# LINNAEUS: THE ORDER OF NATURE, THE NATURE OF MAN, AND EVOLUTION

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A graduate of Medicine, when that Faculty was still responsible for the education of naturalists, Linnaeus is known primarily for the creation of a standard for systematic categories. Until then, classification was at times by different couples, at other times by different triplets (by species and classes, by species, families, orders, and so on). However, the Swedish naturalist conceived a system based on five units (classes, orders, genera, species, varieties), which was soon adopted by the whole scientific community. The fact that it derived from philosophical tradition (by admission of Linnaeus himself, following Aristotelian logic: *Genus summum*, *Genus intermedium*, *Genus proximum*, *Species*, *Individuum*) turned out to be a strength rather than a weakness.

The Swedish naturalist created a new standard for the criteria of ordering. Until then botanical classification was based exclusively on the leaves (L'Obel), the seed (Cesalpino), the corolla (Tournefort), the pericarp (Boerhaave), the calyx (Magnol), and so on. However, Linnaeus elaborated a principle of subordination of characters: classes were identified according to the number, form, position and proportion of the stamens; within classes, orders were determined according to the number, form, position and proportion of the pistils; within orders, genera were delimited according to the other parts of the flower; within genera, species were determined according to the parts of the fruit; within species, varieties were distinguished according to the other parts of the plant. This was (as we would say today) a complex principle of weighted evaluation (the male genital organs were primary, the female ones secondary, and so on), which was known as the "sexual system" and encountered various difficulties in being accepted. This was because the sexuality of plants (supposed by Prospero Alpino in 1592, corroborated by Nehemiah Grew in 1682 and confirmed by Rudolph Camerer in 1694) was rejected by Giulio Pontedera, among others, and would be variably contested again in the 1830s. Moreover, Linnaeus' sexual system was the target of both scientific and ideological criticisms (the German botanist Johann Siegesbeck asked that it be censored so that young people would not be scandalized and corrupted: "who would have thought that hyacinths, lilies and onions were so immoral? [...] And who could expose this method to young people without offending them?").[1] Finally Linnaeus himself undermined the idea, since he could not apply the "sexual system" to the whole animal kingdom: he also classified animals on the basis of the complexity of the circulatory system, the respiratory apparatus, the appendages.

However, despite encountering various difficulties in being accepted, the sexual system also gained some immediate approval and important applications in botany, such as Georg Ehret's *Methodus plantarum sexualis* (1736: see fig. 1), a very effective visualization of the Linnaean system (the *Monandria* were characterized by a stamen and a pistil, the *Diandria* by two stamens and one pistil, and so on), which hung in every profes-

Fig.1


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sional office and was exhibited in every botanical garden. Linnaeus reorganized the botanical garden of Uppsala into twenty-four beds, corresponding to his twenty-four classes, which obviously did not coincide with any of the previously identified sections. Thanks to the application of rigorous criteria also in the zoological field, Linnaeus managed to provide an important contribution to the ongoing rationalization of the natural sciences. This was despite the fact that, due to the objective difficulty in proceeding with empirical controls, Linnaeus was still easy prey of the many fables still in circulation (in 1749, he did not hesitate to set out on a journey to obtain the specimen of a mermaid stranded - he was convinced - on the coast of Denmark). In the first edition of *Systema naturae* (1735), he included myths like the unicorn or the vegetable lamb of Tartary (which apparently grew near Samarkand) among the *Paradoxa* - Absurdities.

