

CARL VON LINNÉ'S BIRTH – FOUNDER OF THE BINOMIAL NOMENCLATURE

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Résumé: On avait attribué le titre nobiliaire à Carl Linné pour la valeur de ses travaux scientifiques dans les domaines de la botanique, de la zoologie, de la minéralogie et de l'ethnographie à la moitié du XVIII^{ème} siècle.

À l'âge de 24 ans, il est parti pour sa première expédition en Laponie et ensuite il avait aidé plusieurs jeunes gens à explorer différentes régions du monde en vue de collectionner et comparer les plantes et les animaux de tous les continents.

Au bout de longues expérimentations pour simplifier les dénominations complexes des plantes et des animaux, Linné a inventé la nomenclature binominale par genres et espèces.

Tributaire aux convictions de son temps, Linné a été d'abord fixiste, en affirmant que l'invariabilité des espèces était la condition essentielle de l'ordre de la nature. C'était à peine dans la douzième édition du livre "Systema Naturae" (1766) s'il avait pu renoncer à la conception fixiste et avait reconnu la variabilité des plantes.

L'oeuvre de Linné est bien connue et appréciée en Roumanie; on a dédié au fameux botaniste suédois plusieurs articles et livres où il a été considéré la deuxième personne qui gardait le secret de la nature, après Aristote.

Mots-clés: Carl von Linné, la nomenclature binominale, "Systema Naturae".

23rd of May 1707, Carolus, the fourth child of the Protestant priest Nils Smaland Linnaeus' family was born at Stenbrouhet – province Smaland of southern Sweden. He was to become the famous botanist, zoologist and geologist (but with a solid education in medicine) of the 18th century. His father desired his son to be a priest. But the beauty and diversity of flowers from the family garden attracted him very early. Because that time botany was compulsory for any doctor who prescribed medicines made of herbs, he comforted his family by attending the Faculty of Medicine of the University of Lund, in 1727. At the end of the first year of study he moved to the University of Uppsala – the most famous in Sweden. More than the study in medicine he was attracted by "the first love" – collecting and studying plants. In spite of the lack of money, in 1731, he organized the first botanical, zoological, mineralogical and ethnographical expedition in Lapland, at the advice of his professor Rudbeckius, and he researched an area of 440 km. In 1734 he went in another expedition, in central Sweden.

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But, for graduating the medical studies, he transferred at the University of Harderwijk, in the Netherlands, in 1735. He made his specialization in treating syphilis at the University of Leiden. During the same year, he published the first edition of his book "*Systema Naturae*", with a plants classification as he could think that time. At the same time, he contacted and consulted the well-known botanists of Europe, working at the development and improving of his system of classification. In 1736, when he was still in Leiden, he published *Bibliotheca botanica*", "*Musa cliffortiana*", "*Hortus Uppsalensis*" and "*Fundamenta botanica*", being supported by Lord Georg Clifford. In the last of these books he laid the foundations of plants classification in varieties, species, genera, orders, classes and kingdom. In the same year, Clifford sent him to study the botanical gardens of London and Oxford, while in his country he was elected member of the Swedish Society of the Researchers of Nature and got the title of "*Dioskorides Secundus*" – the second Dioscoride – after the Greek physician Pedanios Dioskorides, from the 1st century BC, the greatest authority in botany and pharmacology for 17 centuries. In 1737, Linné wrote "*Flora Lapponica*", "*Horuts Cliffortianum*", "*Viridarium Cliffortianum*", "*Corollarium generum*", two volumes "*Genera plantarum*" and "*Critica Botanica*" – first edition. In "*Iter Lapponicum*" he presented also his impressions about the land he had visited before. Next publications were "*Classes plantarum*" (1738), "*Flora Suecica*" (1745), "*Flora Zeylanica*" (1747), "*Hortus Uppsalensis*" (1748). In 1759 and 1763 he wrote on the classification of different types of diseases, with the title "*Genera morborum*", and in 1749, 1750 and 1752, on plants and their medicinal substances, in "*Materia medica*".

But from the point of view of naturalist, we can assert that 1735 was the decisive year when Linné dedicated to the botanical taxonomy, and then to the zoological and mineral one.

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Today it is better understood that the work of taxonomists is crucial for the conservation of biodiversity. They do not tell us only the name of the species but also their logical connections. They help to identify natural patterns and decide the best ways in order to protect the individuals of a species, as a part of biodiversity.

