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## The Zoological Dissertations of Linnaeus

“He (Linnaeus) discovered more animals than any of his predecessors, and he was the first to give them their *characteres genericos et specificos* according to the natural method. The knowledge of the *Insecta* must be attributed to him, not to speak of the method found by him for classifying the fishes according to their fins, *a cardina Conchylia* and *a scutis Serpentes*. *Cetos ad Mammalia, Nantes ad Amphibia reduxit, et Vermes ab Insectis removit*” (1).

Essentially there is a basic difference between Linnaeus’s contribution to the system of botany and that of zoology in that in the field of zoology he made greater contributions to the *natural* system than in that of botany. Furthermore, the system of zoology remained less “open” and constantly admitted of improvement (2). The most important element contributed by Linnaeus is his method of comparison and description; he had a gift for discerning resemblances and correlations between different organisms and basing a system on them.

There exists of course a great deal of literature on this subject; in this context we would only state that in this respect the zoological literature has greatly lagged behind the botanical literature, both absolutely and relatively (3). A possible cause of this relative lag is that Linnaeus’s contributions to zoology—more so than those to botany—are hidden away in his systematic works. One of the principal sources in this field is formed by the zoological dissertations.

Out of the 186 dissertations written during Linnaeus’s professorship at Uppsala University (1741–1773) (4), about thirty were devoted to zoological problems. Linnaeus considered all the theses maintained by students under his guidance as his own work, and this is the reason why he published the collected dissertations under his own name in several volumes under the title of *Amoenitates academicae* (5).

In imitation of Linnaeus, most biographers and bibliographers assume

that the master wrote the dissertations himself and is to be held responsible for the contents. This conclusion has an important practical consequence. Since the Linnaean names have been explicitly established by international rules, the works of Linnaeus, including these dissertations, are very important from the taxonomic point of view. In fact, it is precisely in these dissertations that a considerable number of the best-known animals as well as plants are described.

However, there is yet another complication. Linnaeus was so firmly convinced of his own copyright concerning these dissertations (6) that he would often highhandedly make alterations in the nomenclature when the dissertations were reprinted in the *Amoenitates*. This implies that from the taxonomic point of view one should consult both the version of the dissertation reprinted in the *Amoenitates* and the original version if one is to arrive at a correct nomenclature. In this context it is interesting to note that the Linnaean Society in London possesses those copies of the dissertations which were originally the personal property of Linnaeus. These copies were used by Linnaeus for the reprint in the *Amoenitates*, as appears from the alterations in the text made by his own hand.

Since the great majority of the original dissertations is difficult of access, Messrs Asher of Amsterdam have decided to publish a reprint, at least of those which are important for natural history in general and for taxonomy in particular. It is hoped that this reprint will appear this year, furnished with detailed indices (7).

Although there is already a good deal of literature on the systematic-taxonomic work of Linnaeus in the field of zoology (8)—in which data from several of these dissertations have also been incorporated directly or indirectly—it may be hoped that this publication will have a stimulating effect in this field. However, in this address I would try to describe the contents of these dissertations rather more from the point of view of a student of the history of science, by pointing to the richly varied contents of a number of them. This would appear to be all the more important because on the whole the zoological dissertations are much less well-known than the botanical dissertations. It is therefore to be hoped that this re-publication will stimulate further study of a number of general aspects of the work of Linnaeus, a subject to which some Dutch students have already devoted attention. One of the first themes which seems suitable for this is concerned with the sources used by Linnaeus in these dissertations; this study has meanwhile been embarked upon.

The eighteenth century was a period in which our knowledge of the

world—and especially of the animate world—was rapidly growing. It was the era of longer and shorter expeditions for the exploration of unknown regions so as to find things new to science and useful for economy.

In this connection Linnaeus was active in two ways: by exploring his own country and by sending his students abroad to often very remote regions. These activities are also reflected in a number of zoological dissertations.

Thus, the dissertation *Instructio Peregrinatoris* (9) was intended as a guide for the young traveller to foreign countries. It contains a great deal of practical information (10), and it is described there, *inter alia*, how such a traveller is to behave abroad and how the journal is to be kept. In particular it is indicated what is worth recording, and the following practical advice is given: "If the traveller would be successful in his undertakings, he must make a point of entering and arranging the remarks of each day, before the next arrives" (from Pulteney, p. 426) (11).

The dissertation *Instructio Musei Rerum Naturalium* (12) describes the technique of assembling a collection of natural curiosities and gives directions on what objects should be collected and how this should be done. Furthermore, information is given about the way in which the objects should be exposed and preserved. This dissertation is further interesting because it contains a list of the principal collections of natural curiosities in Sweden.

Some of the dissertations appeared in the form of a kind of travel record, summing up the organisms observed during the journey. An example is the dissertation *Rariora Norvegiae* (13). The text begins with a *Historia literaria*, in which a historical survey of the exploration of Norway is given; this is followed by a list of animals and plants (14) which do occur in Norway, but are scarcely known, if at all, in Sweden. This list includes animals from all the Linnaean classes (15). A very special theme is the subject of the dissertation *Natura Pelagi* (16), which gives a general description of animal life in the open sea. The mammals described include several cetaceans; among the *Amphibia* there are some turtles, but also the shark called *Voraces Squali*; among the fishes there are mentioned, *inter alia*, the flying fishes, tunny, pilot fish, sucking fish, but also the dolphin. However, the majority of the animals described belong to the Linnaean class of the *Vermes*; great attention is devoted especially to the *Corallia*. This dissertation is also of interest on account of the numerous reports from books of travel incorporated in it.