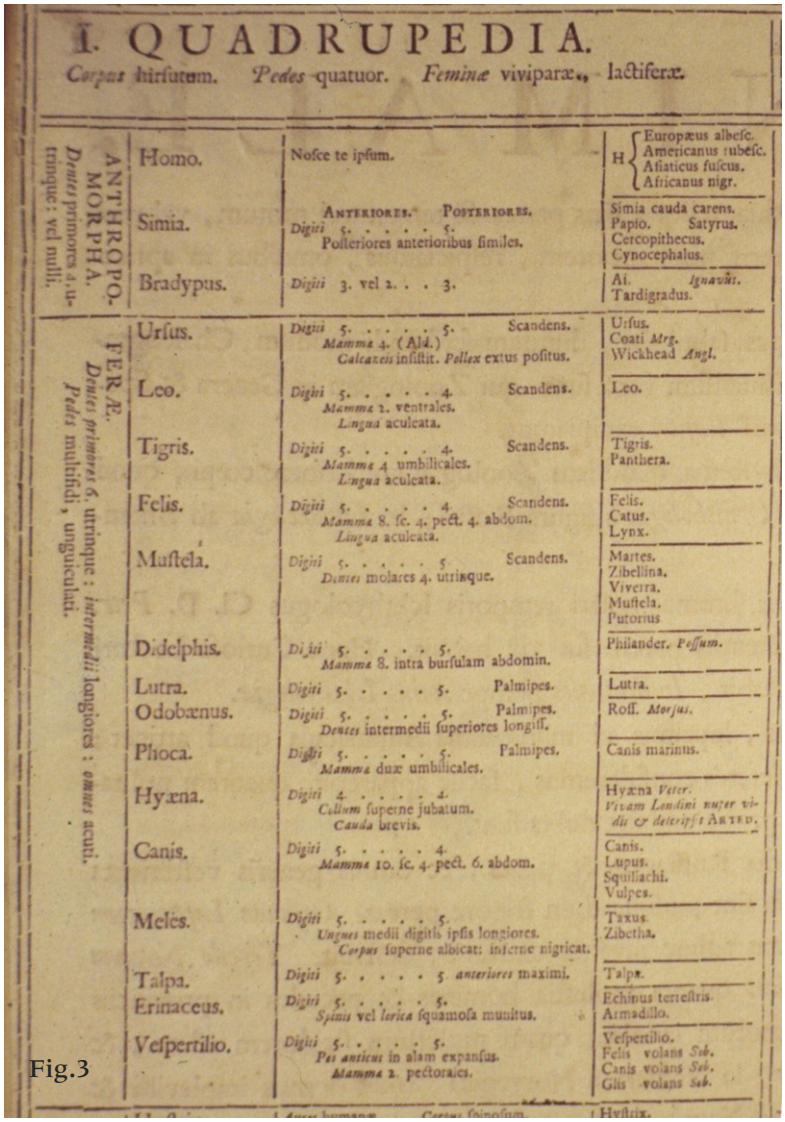
The Swedish naturalist was also responsible for the radical reform of nomenclature. This was not a mere corollary of the taxonomic revolution, nor – as it might seem – a merely formal operation. Botanists still named plants by means of a long "phrase", not by chance also called "diagnosis". It was a synthetic description of the plant which, without the setting of any limit, was designated by five, seven and even sixteen terms: a species of convolvolus was described as *Convolvolus africanus albus, seminibus calyce longissimo immersis, folio subrotundo, ad unum plerumque latus crena singolari donato*.[2] This made memorization, and thus the exchange of information, virtually impossible. Recognizing a difficulty already expressed by, among others, Pierre Belleval and John Ray, Linnaeus wished to impose on all plants, as on all animals, the same brief format, based on the surname-name model, of only two terms: the first indicating the 'family' (the genus) of membership, the second the individual - the species. Thus was born the economical but weighty generic-specific binomial still in use today (*Convolvolus scammonia*, *Canis lupus*, *Felix catus,* etc.), which compelled the Swedish naturalist to rename, like a second Adam, all living things - an operation completed in 1753 for the 7700 plants (*Species plantarum*) and in 1759 for the 4400 animals (tenth edition of *Systema naturae*). This was not, as I mentioned before, the fruit of a merely formal operation: replacing the "phrase" with the generic-specific binomial meant replacing the lacunose (yet cumbersome) morphological description of a living being with the exact identification of its place in nature. As we will soon see, this had extraordinarily important implications.

