family]. It is easy to foretell, that words of such enormous length, though they may serve well for a botanic shorthand, must be too difficult to be remember'd, or to be pronounced; and thence can never come into general use as a botanic language (Linnaeus 1787, xii).

Bergeret's countrymen were no kinder in their assessment of his work. In 1811, Baron Ambroise-Marie-François-Joseph Palisot de Beauvois (1752-1820), a member of the botanical section of the Académie de France since 1806 (Crosland 1981, 619), wrote that the

Phytomatotechnie of Bergeret, the Phytographie of l'As,<sup>13</sup> and many other, similar ones, are so many books confined, as it were, to libraries, and [which] no longer have any other use than that of serving to complete the history of the science by showing its progress and extent, although they do not combine anywhere near the benefits that botanists find in the analytical method of the *Flore française* of M. de Lamarck.<sup>14</sup>

A biographical article written about Bergeret in 1854 mentions the numerous awards and royal acknowledgements he received for his surgical work, but gives much the same assessment of *Phytomatotechnie*: “The execution is very remarkable for the time . . . [but] this work is now not much sought after, even though it is the most important of the author” (Weiss 1854). Alphonse de Candolle similarly singled *Phytomatotechnie* out for excoriation in his 1880 book on how to describe plants properly, suggesting that Bergeret did not publish his entire system because he likely grew discontented with his own work or that his system merely “succumbed to ridicule” (Candolle 1880, 259). Even

<sup>12</sup> This “society” consisted of three members. It was founded by Erasmus Darwin, who was the translator of the works of Linnaeus that the Society published (Browne, 1989, 599).

<sup>13</sup> i.e. de Las, 1783, discussed below.

<sup>14</sup> “Séance Du Lundi 10 Juin 1811,” 1832/1835, 486. Palisot de Beauvois had been a student of the inspirational botany instructor Jean-Baptiste Lestiboudois (Leclair, 1908, 43) at Lille and likely had plenty of first-hand experience using far better texts than these for identifying plants in the field.

today, copies of *Phytonomatotechnie* are valued more for the high production standards of the plates than for Bergeret's systematic treatment of plants.

*The Abbé de Las's Scheme (1783)*

I have not been able to find out very much about the Abbé de Las—not even his first name.

He seems to have lived in Arras and may have also taught chemistry there during the 1780s (Dalmasso 2005.) In 1783, he published his botanical scheme in a work called *Phytographie universelle, ou système de botanique fondé sur une méthode descriptive de toutes les parties de la fleur: avec une nouvelle langue antho-phyllographique*. It does not seem to have attracted much notice other than Palisot de Beauvois's dismissal and scorn. But de Las himself was quite proud of his work and convinced of its importance. Of all the dud-makers I have found, he is the only one who acknowledged the existence of other authors' similar schemes. In particular, he wrote off Bergeret's *Phytonomatotechnie* as inadequate. He also insisted that he had not plagiarized from Bergeret or from von Wolf. Clearly, he saw Bergeret and von Wolf as his rivals in the development of the best variation of an entirely feasible project.

"I wanted," Abbé de Las wrote, "to establish a rapport between plants and their names, a rapport that could serve as a support for the memory" (de Las 1783, 38). Like other French botanists at the time, he considered there to be 20,000 known kinds of plants (e.g. Flourens 1857, 118-119; Senebier 1775, 33-36; Gilibert and de la Tourette 1797, 1). De Las believed that remembering all their names would be impossible. "The more the sphere of botany expands, the more one perceives that its study goes beyond the limits of the human spirit," he wrote.

I know quite well that botany does not consist only of the knowledge of [names of] plants, but I also know that it is the most necessary part for beginners.. [but] memory refuses to keep track of an infinity of words that have no relationships among themselves nor with the things they signify. If an algebraic formula does not bring up the principles that served to build it, do you think I can retain it? The connection it has with its principles fixes it in my mind.

Not only will every man instructed in the characters of flowers as my method indicates be able to recognize the plant that each anthographic word signifies without worrying about making mistakes, he will be equally capable of composing the name of each plant that he will have before his eyes, with the certitude of making it known to all people of whatever nation they are who

are familiar with my characters and the signs that they represent (de Las 1783, 50-54).

To do this, he invented not one but two “languages,” each with different signs and principles. The first, which I call anthographic [*anthographique*], or language descriptive of flowers, has only a very small number of characters, uniquely representing the form, situation, and parts of the flower. It serves to compose the generic name of plants. The second, which I call phyllographic, because its characters are taken for the most part from leaves, serves to distinguish the species [when] united with the first (de Las 1783, 39).

His anthographic rules for naming genera were sufficiently complex that it took de Las 17 pages of text to explain all of their principles, corollaries and exceptions. In brief, they involved a modified Greek alphabet in which each letter stood for a character of the plant and had place value. Vowel sounds were to be added between the consonants at will to make the name sound harmonious (see Figure 3). His phyllographic characters, or specific names, each consisted of two consonants, standing for two outstanding features of the plant’s leaves. Again, vowels were to be added to these consonants so that the resulting two-syllable name would be easy to pronounce. He included a 9-page