People always asked themselves about the number of the species on Earth. It is estimated that there are around 30 million species of plants, animals and microorganisms, each of them with their own part in the global ecosystem. But only 1.7 million species are identified and named.



Fig. 1. Carl von Linné on 12 May 1732, fancy-dressed for five months expedition in Lapland.

The list of systematists lists with the names of species constitutes valuable data base, guide books and atlases, collections and papers of reference, as the revisions of some *taxa* or the state of some groups of beings in the world. All these things are very useful in the programmes of conservation of biodiversity.

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Since Antiquity it is known that the Greeks and Romans named and classified the creatures, mainly those used by them. They named the medicinal plants and animals they hunted or they were afraid of. This tradition continued in northern Europe, where name of flowers were given by botanists. In 1597, John Gerard wrote a book on botany in English where he described the plants known by the native people from different areas.

One can fix the science of the scientific nomination from the end of the 16th century on: at the beginning, long Latin names (paraphrasings) were given to plants and animals. For instance, the modest potato was named *Solanum caule inermi herbacco, foliis pinatis incis*, which could be translated by: Solanaceae with a smooth stem, which is a herb and has segmented plumose leaves.

In the 18th century, the botanists and zoologists tried to give simpler scientific names because the problems and the diversity of species increased. At the beginning, only local plants and animals were known, from restricted areas, but later, after the discovering of other continents (e.g. the New World), the nomination system became extremely complicated. For example, a Jesuit priest who accompanied Pizarro during the conquest of the Inca Empire decided that two Gardens of Heaven should exist: because the vegetation of the Andes was completely different from that of Spain. It was impossible to explain the large diversity of plants and animals on Earth basing only on the biblical paradigms.

LINNÉ AND THE NEW NOMENCLATURE

After leaving the Netherlands for Sweden, in 1738, Linné was a medical practitioner and he delivered lectures in Stockholm till 1741 when he was appointed full professor at the University of Uppsala. There, he reorganized the botanical garden of the university, arranging the plants according to its own system of classification and organizing three expeditions in different regions of Sweden. He was very much appreciated by the students. For 19 of them he created the possibility of going in expeditions of study and scientific discoveries all over the world. One of his well-known students, Daniel Solander, was the naturalist of the first expedition around the world, organized by Captain James Cook, who brought in Europe plants collected from Australia and from the islands of Southern Pacific Ocean. Another Carol Linné's student, Anders Sparrman, was the botanist of Cook's second expedition. Pehr Kalm, Linné's another student, departed to the North-Eastern America and studied the plants of the continent for three years. Carl Peter Thunberg was the first Western naturalist who visited Japan, studied the plants of this country and taught the medicine of Western Europe to the Japanese practitioners. Finally, Linné's other students were in expeditions in South America, South-Eastern Asia, Africa and in Middle East. Some of them died in these expeditions.

After the plants were inventoried, work based mainly on their morphological features, Linné published "*Species plantarum*" in 1753, a long list of the known species (till then) which was structured according to the sexual system (the number of stamens, for the male side, and the number of pistils, for the female one). It became a guide book of plants for the entire world, created after the **binary nomenclature principle**.

Linné's idea was that the scientific names have to be simple, easily learnt by heart, replacing the long paraphrased names, as a matter of fact correct but too much complicated. Binomial system spread fast and had its own rules: the first part of the name is the genus, written with capital letter. The second part is the epithet (determinative element) of the species, written with small letter. Then, it follows the name of the author who described the species and the year.

But Linné tried to describe all creatures of the Earth and that is why he considered his taxonomical studies a fulfilled task. He continued to review “*Systema Naturae*”, which became greater and greater, on the one hand due to the changing of his conceptions and, on the other hand, due to the increasing number of plants and animals received from all over the world. With only 11 leaves in its first edition in 1735, “*Systema Naturae*” reached at its 13th edition (1774) over 2,300 leaves, with the description of the species from the vegetal, animal and mineral kingdoms.

Being much interested in the economical independence of Sweden, he thought he could contribute to the decrease of agricultural importations. In order to realise that, he tried to acclimate in Sweden the cocoa tree, coffee tree, tea shrubs, banana tree, several types of mulberry tree, then the rice, but with no success because of the cold climate.