A presentation of Linnaean systematics (even a summary) would be culpably incomplete if it did not include the place of man in nature. Linnaeus solved this problem - perhaps the most delicate one of all - with a choice that was in itself revolutionary and probably influenced Western culture even more profoundly than his other work. The problem of man's place in nature was closely related to the common image of the anthropoid apes.[3] The chimpanzee was known in a morphologically acceptable manner: it had first been illustrated in 1641[4] and then more correctly in 1699[5], although it was narrated, for instance, that it ate at table "no less properly than you would see doing a refined courtier", that it went to bed "like the most polite of men",[6] and that it was endowed with such intelligence as to perform domestic chores[7] and could ably play the flute and the zither.[8] Nothing was yet known of the gorilla, except for accounts of travellers who referred to it as a simian resembling man from both the physical point of view ("it is very tall, has a human face […] and walks upright") and the behavioural perspective (it uses tools, is organized socially and performs complex rituals, such as that of burial)[9], but who did not illustrate it. The gibbon made its first appearance between 1766 and 1768. Hence naturalists of the time knew, in addition to the chimpanzee, only the orangutan. Yet, it existed only in the version furnished by Jakob de Bondt in 1658[10], and it was narrated that it was not only a bipedal creature of human appearance but also chaste ("the female hides from men she does not know"), capable of all emotions and even able to speak. Indeed, if it did not speak, it was "to not be forced to work"; revealed to belong to the human species (in Malay, "orang-utan" means "man of the woods"), it feared that it would be immediately reduced to slavery.[11] In compensation, there existed for some time a "rare cercopithecus" that appeared in 1486[12] and, extraordinarily, survived thanks to the first of the great naturalistic encyclopaedias, published by Conrad


Fig.2

Gesner between 1551 and 1587, and the fact that it was discussed by Ulisse Aldrovandi. Certainly this was an animal, but it "could be taken for a savage"[13] and was "endowed with so much intelligence that some men are inferior to it".[14]

Linnaeus accepted without question these images (see fig.2)[15] and these descriptions. This might be considered unworthy of his rigour, but it must be considered that nobody had been able to check the veracity of the travellers' accounts and that it was exactly his rigorous nature that compelled him to consider everything present in the literature. Thus he could state that "it is a difficult enterprise to find the specific difference of man"[16], and even that "there is not a single character allowing the distinction of man from simian",[17] not even from the point of view of intellectual performance: "the stupidest simian differs so little from the wisest man that one must still find the geodesist of nature able to trace a line of division between them."[18] And from the first edition of *Systema naturae*, he took the initiative - for the first time in the history of the natural sciences - of classifying man in the animal kingdom (see fig. 3). However, not even this was a purely formal operation. It is true that in classifying the genus *Homo* in the order Anthropomorpha (later Primates) of the class Quadrupedia (later Mammalia), Linnaeus was also influenced by the credit given to the many (too many) fables about apes still in circulation; and it is true that those fables later led him to place the orang-utan (since it "thought") not on the borderline between *Simia* and *Homo* but within the latter genus: renamed *Homo nocturnus* in the tenth edition of *Systema naturae*, the orang-utan was assumed as a second species of man.[19] Yet, whatever can be said about the broadly debatable nature of this great turning point, and whatever can be said about the partially abstract and artificial nature of classifications (which many simply considered a necessary but purely conventional tool), it must be recognized that the Swedish naturalist was, by this method, able to accelerate the ongoing process of the laicization of nature, attempting a complete "mundanization" of man and initiating the transfer of anthropology from the universe of letters and theology to the purview of the natural sciences.



I. QUADRUPEDIA.

*Corpus* hirsutum. *Pedes* quatuor. *Feminæ* viviparæ, lactiferæ.