TABLEAU ANTHOGRAPHIQUE												
CLASSES SIMPLES												
	I. Camposefer- met.	II. Infundibulifer- met.	III. Corticiformes.	IV. Cephalisfer- met.	V. Labiata.	VI. Petaloides.	VII. Ligaminejets.	VIII. Eugies.	IX. Hypog.	X. Ombellifer- met.	XI. Radicata.	XII. Uscata.
1 <sup>re</sup> Division. Unipetalée.	Nazepica. *	Dijopie. *	Geccepia.	Recepi.	Abspici. *	Merpree. Merpica. *	Lepicea.	Tepegia.	Hiacipo.	Opiico.	Serpef.	Uvapica.
2 <sup>de</sup> Division. Bipetalée.	Cancio.	Calafipi.	Figipca.	Crepia.	Jobepeca.	Canecio.	Plaficia.	Pateca.	Phecap.	Copio.	Calapio.	Pafca.
3 <sup>e</sup> Division. Tripetalée.	Pencia.	Codipe.	Epigafie.	Expacia.	Fabacia.	Pamecia.	Felicpa.	Capitefa.	Ichepica.	Fcofa.	Pefcia.	Ciapico.
4 <sup>e</sup> Division. Quadrupetalée.	Pimafco.	Addicpi.	Coxpiga. *	Ciprecia.	Pacabafia. Cofa.	Epijomo.	Calliofpo. *	Pitafico.	Epichecia.	Ovopca.	Caffa.	Pecua.
5 <sup>e</sup> Division. Quinquipetalée.	Kacim. Epikafine. *	Deppedeio. *	Epigafie. *	Piazco. *	Blabefa.	Mocamio.	Licafie.	Tecapre.	Hphico.	Coxpifa.	Capricofa.	Cepicofa.
6 <sup>e</sup> Division. Sextupetalée.	Jepem. *	Pafefdecia.	Cocipge.	Repercia.	Ekopio.	Pimemica.	Pilida. Pellicia.	Pitafca.	Hicaphio.	Cofopca.	Pifafca. Pafca.	Capupio.
7 <sup>e</sup> Division. Septupetalée.	Pimafco.	Deciefla.	Egepijo.	Carperia.	Cabepiobida.	Mocamio.	Elapicalfo.	Pitafca.	Chephica.	Cocofca.	Pifca.	Pepucio.
8 <sup>e</sup> Division. Octupetalée.	Anemio.	Fidipipida.	Pagapico.	Cerpozio.	Ficabembe.	Picromemio.	Cliflicia.	Pocanice.	Ephichajr.	Cerofpico.	Cepiffo.	Pocufio.
9 <sup>e</sup> Division. Nonupetalée.	Ciana.	Addepicadi.	Epigafie.	Profacce.	Picobyha.	Pimovicamio.	Lapillie.	Caperyce.	Jopichca.	Jevopico.	Sepiffo.	Cocupio.
10 <sup>e</sup> Division. Decupetalée.	Nanemio.	Epidejadi.	Epocagie.	Atripiercia.	Cicofca.	Vepemicamio.	Elleplicia.	Cepiafritr.	Jepichca.	Pefcofo.	Picofore.	Cepufore.
11 <sup>e</sup> Division. Undecupetalée.	Kanapicine.	Edlicapod.	Pepigafie.	Cepropicia.	Cofafca.	Faximicamio.	Callifpila.	Capereca.	Jepichca.	Jevopico.	Specaco.	Pocufio.
12 <sup>e</sup> Division. Duodecupetalée.	Fiopeona.	Dualakho.	Jepogigie.	Cepropicia.	Fipocobha.	Pifamemio.	Elleplicia.	Cepireca.	Jochiphe.	Cepofico.	Epacacem.	Cocupio.
13 <sup>e</sup> Division. Tridecupetalée.	Nypace.	Devipicia.	Gypcia.	Rypica.	Bypca.	Mypica.	Lycia.	Ferypca.	Erphycia. *	Ozipefa.	Epifafyca. *	Paxicico.
14 <sup>e</sup> Division. Apetalée.								Kafa.	Kafa.	Kafa.	Lafa.	Kafa.

Figure 3. The *Tableau Anthographique* (Anthographic table) from de Las’s *Phytographie universelle* (1783), showing the names of “simple classes” of plants. Image © and courtesy of Hunt Institute for Botanical Documentation, Carnegie Mellon University, Pittsburgh, PA.

“Phyllographic alphabet” indicating which letters stood for which features and when, supplemented by a 255-word “Phyllographic dictionary” defining each of the words describing the features so as to remove all ambiguity.

The Abbé was aware that his proposal was not mainstream. In fact, he wrote that “fear of the censure of intellectuals on this matter would have made me hold back from printing [it], if M. Bergeret had not published the prospectus of his *Phytonomatotechnie*, which my work resembles too much, to put me at risk of being reproached for plagiarism if I were to defer publication any longer” (de Las 1783, iv). Bergeret’s prospectus was published in May of 1783 (“Phytonomatotechnie Universelle,” 1783). De Las quickly went on the defensive, preparing to publish as soon as possible. He ensured that his readers knew that he had given copies of his project to the leading botanists Michel Adanson and Antoine-Laurent de Jussieu in November 1782, and that Jussieu had given him suggestions on how to improve it. He listed a number of other men of letters with whom he had communicated about his ideas, including several from Arras and others from Dijon and Lyon. “Almost all” of these men, he wrote, “have done me the honour of writing me that they would permit me to call them in proof of the knowledge that they had of my work, long before Mr. Bergeret published the prospectus of his *Phytonomatotechnie*.” He reprinted the attestation of Marc Antoine Louis Claret de Fleurieu de la Tourette (1729-1793), perpetual secretary of the Académie de Lyon, “against whom I doubt that M. Bergeret would dare to bother to argue with me over [*s’élever pour me contester*] the glory of having conceived at the same time as him a project favourable to the progress of botany” (de Las 1783, v).

As well, de Las made sure to explain that he had devised his scheme before he had ever heard of “Mr. Wolf, the Polish physician.” Adanson, de Las wrote, first made him aware of von Wolf’s work

only in conversation. M. de Jussieu showed me the book, which did not rest in my hands, as the same M. Jussieu can attest, for more than around four minutes. However brief this time was, I believe it is possible to assure that it sufficed for me to see how barbarous his method is. It is more of a writing than a language. How to pronounce, in effect, a language that is made up of twenty-five vowels, five *As*, five *Es*, etc., each of these *As* and these *Es* differing only in the pronunciation taken from its neighbours, of the sort that to speak the language of Mr. Wolf, one must know not only German, but also all of its dialects. What confusion! Could the author ever promise that his language would be adopted?

De Las was emphatic that his own method was easier to pronounce than any other. He demonstrated that, for instance, according to von Wolf’s plan, the letter *B*

signifies that the fruit is a berry, *Â* with a circumflex accent, that the flower has four petals, *W*, that the calyx is conical, and plain *E* that the calyx has four segments. [The Linnean genus] *Actaea*, placed by this author in the second class, distinguished by all its characters, is named by Mr. Wolf *Bâê We*, which is equivalent in pronunciation to *Baæeoue*, and consequently cannot be pronounced. The same plant is named *Cucagexpi* in my method, and is more completely described, because this word includes again the form that the petals take among themselves and the number of stamens and the pistil (de Las 1783, 58).

Combining the Abbé de Las's anthographic genus names and phyllographic species names makes for a particularly awkward nomenclatural scheme, one that was never adopted.

The final dud-maker whose work I located was, like John Wilkins, an Englishman. Nevertheless, his ideas about botanical classification were clearly developed independently from Wilkins' and all other preceding schemes discussed above.

#### *John Henderson's Scheme (1830-1831)*

Dr. Henderson (d. 1836) arrived in Hobart, Van Diemen's Land (Tasmania) as Ship's Superintendent on the *York* on Aug. 29, 1829. Not much is known about his life prior to this point, though a detailed study by Michael Edward Hoare—the source of most of the following details of Henderson's life—paints a picture of a restless traveller eager to explore and to help his fellow men. Between 1815 and 1829 Henderson lived in eastern India as a medical officer and then surgeon to the British military. In 1829, Henderson "received permission to go on leave to Australian colonies and came 'with shattered health, and in embarrassed circumstances' to Van Diemen's Land" (Hoare 1968, 10-11).