In 1758, he bought some land outside Uppsala, where he built a museum for his collections, very numerous and without a proper spade for being stored. In 1761 he got the noble title and became Carl von Linné. The next years he suffered from strong depression and pessimism. The lack of strength and the general worsening of his health led to his death in 1778. Together with Elisabeth-Sara-Lisa (married on 21st of June 1739) he had four girls and two boys. The elder son, named Carolus, followed too the educational carrier at the University of Uppsala, but he was never very fond of botany. Nevertheless he assured the control and completion of the subsequent editions of his father’s books, “*Systema vegetabilium*”, “*Species plantarum*” and “*Genera plantarum*”. After only five years Carl Linné jr. died too, and his mother and sisters, without any inheritance, sold the library, manuscripts and collections of natural history to the English naturalist Sir James Edward Smith, who founded the Linnean Society of London, in order to preserve this treasure in good conditions.

LINNÉ’S SCIENTIFIC IDEAS

Carl von Linné was deeply in love with nature and, as we have already noted, was very attracted by the diversity of plants and animals since his childhood. His belief guided him towards **natural theology**, a school dating since ancient times, but largely spread at the beginning of the 18th century. The main idea of the natural theology was that *God created the world, therefore it is possible to understand God’s wisdom studying his creation*. As he wrote in the Foreword of the 10th edition of the book of reference “*Systema Naturae*”: “*Creationis telluris est gloria Dei ex opere Naturae per Hominem solum...*” – he considered the creation of the Earth a glory of God, as man can see the work of Nature. The study of nature could underline the Celestial Order of God’s creation and it was the task of naturalists to think and build a “natural classification” which could put in light this Order in Universe.

First, the taxonomy of plants made by Linné was based only on the number and arrangement of the reproductive organs: the stamens (male organs) and the pistils (female organs). Obviously, such kind of conception led to unnatural groups of plants. An example is the class Monoecia, Order Monadelphica which included conifers (firs, pines, etc. of the Pinaceae Family) and those of the genus *Cupressus* (with scale-like leaves, Cupressaceae Family), not only because the difference between flowers and conifer cones was not known that time, but also because it included some plant with flowers, as *Ricinus communis*.

Plants without prominent sexual organs were included in Cryptogamia Class, named also “plants with a secret marriage”, gathering algae, lichens, fungi, moss and ferns. Later on, Carl Linné admitted that it was “**an artificial classification**” and not a natural one, which took into consideration all similarities and differences between organisms. But, as many naturalists of the time (among them also being Erasmus Darwin), Linné paid high attention to the plants with sexual reproduction, this problem being clarified much later. Linné established some surprising similarities between the sexuality of plants and man’s love. In 1729, he wrote: “...*Flower leaves are nuptial beds which God arranged so beautifully, decorated with these noble “beds” and so finely perfumed which attract the bride and the groom to their wedding of high solemnity...*”

Even if later the classification system followed that proposed by John Ray, consisting of the use of morphological features of all parts of the organism, in all their development stages, **the method of hierarchic classification and binomial nomenclature were kept from the Linnean system.**

For Carl Linné, the species were real entities which could be grouped in upper categories named *genera* (*taxa*, as named today). It can be asserted that Linné did not say anything new, because, since Aristotle, biologists used the word “genus” for a similar group of organisms, with specific differences (*diferentio specifica*) of every type of organism. But, there were difficulties in grouping *genera*. Even today, naturalists use arbitrary criteria for grouping creatures, putting together all domestic animals or all aquatic animals.

Linné’s innovation consisted in grouping *genera* in upper *taxa*, by basing also on similar features. In Linné’s original system, *genera* were grouped in orders, those ones in classes, and classes in kingdoms. Animalia included Class Vertebrata, with the Order Primates, which included genus *Homo* with the species *sapiens*. Later, biologists added intermediary categories, which represented different levels of similarities: subfamilies and superfamilies, sub- and superclasses, phyla, etc.