| | | | |
|---|---|---|---|
| ANTHROPOMORPHA. *Dentes primores 4. utrinque: vel nulli.* | Homo. | Nosce te ipsum. | H { Europæus albesc. Americanus rubesc. Asiaticus fuscus. Africanus nigr. |
| | Simia. | ANTERIORES. POSTERIORES. *Digiti* 5. . . . . 5. *Posteriores anterioribus similes.* | Simia cauda carens. Papio. Satyrus. Cercopithecus. Cynocephalus. |
| | Bradypus. | *Digiti* 3. vel 2. . . 3. | Ai. *Ignavus.* Tardigradus. |
| FERÆ. *Dentes primores* 6. *utrinque: intermedii longiores: omnes acuti. Pedes multifidi, unguiculati.* | Ursus. | *Digiti* 5. . . . . 5. Scandens. *Mamma* 4. (Ad.) *Calcaneis* insistit. *Pollex* extus positus. | Ursus. Coati *Mrg.* Wickhead *Angl.* |
| | Leo. | *Digiti* 5. . . . . 4. Scandens. *Mamma* 2. ventrales. *Lingua* aculeata. | Leo. |
| | Tigris. | *Digiti* 5. . . . . 4. Scandens. *Mamma* 4 umbilicales. *Lingua* aculeata. | Tigris. Panthera. |
| | Felis. | *Digiti* 5. . . . . 4 Scandens. *Mamma* 8. sc. 4. pect. 4. abdom. *Lingua* aculeata. | Felis. Catus. Lynx. |
| | Mustela. | *Digiti* 5. . . . . 5 Scandens. *Dentes* molares 4. utrinque. | Martes. Zibellina. Viverra. Mustela. Putorius |
| | Didelphis. | *Digiti* 5. . . . . 5. *Mamma* 8. intra bursulam abdomin. | Philander. *Possum.* |
| | Lutra. | *Digiti* 5. . . . . 5. Palmipes. | Lutra. |
| | Odobænus. | *Digiti* 5. . . . . 5. Palmipes. *Dentes* intermedii superiores longiss. | Ross. *Morjus.* |
| | Phoca. | *Digiti* 5. . . . . 5. Palmipes. *Mamma* duæ umbilicales. | Canis marinus. |
| | Hyæna. | *Digiti* 4. . . . . 4. *Collum* superne jubatum. *Cauda* brevis. | Hyæna *Veter.* *Vivam Londini nuper vidi & descripsi* ARTED. |
| | Canis. | *Digiti* 5. . . . . 4. *Mamma* 10. sc. 4. pect. 6. abdom. | Canis. Lupus. Squiliachi. Vulpes. |
| | Meles. | *Digiti* 5. . . . . 5. *Ungues* medii digitis ipsis longiores. *Corpus* superne albicat: inferne nigricat. | Taxus. Zibetha. |
| | Talpa. | *Digiti* 5. . . . . 5 *anteriores* maximi. | Talpa. |
| | Erinaceus. | *Digiti* 5. . . . . 5. *Spinis* vel *lorica* squamosa munitus. | Echinus terrestris. Armadillo. |
| | Vespertilio. | *Digiti* 5. . . . . 5. *Pes anticus* in alam expansus. *Mamma* 2. pectorales. | Vespertilio. Felis volans *Sub.* Canis volans *Sub.* Glis volans *Sub.* |

Fig.3

It should also be underlined that his new systematics overturned the traditional idea of *scala naturae*. Linnaeus was also the one who, together with Vitaliano Donati, promoted a new image of nature:[20] that of the "network" or "map" (nature is arranged "like the territory on a geographical map"),[21] consequent to the discovery that there are multiple, diversified and cross relationships among living beings (because they are variably distributed), which do not allow us to align them but rather compel us

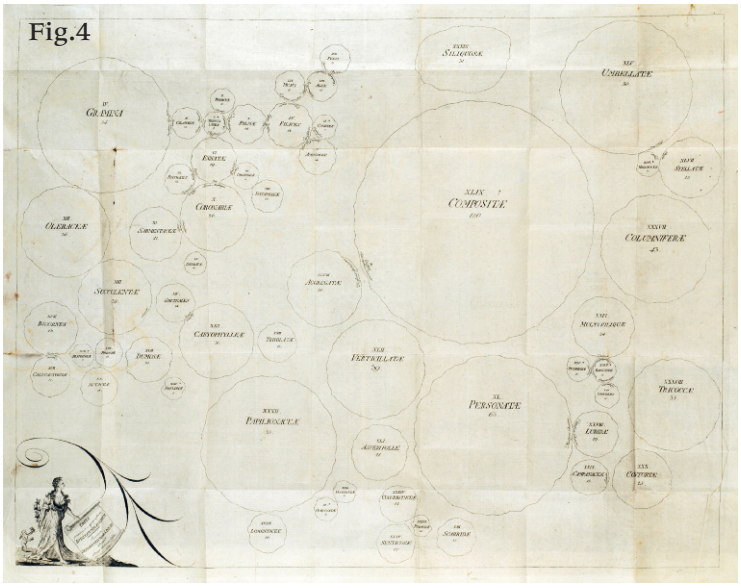


Fig.4

to arrange them in clusters, as if distributed in "constellations" of bodies (see fig. 4).[22]

Finally it should be underlined that, in overturning the traditional image of the *scala naturae*, the new Linnaean systematics also overturned the idea of the absolute immutability of nature. The Swedish naturalist is usually presented as a champion of the most radical fixism (and an unequivocally creationist fixism) since in his works we find statements, which seem to be given great importance, such as "there are as many species as there are the forms created at the beginning of time",[23] which "have reproduced always remaining identical".[24] But these were purely rhetorical concessions. In fact, Linnaeus supported a compelling evolutionary theory, suggested to him by the pattern of the "geographical map" (within which species, arranged in clusters, seemed to radiate from a common point) and by the new systematics, which had inspired and encouraged him. Species were no longer included singularly (the dog, the wolf, the fox...) and in isolation. Thanks to the generic-specific binomial, they were grouped (*Canis domesticus*, *Canis lupus*, *Canis vulpes*...) as in 'families' characterized by the same 'surname', and this not only underlined the numerous morphological affinities, it also suggested close genealogical relationships. The result was an interesting form of evolution by hybridization,[25] which Linnaeus could present as the coherent development of already proposed hypotheses.