Hobart Town, the capital of Van Diemen's land, was only 24 years old when Henderson arrived. Its population was largely rough and uncultured, as befitted this former penal colony in such an isolated location. Still, by January 1830, Henderson had persuaded "most of the respectable settlers throughout the Island" to form the Van Diemen's Land Society, otherwise known as the Philosophical Society or the Van Diemen's Land Scientific Society (Hoare 1968, 12).

Henderson, as President of the Society, gave a long speech before more than 100 of the most influential islanders, who gathered in the courthouse for the first meeting. The Hobart Town Courier reported on January 23, 1830, that at the heart of Henderson's talk was a proposal for

an entirely new system for introducing one general and determinate form of expression by which those who collected new plants, animals and other curiosities, through at a distance from each other, might infallibly be enabled to give the same



name to their discoveries... [He had waged] war against 30,000 arbitrary names of plants received in the nomenclature of botany, and had suggested the substitution of certain syllables and letters, of which might be compounded names expressive of the diagnostic marks of each particular plant (Hoare 1968, 14-15).

Henderson later claimed to have been inspired to develop these ideas not from experience with botany, but from observing that judges presented with practically the same legal arguments were likely to interpret them differently. He surmised that a logical outline of how to proceed in each instance would help reduce uncertainty and variation in each legal decision. If such a system were in place, “legal language would . . . become brief and determinate; each legal document, henceforth constituting of a series of definitions, arranged in a regular and successive order,” would direct judges to follow the same, proper path (Henderson 1832, 176-177). Henderson thought that botany was adrift in a sea of unintentional synonymy caused by a lack of guidelines on how exactly to name plants. He believed it could benefit from this kind of logical overhaul as well.<sup>15</sup>

The talk was “received politely and well,” though “opinion was divided” about it. A prominent physician argued in favour of naming local plants according to Henderson’s principles, while the publisher of the Hobart Town Courier thought that classifications developed in Europe by expert botanists were better. He recommended the Linnaean sexual system. There is no record of anyone in attendance mentioning Robert Brown’s well-respected *Prodromus florae Novae Hollandiae et Insulae Van-Diemen* (Introduction to the flora of New Holland [Australia] and Van Diemen’s Island), a Latin work published in England in 1810 and arranged according to Jussieu’s “natural method” (Hoare 1968, 15).

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<sup>15</sup> Henderson explained his ideas in detail in a letter, described below. He also devoted several pages to explaining how dividing plants into successive pairs of groups of equal size would be the ideal way to organize information about them. His fixation on dichotomous divisions may have been inspired by similar proposals put forth in Jeremy Bentham’s *Chrestomathia* (1817), or John Fleming’s *Philosophy of Zoology* (1822), with which he shares the unusual terminology of “positive and negative” divisions. (His apparent inability to read French makes familiarity with George Bentham’s more extensive and more botanical *Essai sur la nomenclature et la classification* of 1823 unlikely). Henderson’s proposal also resembles Gottfried Wilhelm Leibniz’s 18<sup>th</sup>-century idea for a universal language designed to prevent illogical legal decisions from being made, which was, in turn, inspired by Bishop John Wilkins’ *Essay towards a real character* (1668) (Maat 2004, 156, 301-302). Henderson’s proposal, however, was not lifted wholesale from any of these works. It also contains enough original elements – including flaws addressed in some of his predecessors’ schemes – to suggest that he devised its details on his own even if he had heard of similar ideas from others. In several ways, Henderson’s proposal may be the botanical nomenclature analogue of the Cherokee writing system, a system devised by the illiterate, unilingual Sequoyah after he saw English-speakers communicating by means of written symbols. Several other North American Indian writing systems were similarly invented in this way (Walker 1981, 145-147, 151-152).

Printed transactions of Society meetings were supposed to be issued, but none ever was published (Hoare 1968, 16).

Henderson left Van Diemen's Land shortly after the first meeting of the Scientific Society. He was disappointed with the people for caring only for wealth and status rather than the natural riches around them. He travelled through New South Wales and then left Sydney for Bengal in January, 1831, on his way back to resume his military duties in India (Hoare 1968, 11). By the first of November of that year, had distilled the ideas he had presented in Hobart Town into a treatise, 'On Nomenclature.' He sent it from Juanpore (Kanpur) to Antoine-Chrysostome Quatremère de Quincy (1755-1849), Perpetual Secretary to the Institute of France in Paris.

This English-language treatise speaks well to what those familiar with Henderson's dealings in Hobart Town characterized as his "ensorious and dogmatic" character (Hoare 1968, 19). He began by stating bluntly that he preferred to send his ideas to France, the home of Lavoisier, reformer of chemical nomenclature, than to the Royal Society in England. He did not expect a "favourable reception" from the English, who, he wrote, had "firmly rooted prejudices" "inimical" to nomenclature reform (Henderson 1832, 156). He followed these remarks with a bloated and vituperative list of standard botanical complaints: there are too many kinds of plants to remember; too many absurd and arbitrary plant names; too many synonyms and disputed names; too many technical terms; and too many botanical works to look through in order to identify plants. Henderson proposed that a study of plant physiology was what really mattered, and it would be best served if botanists abandoned artificial systems written in dead languages (Henderson 1832, 157-159).

Discussing "artificial systems" in this context would have been the equivalent of waving a red flag before a bull. French botanists had been, for the most part, quite proud to have abandoned the arch-artificial sexual system of Linnaeus several decades earlier. To speak of botany without mentioning the celebrated "natural method" of Jussieu was to insult all French intellectuals. As well, while England had been a stronghold of the sexual system until the mid-1820s, English botanists were switching to Jussieu's method in large numbers by the time Henderson sent his letter. Samuel Frederick Gray (1766-1828) and John Lindley (1799-1865) had already published several English-language botanical texts arranged according to its principles. Even Sir James Edward Smith (b. 1759), President of the Linnean Society of London from the day he founded it in 1788 until his death in March 1828, came to praise Jussieu. In the introduction to his *Grammar of botany* (1826), Smith wrote that, "Natural affinities cannot now be overlooked, by those who contemplate the Vegetable Kingdom with any degree of philosophical attention." English botanists would be best served by catching up with their French counterparts in this respect (Smith 1826, x).

Assuming that Quatremère de Quincy had continued reading past this gaffe, he would have come to the crux of Henderson's argument. Henderson wished to

propose “the formation of a regular system of nomenclature” such that it would be clearly working

*when an individual, who might in one country discover a new chemical substance, mineral, plant, insect, or other animal, should be enabled by means of the system to give it the self-same appellation that another individual, having no communication with the first, would have assigned to it, had he discovered its co-partner in any other part of the world [Henderson’s italics].*

He wrote that he intended “to prove, not only that such a system was perfectly practicable, but that it could be likewise reduced to simple and easy regulations”—unlike the Linnaean sexual system, which he then criticized again at length (Henderson 1832, 160).