We have already mentioned that the name of the species was different before Linné. Many biologists gave the species they described a long Latin name, which could be changed as they wanted. A scientist who compared the description of two species could not understand to which one the description referred. For instance, different botanists named wild rose *Rosa sylvestris inodora* or *canina* and *Rosa sylvestris alba cum rubore, folio glabro*. The need of a functional system became

higher after a huge number of plants and animals were brought in Europe from Asia, Africa and America. **After some tested alternatives, Linné simplified the paraphrases (long names) choosing a name for the genus and another one (short) for the species. These two names created the binomial nomenclature of the species.** For example, in his two volumes of “*Species plantarum*”, Linné renamed the wild rose *Rosa canina*. Binomial system became quickly the standard system of the denomination of species. This is the reason we assert today that the priorities of the botanical and zoological taxonomy have become since Linné; the oldest plant names, considered still valuable are those published by Linné in “*Species Plantarum*”, in 1753, and the oldest animal names are those from the 10th edition of “*Systema Naturae*” (1758), the first edition where the binomial system was used consistently and coherently.

In his youth, Linné thought that the species are not only real entities, but also stable, without changing. “*Unitas in omni specie ordinem ducit*” (invariability of species is the basic condition of order in nature), he declared. But later, remarking how different species of plant could hybridize and new species could result, Linné gave up the concept of species steadiness and variability and suggested that some of them (probably most of them) appeared after Genesis, by hybridization. In the 12th edition of “*Systema Naturae*” (1766) he abandoned the concept of steadiness and recognized the plant variability.

Advising his fellow countrymen to a simple life and being against buying very expensive goods from abroad, he also tried to cultivate foreign plants in Sweden. As his attempts have no success, Linné ventured the theory that plants can be altered by acclimatisation processes. Within his last years of life, Linné studied what he thought there were crossing cases between genera and suggested that, probably, new genera (what we consider belonging to macroevolution) can appear also by hybridization.

Therefore, a new question rises: was Linné an evolutionist? We mentioned above that during his life he gave up the concept of steadiness according to which the species were stable. Then, he recognized that new species of plants can appear by hybridization, and in some cases, animals. Nevertheless, for Linné the process of apparition of new species was unequivocal and unlimited. According to Linné, new species could appear from *primae speciei*, from the original ones, from the Eden Garden, where they were a part of the God’s Creation plan. Linné observed the fight for existence or for survival and named Nature a “block of slaughters” and a “war of everybody against anybody”. Yet, he considered necessary for the maintenance of the natural equilibrium, as a part of Celestial Order, the fight for existence and competition in Nature. Linné has never opened evolutionary conceptions, without a predetermined purpose. In spite of this, Linné’s hierarchical classification and binomial nomenclature (even if they were modified) remained standard concepts for the last 250 years, his works being studied by entire generations of naturalists, including Erasmus Darwin and Charles Darwin. The

search for and the application of a “natural system” of classification is still of topical interest, and some systematists use modern methods for establishing the evolutionary relationships among taxa.

CRITIC AND HOMAGE DURING LINNÉ'S LIFE

The sexual bases of plants' classification, made by Linné, were commented during his life. It is true that the system was easy to learn and to use, although in many cases such kind of classification did not fit. But his contemporary fellows did not criticize plants' classification as such and the fact that it cannot be applied without exception, but only the explicit way of describing sexuality. Botanist Johann Siegesbeck considered Linné's classification “...*disgusting and outrageous*”. Linné's reply was naming *Siegesbeckia* a wild plant from Europe, with no value.

His French contemporary, Georges-Louis Leclerc Buffon, and author of the Natural History in 40 volumes, offended him several times because of the same origin of plants' classification. But when Linné described a new species of the genus *Juncus* (of Family **Juncaceae**) he “dedicated” it to the eminent French naturalist, but written with a single “*f*” (*bufonius*), reminding Common toad, *Bufo bufo*.

To his critic, Pison, Linné dedicated a species of a spiny plant, “*psoneta*”, and to Pliochenet, the species “*pliochenatia*”, for a plant with a monstrous aspect. To Cammelin brothers he dedicated the species “*cammelina*”, whose flowers had three stamens, two longer and one short, because two of these brothers succeeded in becoming famous, and the third one did not do anything in his life.

Linné wrote in 1753, replying to his contemporaries' wickedness: “... I shall bear all these (critics, D.M.) ... and why I won't bear those are to come from illwilled people, while some real botanists, who distinguish from those well educated, overwhelm with the higher distinctions”.