Anders Sparrman, one of Linnaeus's best-known "apostles", like all the other apostles, is indeed known as a botanist, but his dissertation is largely devoted to zoology. In 1765 Sparrman went to China for two years as a ship's surgeon; this was also the most successful voyage ever undertaken by any naturalist under the auspices of the Swedish East India Company (17). Under the title *Iter in Chinam* (18) Sparrman gives an enumeration of the animals observed by him during that voyage, an enumeration which, however, is quite unsystematic. The description of newly discovered species is given very summarily in the form of foot-notes.

The zoological objects collected were as a rule accommodated in so-called collections of natural curiosities. As will be stated elsewhere, Linnaeus became acquainted with these collections during his stay in the Netherlands (19), and after his return to Sweden he popularized the keeping of such collections there as well (20). It is interesting to note that the specimens in these Swedish collections largely originate from Holland; some attempts are now being made to ascertain the origin of this material. Thanks to his study of the royal collections (21) in particular, Linnaeus was able to extend his knowledge of zoology tremendously, as may be inferred, *inter alia*, from a comparison of the different editions of the *Systema Naturae*.

Four of the oldest zoological dissertations are concerned with the description of curious specimens from collections of natural curiosities. They are devoted to collections donated to Uppsala University, and they give accurate descriptions of a number of frequently common, but noticeable animals. These collections were donated by King Adolph Fredrik (22); by Claudius Grill, a collection coming from Surinam (23); by Magnus Lagerström, director of the Swedish East India Company and one of the greatest promoters of natural history in Sweden (24); and by August Carl Gyllenborg, Chancellor of Uppsala University (25). In this last-mentioned dissertation a first attempt is made to derive the specific character of the various serpents not from the highly variable colour-pattern, but from the different numbers of the *scuta* and *squama* of the body and the tail (26).

Linnaeus's journeys were made not only for a scientific purpose but they also, and equally emphatically, had economic importance. It is especially this latter importance which was set forth by Linnaeus in his 1741 address: *De Necessitate Peregrinationum Intra Patriam*, the importance of travelling through one's own country (27). The prospective traveller—

the speaker was thinking of young doctors—is recommended to pay attention especially to the exploration of the natural resources of Sweden for the benefit of the whole nation, in order to make the country independent of other countries. Thus, local diseases should be described, along with the medicines used against them; the uses of newly found plants, either as medicine or as food for men or domestic animals, should be stated; agricultural methods should be studied, etc.

The well-known dissertation *Pan Svecicus* (28) is designed entirely on these lines. Its object is to ascertain which meadows in Sweden yield good, bad, or even toxic food for the commonest domestic animals, such as cows, goats, sheep, horses, and pigs. In the dissertation *Esca Avium Domesticarum* (29) it is studied what animals and plants respectively are eaten by geese, ducks, and chickens; in particular it is ascertained what species of lower animals are eaten by chickens.

Interesting features are the reflections on the comparability of the data and the difficulties involved in the experimental circumstances; attention is drawn to matters such as seasonal circumstances, the fact that certain parts of plants are and others are not consumed, that the animals must not be too hungry, etc.

An economic background is also present in two dissertations which appeared in 1766. In the first, entitled *Usus Historiae Naturalis in Vita Communi* (30), attention is drawn to the need of a growing knowledge of natural history for the improvement of agriculture, horticulture, and cattle breeding; to the uses of some plants and animals for therapeutic purposes; to useful and noxious insects, their significance for the equilibrium in nature, and the means that can be used for combating noxious insects. In the second dissertation, entitled *Necessita Promovendae Historiae Naturalis in Rossia* (31), a Russian nobleman tries to stimulate his compatriots to study the natural history of their native country. This dissertation contains, *inter alia*, a list of zoological objects present in the Museum Petropolitanum and biographical information about a number of scholars who had contributed to the knowledge of the natural history of Russia.

A number of dissertations are devoted to the lower animals. Although Linnaeus recommended his students to use a microscope, he himself only seldom made use of this instrument. This has had its consequences for the classification of the lower animals, for his group of the lowest animals, the *Vermes*, represents a very heterogeneous collection of animals; the only thing that can be said of it is that they belong neither to the vertebrates nor to the arthropods.

In the dissertations on the *Vermes* Linnaeus frequently appears as a man who corrects, ridicules, or praises other authors. This group of animals forms the subject of a special study.