Henderson’s explanation for why his proposed system would be easier to use than the sexual system involved an outline of how he believed human memory to work. He acknowledged that oral histories passed on as poems are “less easily corrupted, and more easily recollected than prose,” attributing this to their regular structure of a narrative “chain of ideas” reinforced through rhyme. Linnean nomenclature, however, offers “neither line of connection betwixt the specimen and the name, or betwixt one name and another.” When names are given willy-nilly like this, “the mind endeavours to supply the defect by an ideal chain of its own construction.” In general terms, an “unharmonious” order of materials presented to a learner causes difficulties in recollection (Henderson 1832, 162-163).

Henderson consequently proposed “to simplify and establish a general systematic nomenclature in science” by “rendering as determinate as possible our methods of arrangement” such that each name would “describe . . . the exact position of the specimen in the established system of classification.” Since he wished his classification scheme to be as natural as possible, the classification and nomenclature for each plant needed to be based on “some fact or quality in the class or specimen” (Henderson 1832, 168, 175). Henderson considered it feasible for each class, order and genus of plants to be defined according to a property shared among all its members, something botanists more familiar with botanical classification knew was impossible. Numerous species of plants have different numbers of stamens and/or pistils from other plants considered to belong to the same natural genera. One example discussed at length in botanical circles since the 1760s is the species *Valeriana rubra*. It has one stamen instead of the three found in other species of valerian (Müller-Wille and Scharf submitted 2008).

Henderson’s next steps were to designate each class with a different consonant and to assign a different vowel to each order. The genera in each order were likewise each to be represented by a consonant, while the species were to be labelled with vowels, “resorting to the employment of double letters,

diphthongs, or even to consonants, wherever the higher numbers may be called for” (Henderson 1832, 176). This method of combining alternating consonants and vowels, each with its own descriptive significance, would generate meaningful and pronounceable names of organisms. As Henderson explained,

the name ‘Bal’ will clearly represent the first subdivision of Monandria Monogynia [plants with one stamen and one pistil]; and Balba will equally represent the first species, in the first genus, in the first subdivision, in the first order of the first class of the Linnaean system. One point more yet requires to be determined; namely, to what science this name may belong; and we must therefore append to it some termination, such as ‘na,’ or Balbana, in order to indicate its being the name of a plant, and to distinguish it from that of an animal or mineral. The name ‘Dombina’ will in the same manner represent the third species of the second genus, in the second subdivision of Tetrandria Tetragynia [plants with four stamens and four pistils]; the termination ‘na’ becoming the symbol of the class-word, indicating thereby, its relation to the department of Botany.

Any living thing or mineral could easily be named in this way, achieving Henderson’s goal of a system of nomenclature that would enable anyone, anywhere, to spontaneously come up with the same name for the same kind of organism or mineral (Henderson 1832, 176-178).

There is no record of a reply to Henderson from the Institut de France. In all likelihood, Quatermère de Quincy ignored the missive as yet another waste of paper from an uneducated crank.

#### *Summary of Differences and Similarities among the Schemes*

So far, we have looked at botanical schemes produced by a 17<sup>th</sup>-century Silesian and Englishman, and a Pole, a Swede, two Frenchmen who lived in the 18<sup>th</sup> century, and a 19<sup>th</sup>-century Englishman in Australia. Can we really say that the schemes they produced count as a multiple?

As Kuhn (1959, 344 note 348) and Troyer (1992, 838) note, using vague criteria about what counts as a multiple invention will make dissimilar inventions seem alike, whereas using overly strict criteria will make similar inventions seem dissimilar. While the strictness of criteria are subjective, I think it is reasonable to attempt to take a middle road, as Misa (1994) suggests, and assume that the dud-makers were working on the same sort of project, despite the individual differences. The differences can then be taken as evidence in support of the independence of the inventors. De Las’s opinions of Bergeret’s and von Wolf’s schemes as fundamentally similar in aim though not in execution substantiate this. Table 1 summarizes the differences among the schemes.

As is evident from the data in the following table (Table 1), there are no two inventors whose schemes look exactly alike. The languages they spoke, the

languages in which they wrote their proposals, and the precise details of the forms of the names that their schemes were meant to generate are variable. I have found only one obvious trend in their output: that is, the influence of Linnaeus on the characters acceptable to use for plant identification. In his *Genera plantarum* (1737), and in subsequent publications, Linnaeus restricted the kinds of evidence acceptable to use in descriptions of plants to number, figure, position, and proportion, banning reliance on colour, smell, taste, and other features dependent upon a plant's effect upon the person describing it (Linnaeus 2003, 219-236; Müller-Wille 2005, 88). These rules became widely accepted among botanists. Bergeret, de Las and Henderson obeyed these conventions, in contrast to Kinner, Wilkins, Polhem and von Wolf. This change in the conventions of which characters are suitable to use in plant descriptions is indicative of a basic shared awareness of at least some contemporary ideas in botany.

Person	Kinner	Wilkins	Polhem	von Wolf	Bergeret	de Las	Henderson
<b>Lived</b>	?-1649	1614-1672	1661-1751	1724-1784	1751 or 1752-1813	unknown	?-1836
<b>Occupation and/or interests</b>	Physician, lawyer, language instructor	Bishop	Mathematician and engineer	Physician, astronomer	Botanical instructor	Abbot, chemistry instructor	Naval surgeon, agricultural entrepreneur
<b>Scheme produced</b>	1645	1668	1739, 1741	1776, 1782	1783	1783	1830, 1831
<b>Location</b>	Silesia	London, England	Uppsala, Sweden	Gdansk, Prussia	Paris, France	Arras, France	Australia and India
<b>Languages spoken</b>	Latin, others	English, Latin	Swedish	Polish, French, some English	French	French, Latin	English
<b>Scheme language</b>	Latin	English	Swedish	Latin	French	French	English
<b>Taxon named</b>	Specimen or species	Specimen	Specimen	Family and genus (1776), family, genus and species (1782)	Species	Genus and species	Species
<b>Kind of plant features coded for</b>	'Qualities,' degrees of qualities, medicinal powers, habitat	Taxonomic position in the scheme	Shape, size, sensations plants produce in the viewer	Pistil number, stamen number, fruit type, inflorescence features, smell, taste, etc.	Flower form, number of flower parts, floret type (for composites)	Flower form, number of flower parts, leaf form	Pistil number, stamen number, taxonomic position in sexual system
<b>Plant features coded as alternating</b>	Letters or syllables	Letters	Letters (in different sizes and fonts)	Letters (with different accents)	Letters (in alphabetical order rather than with alternating consonants and vowels)	Letters (consonants, with vowels added at will)	Letters
<b>Format</b>	uninomial	uninomial	uninomial	Binomial	uninomial of 15 letters	binomial	Uninomial

Table 1. Summary of differences among the schemes discussed in this article.