In 1721, Jean Marchant, who had discovered two new varieties of *Mercurialis*, speculated - albeit in a single place - that God had created a single type of plant ("a model") for each genus, and that "these models, or founders of each genus, produced varieties, some of which, remaining constant and permanent, gave rise to the present-day species".[26] And in 1749, Johann Georg Gmelin, who had discovered six new varieties of *Delphinium*, published a memoir on "new plants that appeared after the divine creation."[27] Linnaeus had announced in 1744 the discovery of *peloria*, assuming that a new species had arisen by hybridization from *linaria*, and he had obtained one of the first experimental hybrids (*Tragopodon hybridum*) by pollinating *T. pratense* with *T. porrifolium*. In 1760, after a long discussion in various publications[28] of the phenomenon of hybridization (which he called *mixtura*, *miscela*, *hybridus partus*, *diversa copula*, *generatio hybrida* or *generatio ambigena*), he stated that "it cannot be doubted that new species appear through hybridization. From this we learn that the hybrid is, for the medullary substance, the internal parts of the plant and the reproductive organs, an exact image of the mother but, for the leaves and other external parts, an image of the father. These considerations give new bases for the study of nature. (...) In fact, it seems to follow that the various species of plants belonging to the same genus were, originally, a single plant, and arose from it by hybrid generation. (...) The botanist should think that the species of each genus are only as many different plants as there were different associations with the flowers of a single species and that, therefore, a genus is nothing but a certain number of plants derived from the same mother by the work of different fathers."[29]

The theory was re-discussed and refined in *Fundamenta fructificationis* (1762) and in the appendix to the sixth edition (1764) of *Genera plantarum*, in which Linnaeus maintained that God could originally have created a single species for a whole order of presently existing plants. According to the Swedish naturalist, this evolution by hybridization would have occurred in parallel to the subsidence of the waters leading to the progressive increase in size of the subequatorial island off the coast of Africa in which he had postulated the location of Eden.[30] Clearly and even declaredly influenced by his reading of *Relation d'un voyage au Levant*[31] by the French botanist Joseph Pitton de Tournefort, Linnaeus imagined the island as dominated by a high mountain that created the entire range of climatic conditions - from polar to equatorial. Encouraged by the publication of a successful book by Antoine-Nicolas Duchesne, who with his father had discovered a new variety of strawberry,[32] the Swedish naturalist came to generalize in 1779 that "species are the work of time."[33]

## NOTES

1. Siegesbeck 1737, p. 49.
2. see Plukenet 1700.
3. see Barsanti 2009.
4. see Tulp 1641.
5. see Tyson 1699.
6. Tulp 1641, pp. 271-272.
7. see Dapper 1668 and Bosman 1704.
8. see Gassendi 1641.
9. see Battell 1613, p. 982.
10. Bondt 1658, p. 84.
11. Bondt 1658, pp. 84-85.
12. see Breydenbach 1486.
13. Gesner 1551, p. 970.
14. Aldrovandi 1637, p. 245.
15. Linneo 1760, plate opposite p. 76.
16. Linné 1746, p. 3 v.
17. Linné 1747, p. 25.
18. Linné 1766-1768, I, 1766, p. 34.
19. Linné 1758-1759, I, 1758, p. 24.
20. see Barsanti 1992.
21. Linné 1736 and 1751, aphorism 77.
22. Linné 1792.
23. Linné 1736, aphorism 157. And see also aphorism 132.
24. Linné 1751, aphorism 157.
25. see Barsanti 2005.
26. Marchant 1719-1721, p. 65.
27. see Gmelin 1749.
28. Among which see, in particular, Linné 1751, 1755, 1759.
29. Linné 1760, pp. 127-128.
30. see Linné 1764.
31. see Tournefort 1717.
32. see Duchesne 1766.
33. see Linné 1779.

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