However, because of his great scientific work, Linné knew the glorious days: first of all, his students' ovations, “*Vivat Linnaeus!*”, at his lectures or when they came back from trips. He also received the eulogies of brothers Antoine and Bernard de Jussieu, well-known French botanists, during the period when he worked in the Botanical Garden from Paris. Listening to him accidentally, Bernard de Jussieu interposed: “Considering the explanations you gave, you cannot be someone else but Linné”. Jussieu brothers presented and recommended him as corresponding member and then full member of the Academy of France. They also proposed to Linné to settle down in France, but his patriotic feelings made him to refuse this invitation. Later, he was invited to lead institutions of scientific research in the natural sciences (e.g., botanical gardens from Madrid, Sankt Petersburg and Cambridge), but he chose to remain in his country, where, besides the title of full

professor of botany at the University of Uppsala, he was appointed manager of the Botanical Garden of the same town. Till Linné's leadership, the collections of the garden had only 100 species. After, they increased to 1,000 species.

Due to his scientific activity, Linné was highly appreciated and supported by King Gustav of Sweden, to whom he gratefully dedicated a new genus, *Gustavia* L. (1775).

When the Academy of Sciences of Sweden was founded, he was appointed as its first president. The numerous books and more than 4,000 published articles got him the "North Star" Order and a noble rank.

RENDERING HOMAGE TO CARL LINNÉ

Nowadays, after 300 years since his birth, Linné remains a well-known scientist in biological sciences. On the occasion on his anniversaries or commemoration, physicians, naturalists, philosophers, historians, theologians, painters pointed out different aspects of his life and work. His name is preserved as name of many streets and botanical gardens in many towns and cities. At the same time, some educational and scientific institutions, as well as scientific societies have the name of Linné. In his honour, stamps and medals were emitted in Sweden and all over the world.

In the Cathedral of Uppsala his friends and students erected him a monument of porphyry of Alvdal, and decorated with a bronze medallion, right next to altar.

A part of the plants preserved in Linné's herbarium is still present in the collections of the Museum of Natural History of Stockholm, together with the biographical archive. The University of Uppsala has data on Linné's botanical garden and on his estates from Hammarby. University of Uppsala has a site "Linné On Line" with information on the founder of taxonomy, master of his time.

The Linnean Society of London was founded some years after Linné's death, and it is one of the important international societies dedicated to the study of natural history. The society preserves the largest part of his collections, manuscripts and Linné's library. In USA, the greatest collections and works written by Linné or about him can be found at "Strandell Collection of Linneana" of the University of Carnegie-Mellon and in "Mackenzie Collection of Linneana" of the University of Kansas State. Within the site of the Museum of Natural History of London there is a "Linnaeus Link" with e-versions of Linné's documents and letters.

THE ECHO OF LINNÉ'S NAME IN ROMANIA

In Romania, several articles and books on Linné were published (Borza, 1944, Ștefureac and col., 1957; Radu, 1957; Zennström, 1959; Motaș, 1960; Fabian, 1979; Pop, 1957, 1958, 1968; Váczy and col., 1999; Bejinaru, 2006). In spite of

this, we cannot say that it's enough, the mentioned articles and book not being easy to find by the young people. As "legislator of the creature world or the second secretary (having the sense of secret keeper) of nature after Aristotle"², he should be known much more in Romania, being an example of a hard working intellectual (he worked from sunrise to sunset), a partisan of the masses (he was very impressed by the miners' life, by the horrors of war), an example of high morality and sense of equilibrium in life.

It is not less important to mention that there were some plants from the Romanian territory among those named by Linné, 300 years before. *Dracocephalum moldavica* L. from the scientist's herbarium has in its diagnosis... "Habitat in Moldavia", and *Scabiosa transsylvanica* L. of **Dipsacaceae** Family has in its description "Habitat in Transsylvania"; the last species was later included in genus *Cephalaria*.

In the Călimani Mountain (Piatra Cușmii) was found Linné's dearest plant, *Linnaea borealis*, described by the Dutch physician and naturalist Johannes Fredericus Gronovius: a glacial relict, southernmost isolated area, East to the Alps; some Romanian botanists (e.g., Vasile Ciocârlan, 2000) haven't found it in the reported place.

In Romania and all over the world, the need of revival of natural sciences is felt with acuity. This revival relates some extraordinary innovations to those of the scientific born 300 years before.

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² Constantin Motaș, book (1960).