As well, Kinner, von Wolf, Bergeret, and Henderson were physicians. This automatically gave them further familiarity with plants. The dud-makers were also all intellectually adventurous and motivated to succeed in their respective professions. Further, even the men who were not physicians received formal educations. They may therefore have all been exposed to similar perspectives about the functions of language and memory, particularly scholastic ideas such as Lullian combinatorics and syllogistic logic.

### *Influence of Lull*

Before combinatorial techniques were applied to botanical schemes, they were used to generate new *ideas*. Combinatorial approaches to idea generation had been tried in religious contexts since at least the 13<sup>th</sup> century, when Ramon Lull (1232?-1236?-1315) and his followers popularized his “art.” This was a way of looking at the world in terms of the attributes of God that could be found to varying extents in any given thing. The “art” was based on kabbalistic numerology, but Lull explained it with diagrams of concentric wheels with letters standing for divine attributes arranged on them. Rotating the wheels with respect to one another revealed different combinations of these attributes (Yates 1966, 176). When this was combined with the Ramist assumption of concepts as units that can be manipulated and the desire to methodize all knowledge so as to render it easier to memorize, the appeal of a combinatorial technique to discover new things about the world became even stronger. Alsted, a Lullist, Ramist, and prolific writer of all manner of encyclopaedic texts, spread the word until the mnemotechnic/ combinatorial/unified system of knowledge tradition was prevalent all over Europe (Rossi 2000, 131-136). As mentioned earlier, Alsted was the teacher of Comenius, the language reformer who went on to influence a number of universal language projectors in the mid-to-late 17<sup>th</sup> century, including John Wilkins (Lewis 2007, 131-132; Maat 2004, 11-12). But the development of an all-encompassing combinatorial approach to knowledge was to hit a major snag. The polymath Gottfried Wilhelm Leibniz’s (1646-1716) experience with it illustrates what went wrong.

Leibniz was certainly inspired by Lullist and Ramist conceptions of knowledge, especially through his readings of the philosophical language projectors George Dalgarno (1626?-1687, another member of Hartlib’s circle) and Wilkins (Maat 2004, 69, 184, 270; but see also Lewis 2007-132). He took the idea of combining unit attributes in many different ways to a new level. He not only envisaged the generation of new ideas by combinatorial means, by transporting the permutation and combination techniques he developed in mathematics to the realm of human thought in general; he also wrote that if all ideas could be reduced to their basic components, and if those basic elements of thought could be recombined systematically, all known ideas as well as new and interesting ideas could be generated (Maat 2004, 273). Leibniz’s emphasis on as-yet-undiscovered ideas becoming obvious because of the possibility of exhausting all logical combinations was unusual; most of his predecessors and

contemporaries did not quantify the number of ideas that would be generated or make recourse to logic in this way. Most importantly, Leibniz also perceived that many of the ideas generated this way would be irrelevant. He saw that their number would also be so vast that nobody would have the time to deal with them all one by one. He suggested that a “method of exclusions” would be a way to separate the wheat from the chaff (Davies 1986, 267). This mental winnowing technique, like many of his other ideas concerning the complete enumeration and systematization of everything and the perfection of human thought, was more of a desideratum than a functional algorithm. Neither he nor anyone else was successful in developing an *a priori* method to separate the useful from the fanciful or the existent from the possible. Despite the centuries of efforts put into them, scholarly attention to combinatorial idea-generation techniques began to fade by the 18<sup>th</sup> century (Rossi 2000, xviii, 44). The evolutionary epistemology of trial and error—the only way that worked to pick out good ideas—was simply not quick or logical enough (Campbell 1974).

Combinatorial descriptions, however, did experience a certain form of revival in a discipline in which they still promised some utility—botany (Rossi 2000, 171). The technique survived in botany not because it had any absolute predictive value, but rather because it provided a tool for describing plants that worked well with the knowledge of plants that was available in the 18<sup>th</sup> and 19<sup>th</sup> centuries, as described above.

#### *Mnemonic Names for Syllogistic Moods*

Though details of their formative years are few, the dud-makers likely also shared exposure to the same mnemonic technique used in philosophy classes. It was normal until the logic reforms of the 19<sup>th</sup> century for the medieval names of categories of syllogisms, called moods, to be explained in university courses through the use of 24 odd-sounding mnemonic names: Barbara, Celarent, Darii, Ferio, Barbari, Celaront, Cesare, Camestres, Festino, Baroco, Cesaro, Camestrop, Darapti, Disamis, Datisi, Felapton, Bocardo, Ferison, Bramantip, Camenes, Dimaris, Fesapo, Fresison and Camenop. Each of the three vowels in the name of a mood indicates in turn the categorical forms of the two different premises and the conclusion of all syllogisms that are of that mood. The consonants yield information about how to convert syllogisms of the last twenty moods into syllogisms of the first four moods through a series of logical operations somewhat akin to proving trigonometric identities.<sup>16</sup> Youthful familiarity with these coded, descriptive, meaningful and pronounceable names may have implanted the idea in the dud-makers’ minds that plant names formed in a similar way could solve the problem of synonymy. However, none of the dud-makers referred to the naming of syllogistic moods in his works, and none

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<sup>16</sup> See Spade 2002, 14-25, for a detailed explanation of how this system worked.

claimed to have made systems that were intended, as syllogistic moods were, to exhaust all logical possibilities. Chances are that whatever influence knowledge of the syllogistic mood names had on the dud-makers was not in the forefront of their minds when they were constructing their schemes.

Considering that the men grew up in different economic and cultural circumstances and also had different interests, there must also be other factors at play to differentiate the dud-makers from their contemporaries who shared similar university educations and an interest in botany, but who did not go on to create duds. Whatever these factors were in the lives of the individual dud-makers, however, is likely to be impossible to determine, given both the fragmentary records of their lives that have been preserved and the difficulty of pinpointing exact sources of scientific inspiration.

### *Why Was This Dud Reinvented?*

Well, what are we to make of these ‘duds’? Clearly they did not work as well in practice as their inventors had hoped. Names cannot be and should not be detailed descriptions of things. Other, more worldly botanists pointed out that the descriptive names generated by these schemes would be similar for similar-looking plants, or too long, or unpronounceable, or even just useless. Von Wolf’s, Bergeret’s, de Las’s and Henderson’s schemes would also have had to overcome the entrenched standard of Linnaean binomials in order to gain acceptance—not to mention the problems that these schemes would have had with giving distinct names to specimens with absent, unclear or unusual features. The dud-makers had all come up with something that worked for them for tens or hundreds of plants and extrapolated their schemes’ potential without accounting for problems of scale.

Botanists with better access to collections and greater networks of collaborators than the men whose schemes I described realized that schemes based on memorization alone were not going to work. In the 17<sup>th</sup>, 18<sup>th</sup>, and early 19<sup>th</sup> centuries, species of plants were thought to be the most numerous kind of thing in the world.<sup>17</sup> As mentioned in the introduction above, Caspar Bauhin was said to have described over 6,000 plant kinds had in his *Pinax theatri botanici* of 1623. Authors of more widely-accepted botanical schemes frequently mentioned the number of entries in the *Pinax* when discussing how numerous plant kinds are. They were aware that whatever schemes they were to develop had to distinguish these memory-busting numbers of kinds. And although each of the proponents of meaningful plant names was concerned with the pronounceability, regularity and brevity of the names they designed, the names themselves were far from memorable. Kinner, Polhem, von Wolf and the others had all made the same mistakes in regarding human memory as operationally equivalent to the “artificial memory” of the written word.

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<sup>17</sup> Whether the “species” hold up as valid species today is beside the point, since what matters here is the number of kinds of things that needed to be distinguished in the schemes.



For instance, while Henderson was correct that memory is helped by narrative, rhyme, and order of a sort, he and all of the other scheme-builders described here neglected to take into account that imagery, spatiality, dramatic elements, metaphor and metonymy are also effective mnemonic aids. The centuries-old tradition of *ars memoria*, based on these techniques, may have been dying in the 17<sup>th</sup> century, but it was still in use among lettered and unlettered folk alike during the time when at least Kinner and Wilkins were writing (Rossi 2000, original Italian publication 1975). No dud-maker described in this paper, however, refers to or seems to make use of this tradition. Instead, what their names made up for in regularity, they lost in salience. Essentially what these men had done was to take techniques that worked well in print—a fixed order, coded short forms, tabular layouts—and assumed that they would transfer well to memory and speech. The results “speak” for themselves.

This kind of thinking about thought, I should add, was not confined to dud-makers. A number of their contemporaries also seemed so comfortable with books and their layouts that they imposed these arrangements on their conceptions of how the natural world is structured. When the English botanist John Hill, for instance, proposed in 1759 the foundation of a botanical garden for public instruction, he wrote that such a garden would be “a kind of living herbal” (Hill 1759, 17). Hill’s remark shows that the printed page as a means of organizing natural history was well entrenched in enlightenment culture. Hill brought his comfort with books with him into the field and turned herbals, which were meant as stand-ins for living plants, into models for arranging gardens. All of these examples suggest that we should be extra-careful not to justify classifications according to the techniques or metaphors that happen to be trendy at a given time. As we push the envelope of each new tool for investigating and maintaining information about nature, we also confine ourselves to thinking about nature in terms of our tools’ limitations.

A friend of mine, systematic botanist Tim Dickinson, explained to me years ago that any good system of botanical organization has to have local memorizability, so that botanists can recall the names of plants that they work with, and global “look-upability,” so that unfamiliar plants can be identified quickly. The sheer number of plant kinds necessitates a written record for this purpose. And if a record is written, it is best recorded in terms that a casual reader can understand: that is, in ordinary words, which do not require users to memorize both technical distinctions and their letter codes. Kinner, Polhem, and the others did not work hands-on with enough plants when they were writing their schemes to have encountered these limits of human memory.

### *Aftermath*

Although some isolated people were still promoting combinatorial plant names into the 19<sup>th</sup> century, the majority of botanists and even laypeople by

that time were cynical enough to greet proposals of this type with sarcasm. For instance, a notice in the *Athenaeum*, a popular magazine, stated, “We understand that some German botanists are labouring at the invention of cabalistic characters for plants ... we suppose the Algebraic botany will be called a natural system!!” (“Algebraic Botany” 1828) The two exclamation marks leave no doubt about how many combinatorial schemes and so-called “natural systems” the public had seen come and go before.

Curiously, one might say, duds of the kind described earlier did not remain duds forever. Rusty and abandoned technologies can be refined and transported to new contexts where they will shine. Removing the need for coded plant descriptions to be names, for instance, results in a kind of shorthand. A number of 18<sup>th</sup> century botanists had toyed with symbolic ways to describe plant features to compress information in this way, including Jean-Jacques Rousseau (Cook 2004, 80-87). Peter Stevens has described a number of other formalized floral diagrams and floral formulas from the early 19<sup>th</sup> century (Stevens 1994, 139-141; Stevens reproduces a page of floral formulas from Seringe and Guillard 1836). Like shorthand, floral diagrams and formulas can be useful tools for describing plant structure in a compact and efficient way. And like shorthand, they are not meant to be read aloud as anything but a series of words.

Maintaining the reference function of descriptive coded names and the place values of each letter, but removing the need for them to be pronounced, yields a way to make call numbers. Schulte-Albert’s work on Kinner praises him for developing a “faceted classification” much like those now used in library catalogues.<sup>18</sup> Nobody memorizes thousands of call numbers, but they are useful written reminders of where books are located. Modifying the schemes in another way produces “hash tables.” These are essentially one-line, computer-generated summaries of database entries, also used as their addresses. And Henderson’s logical guidelines for deciding legal cases and for identifying and naming plants can be easily turned into flow charts or computerized “expert systems,” used for similar diagnostic purposes since the 1960s. Evidently, substituting written “memory” or computer memory for human memory could give these duds new life.

This situation should raise a historiographical flag regarding the extent to which scientific creativity may be technologically determined, or, at least, constrained. Cases of multiple duds becoming multiple inventions support the idea that, to paraphrase Greg Radick’s assertion about theories, in principle, any unsuccessful invention may have the potential to succeed with the addition of the right technological fix (Radick 2006, 31). If duds can be converted to success stories merely by the addition of new technologies, we need to look in more detail at technologies that were rejected in their own times. Only then will we be

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<sup>18</sup> In fact, the colon classification “facets” of S. Ranganathan, the man now hailed as the father of faceted library classifications – personality, matter, energy, space and time – bear an uncanny resemblance to Aristotle’s predicaments or categories – substance, quantity, quality, relation, place, time, position, state, action, and passion – as Hans Schulte-Albert pointed out (1974, 324).

able to give a more complete account of what processes give rise both to the contingency and the inevitability of both dud and successful multiple inventions.

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### *References*

- Algebraic Botany. 1828. *Athenaeum* 60: 956.
- Bergeret, J. 1783-1784. *Phytonomatotechnie universelle*, Vol. I-III. Paris: l'auteur, Didot, et Poisson,
- Bergeret, J. 1783. *Phytonomatotechnie universelle. Journal de physique, de chimie, d'histoire naturelle et des arts.* 22(1): 157-159.
- Brannigan, A. 1981. *The Social Basis of Scientific Discoveries*. Cambridge: Cambridge University Press.
- Browne, J. 1989. Botany for Gentlemen: Erasmus Darwin and the Loves of the Plants. *Isis* 80(4): 592-621.
- Buffon, G. 1749. *Histoire naturelle générale et particulière, avec la description du Cabinet du Roy*. Vol. 2. Paris: Imprimerie Royale.
- Campbell, D. T. 1974. Evolutionary Epistemology. In *The Philosophy of Karl Popper*, ed. P. A. Schlipp. La Salle: Open Court.
- Candolle, A. de. 1813. *Théorie élémentaire de la botanique*. Paris: Déterville.
- Candolle, A. de. 1880. *La phytographie*. Paris: G. Masson.
- Cook, A. 2004. Rousseau and the Languages of Music and Botany. In *Musique et langage chez Rousseau*, ed. Claude Dauphin. Oxford: Voltaire Foundation.
- Crosland, M. 1981. Scientific Credentials: Record of Publications in the Assessment of Qualifications for Election to the French Académie des Sciences. *Minerva* 19(4): 605-631.

- Dalmasso, G. 2005. Presence de la 'chymie' dans la France du Nord, de la deuxième moitié du XVIII<sup>e</sup> siècle au premier tiers du XIX<sup>e</sup>: sa diffusion et son enseignement public et privé, son application aux arts. Ph. D. diss., Université Charles de Gaulle de Lille III.
- Davies, R. 1986. Classification and Ratiocination: A Perennial Quest. In *Intelligent Information Systems: Progress and Prospects*, ed. R. Davies. Chichester: Ellis Horwood.
- Dayrat, B. 2003. *Les botanistes et la flore de France: trois siècles de découvertes*. Paris: Muséum National d'Histoire Naturelle.
- DeMott, B. 1958. The Sources and Development of John Wilkins' Philosophical Language. *Journal of English and Germanic Philology* 57: 1-13.
- Deshoussayes, A. 1781. Lettre de M. l'Abbé des Houssayes sur une nouvelle distribution botanique, par un autre étranger. *Journal de physique, de chimie, d'histoire naturelle et des arts*: 404-406.
- du Petit-Thouars, A. 1811. Dissertation sur l'enchaînement des êtres, lue en la séance publique du Collège des Philalèthes de Lille, du 19 mai 1788. In *Mélanges de botanique et de voyages*. Paris: Arthus Bertrand.
- Duméril, A. C. 1806. *Zoologie analytique, ou méthode naturelle de classification des animaux, rendue plus facile à l'aide de tableaux synoptiques*. Paris: Allais.
- Flourens, P., ed. 1857. *Recueil des éloges historiques lus dans les séances publiques de l'Académie des Sciences ... 2<sup>e</sup> Série*. Paris: Garnier frères.
- Frängsmyr, T. 2000. *Svensk Ideéhistoria: Bildning och Vetenskap under Tusen År*. Vol. 1. Stockholm: Natur och Kultur.
- Gilibert, J. E., and L. C. de Fleurieu de la Tourette. 1797. *Démonstrations élémentaires de botanique*. 3rd ed. Lyon: Bruyset Frères.
- Henderson, J. [1832] 1965. A Letter on Nomenclature Addressed to M. Quatremere de Quincy, Perpetual Secretary to the Institute of Paris. In *Observations on the colonies of New South Wales and Van Diemen's Land*. Reprint, Adelaide: Adelaide Libraries Board of South Australia.
- Hill, J. 1759. *The Usefulness of a Knowledge of Plants: Illustrated in Various Instances, Relating to Medicine, Husbandry, Arts, and Commerce*. London: R. Baldwin and J. Jackson.
- Hoare, M. E. 1968. Dr. John Henderson and the Van Diemen's Land Scientific Society. *Records of the Australian Academy of Science*. 1(3): 7-24.
- Hughes, T. P. 1994. Technological Momentum. In *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. M. R. Smith and L. Marx. Cambridge, MA: MIT Press.
- Hunt Institute of Botanical Documentation. 1963. *The Bicentennial of Michel Adanson's "Familles des Plantes."* Vol. 1. Pittsburgh: Carnegie Institute of Technology.
- Kasia. 2004. *Gdanskcy Lekarze: Nathaniel Mateusz Wolf*. Gdansk: Akademia Rzygaczy. Accessed September 2006.  
<http://www.rzygacz.webd.pl/index.php?id=31,155,0,0,1,0>.

- Kuhn, T. S. 1959. Energy Conservation as an Example of Simultaneous Discovery. In *Critical Problems in the History of Science*, ed. M. Clagett. Madison: University of Wisconsin Press.
- Lamb, D., and S. M. Easton. 1984. *Multiple Discovery: The Pattern of Scientific Progress*. Amersham: Avebury.
- de Las, A. 1783. *Phytographie universelle*. Stockholm: Frères Perisse.
- Leclair, E. 1908. Les Lestiboudois (Jean-Baptiste, François-Joseph, Thémistocle): Botanistes Lillois. *Bulletin de la Société d'Études de la Province de Cambrai* 12: 39-91.
- Lewis, R. 2007. *Language, Mind and Nature: Artificial Languages in England from Bacon to Locke*. Cambridge: Cambridge University Press.
- Lindroth, S. 1997. *Svensk Lärdomshistoria*. Vol. 2. Stockholm: Norstedts.
- Linnaeus, C. 1737. *Genera plantarum*. Batavorum: Conradum Wishoff.
- Linnaeus, C. 1738. *Classes plantarum*. Lugduni Batavorum: Conradum Wishoff.
- Linnaeus, C. 1787. *The Families of Plants, with Their Natural Characters, According to the Number, Figure, Situation, and Proportion of All the Parts of Fructification*. Vol. 1. Lichfield: "A Botanical Society."
- Linnaeus, C. 2003. *Philosophia botanica*. Translated by Stephen Freer. Oxford: Oxford University Press.
- Maat, J. 2004. *Philosophical Languages in the Seventeenth Century: Dalgarno, Wilkins, Leibniz*. Dordrecht: Kluwer.
- McMahon, S. 2001. Constructing Natural History in England: 1650-1700. Ph. D. Diss., University of Alberta.
- McQuat, G. R. 1996. Species, Rules and Meaning: The Politics of Language and the Ends of Definitions in 19<sup>th</sup> Century Natural History. *Studies in History and Philosophy of Science* 27(4): 473-519.
- Merton, R. K. 1961. Singletons and Multiples in Scientific Discovery: A Chapter in the Sociology of Science. *Proceedings of the American Philosophical Society* 105: 470-486.
- Misa, T. J. 1994. Retrieving Sociotechnical Change from Technological Determinism. In *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. M. R. Smith and L. Marx. Cambridge, MA: MIT Press.
- Müller-Wille, S. 2007. Collection and Collation: Theory and Practice of Linnaean Botany. *Studies in History and Philosophy of Biological and Biomedical Sciences* 38(3): 541-562.
- Müller-Wille, S. 2005. La science baconienne en action: la place de Linné dans l'histoire de la taxonomie. In *Les fondements de la botanique: Linné et la classification des plantes*, ed. T. Hoquet. Paris: Vuibert.
- Müller-Wille, S. 1995. Linnaeus' Concept of a 'Symmetry of All Parts'. *Jahrbuch für Geschichte und Theorie der Biologie* 2: 41-47.

- Müller-Wille, S., and S. T. Scharf. Submitted 2008. Indexing Nature: Carl Linnaeus (1707-1778) and His Fact-Gathering Strategies. Working paper in *The Nature of Evidence: How Well Do 'Facts' Travel?* London: London School of Economics and Political Science.
- Phytonomatotechnie universelle. 1783. *Journal des Sçavans*: 311-312.
- Poggendorff, J. C. 1863. *Biographisch-Literarisches Handwörterbuch zur Geschichte der Exacten Wissenschaften*. Vol. 2. Leipzig: Johann Ambrosius Barth.
- Polhem, C. 1954. *Efterlämnade Skrifter. Utg. Av Lärdomshistoriska Samfundet*. Vol. 4. Uppsala: Almqvist and Wiskell.
- Presents Made to the Royal Society from November 1780 to July 1781; with the Names of the Donors. 1781. *Philosophical Transactions of the Royal Society of London* 71: 527.
- Presents Made to the Royal Society from November 1783 to July 1784; with the Names of the Donors. 1784. *Philosophical Transactions of the Royal Society of London* 74: 503.
- Radick, G. 2006. Other Histories, Other Biologies. In *Philosophy, Biology and Life (Royal Institute of Philosophy supplement 56)*, ed. A. O'Hear, 21-47. Cambridge: Cambridge University Press.
- Ray, J. [1848] 1975. *The Correspondence of John Ray*, ed. E. Lankester. London: Ray Society. Reprint, Arno Press.
- Rossi, P. 2000. *Logic and the Art of Memory: The Quest for a Universal Language*. Trans. Stephen Clucas. London: The Athlone Press.
- Library and Archive Catalogue Record Ec/1776/26: Certificate of Election and Candidature for Wolf, Nathaniel Matthew. In *Royal Society of London Database*. London: Royal Society of London.  
<http://www.royalsoc.ac.uk/Dserve/dserve.exe?dsqIni=Dserve.ini&dsqApp=Archive&dsqDb=Catalog&dsqSearch=RefNo=='EC/1776/26'&dsqCmd>Show.tcl>.
- Salmon, V. 1966. Language-Planning in Seventeenth-Century England: Its Contexts and Aims. In *In Memory of J. R. Firth*, ed. C. E. Bazell, J. C. Catford, M. A. K. Halliday and R. H. Robins. London: Longmans, Green and Co.
- Scharf, S. T. 2009. Identification Keys, the "Natural Method," and the Development of Plant Identification Manuals. *Journal of the History of Biology*. 41(1). <http://www.springerlink.com/content/2p5p725220416620/>.
- Scharf, S. T. 2007. *Identification Keys and the Natural Method: The Development of Text-Based Information Management Tools in Botany in the Long Eighteenth Century*. PhD Diss. Toronto: University of Toronto.
- Schulte-Albert, H. G. 1979. Classificatory Thinking from Kinner to Wilkins: Classification and Thesaurus Construction, 1645-1668. *Library Quarterly* 49(1): 42-64.
- Schulte-Albert, H. G. 1974. Cyprian Kinner and the Idea of a Faceted Classification. *Libri*. 24(4): 324-337.

- Séance du lundi 10 juin 1811. 1832/1835. In *Comptes-rendus hebdomadaires des séances de l'Académie des Sciences publiés . . . par les Secrétaires Perpétuels*. Paris: Académie des Sciences.
- Senebier, J. 1775. *L'art d'observer*. Genève: Cl. Philibert et Bart. Chirol.
- Seringe, N., and J. Guillard. 1836. *Essai de formules botaniques représentant les caractères des plantes par des signes analytiques qui remplacent les phrases descriptives*. Paris: J. Albert Mercklein.
- Simonton, D. K. 1986. Stochastic Models of Multiple Discovery. *Czechoslovak Journal of Physics* 36(1): 138-141.
- Simonton, D. K. 2003. Scientific Creativity as Constrained Stochastic Behavior: The Integration of Product, Person, and Process Perspectives. *Psychological Bulletin* 129(4): 475-494.
- Simonton, D. K. 2004. *Creativity in Science: Chance, Logic, Genius, and Zeitgeist*. Cambridge: Cambridge University Press.
- Slaughter, M. M. 1982. *Universal Languages and Scientific Taxonomy in the Seventeenth Century*. Cambridge: Cambridge University Press.
- Smith, J. E., Sir. 1826. *A Grammar of Botany, Illustrative of Artificial, as well as Natural, Classification, with an Explanation of Jussieu's System*. London: Longman, Rees, Orme, Brown, and Green.
- Spade, P. V. 2002. *Thoughts, Words and Things: An Introduction to Late Medieval Logic and Semantic Theory*. 1.0.  
[http://pvspade.com/Logic/docs/thoughts1\\_1a.pdf](http://pvspade.com/Logic/docs/thoughts1_1a.pdf).
- Stevens, P. F. 2006. An End to All Things? Plants and Their Names. *Australian Systematic Botany* 19(2): 115-133.
- Stevens, P. F. 1994. *The Development of Biological Systematics: Antoine-Laurent de Jussieu, Nature, and the Natural System*. New York: Columbia University Press.
- Stevens, P. F. 2002. Why Do We Name Organisms? Some Reminders from the Past. *Taxon* 51(1): 11-26.
- Troyer, J. R. 1992. On the History and Characteristics of Some Multiple Discoveries in Botany, 1648-1965. *American Journal of Botany* 79(7): 833-841.
- Walker, W. 1981. Native American Writing Systems. In *Language in the USA*, ed. C. A. Ferguson and S. B. Heath. Cambridge: Cambridge University Press.
- Weiss. 1854. Bergeret (Jean-Pierre). In *Biographie universelle*, ed. Michaud. Paris: Madame C. Desplaces.
- Wilkins, J. 1668. *An Essay towards a Real Character and a Philosophical Language*. London: S. Gellibrand.
- Withering, W., and J. Stokes. 1787. *A Botanical Arrangement of British Plants*. Birmingham: M. Swinney.
- Von Wolf, N. M. 1776. *Genera plantarum vocabulis characteristicis definita*. n. c.: n. p.

- Von Wolf, N. M. 1781. *Genera et species plantarum vocabulis characteristicis definita*. Marienwerder: Joan. Jac. Kanteri.
- Yates, F. A. 1966. *The Art of Memory*. Chicago: University of Chicago Press.