The minutest organisms—even smaller than the motes dancing in a beam of light—according to Linnaeus were responsible for the origin and the transmission of contagious diseases. In two dissertations (32) he further developed this theory about the importance of the *Animalcula viva* for the origin of diseases and reckoned diseases such as whooping cough, smallpox, dysentery, plague, and leprosy among the diseases caused in this way: typical infectious diseases, which we now know to be transmitted by bacteria or viruses. The dissertations contain much information on seventeenth-century notions concerning the possibility that tiny animals might be the transmitters of diseases. This discussion became of current interest in particular after Antoni van Leeuwenhoek had discovered that scabies was caused by a tiny animal, the itch-mite (33).

Another phenomenon in which tiny animals play a part is the phosphorescence of the sea, a phenomenon to which the dissertation *Noctiluca Marina* is devoted (34). A survey of other views of this phenomenon is given.

The group of the *Vermes* is classified by Linnaeus according to fairly broad morphological criteria (35). Probably he carried out very little research on living animals and based himself especially on material from collections or from illustrations, as he admits more or less in the dissertation *Fundamenta Testaceologiae* (36). The *Testacea* in Linnaeus are largely identical with those animals we now call the *Mollusca* (37). The dissertation contains an account of Linnaeus's views on the classification of these animals and accurate descriptions of the structure of the shell; a list of conchyliological terms is added.

A good deal of attention is paid in several dissertations to the corals, to which Linnaeus's first zoological dissertation, the *Corallia Baltica* (38), was already devoted. One of the interesting aspects of this dissertation is that it contains a historical survey of all the writings that had so far appeared about these organisms. The author discusses in detail the question of whether the corals must be considered to belong to the vegetable or the animal kingdom or to the mineral kingdom; however, he does not consider himself competent to answer this question and refers to future research.

The problem of the nature of the corals is one of the main themes of the dissertation *Animalia composita* (39), in which it is stated that it is very difficult to draw absolute lines of demarcation between the three king-

doms of nature when one descends to the lowest organisms (40). Linnaeus makes a distinction between the *Lithophyta* and the *Zoophyta*, the former of which, in view of their calcareous skeleton, show much affinity on the one hand with the mineral kingdom and on the other hand with the *Testacea*. The *Zoophyta* according to Linnaeus show great affinity with the vegetable kingdom (41). Then a number of broad analogies between plants and animals are described, composite plants being compared with composite animals, the medulla of the plant with the *medulla spinalis* of the animal, etc.

In the dissertation *Mundus invisibilis* (42) Linnaeus developed the following theory about the *Lithophyta* and the *Zoophyta*: the *Zoophyta* in combination with the *Fungi* are in the boundary area between the vegetable and the animal kingdom. As to the *Fungi*, the young leave the seed in the form of animalcules and are then transformed into vegetable *Fungi*. As to the *Zoophyta*, they arise from plants in the form of animalcules; the growing stem belongs to the vegetable kingdom, the flower-like animal to the animal kingdom. According to Linnaeus this metamorphosis can be compared to the way in which leaves are transformed into petals. The taxon of the *Lithophyta*, finally, according to Linnaeus consists of animalcules which build a house. When they live together as families, they form colonies of corals.

On two species of worms a monograph has been written as a dissertation. The first deals with the tapeworm (43), and four species of *Taenia* are described. Then the author discourses on whether the head of the tapeworm can or cannot be compared to that of other animals and whether each of the segments of a tapeworm consists of a complete animal (44). A survey of the theories concerning the reproduction of these worms is given. Finally the dissertation contains an attempt at subdividing the *Vermes* into the *Mollusca*, the *Testacea*, the *Lithophyta*, the *Zoophyta* (44), and the creeping worms. The second monograph is devoted to the leech (45). In addition to a discussion of its anatomy, its medicinal use, etc. a historical survey is given of the different views of this animal since Antiquity (46).

Until shortly before Linnaeus the study of the world of insects had been very unattractive, because scholars—in imitation of Aristotle—assumed that the lower animals arose as a result of spontaneous generation. It was assumed that they were generated in infinite numbers and that their outward form was not subject to any laws.

After Redi had shown that flies are only generated by flies, after

Antoni van Leeuwenhoek had shown that even the most inconsiderable insects have a highly complicated anatomical structure and that—just like the higher animals—they reproduce sexually, and after Jan Swammerdam had shown that different groups of insects can be distinguished on the basis of the progress of their metamorphosis, the road for further entomological research was open.

More than anyone else Linnaeus contributed to the development of entomology, and this is reflected very plainly in the dissertation *Fundamenta Entomologiae* (47).

In the dissertation it is stated that the seventeenth and eighteenth centuries saw an explosive increase of our entomological knowledge, in consequence of new geographical discoveries, of the assembling of collections of natural curiosities, and of the publication of pictures of insects (48). Although Linnaeus did not speak very highly of his predecessors, still he borrowed a good deal from other authors, and in this dissertation he gives a chronological list of the most important entomological literature published before his time. His predecessors, however, had not succeeded in giving a clear description of the outer structure of the body of insects, so that it was impossible to compare them with each other; moreover, there existed a complete chaos in the matter of nomenclature. Both these aspects were disposed of by Linnaeus in this dissertation, and this goes to show his importance for the development of entomology. Linnaeus gives a simple but at the same time plain and very logical terminology for the description of insects. Unfortunately he does not always mention the sources from which he has taken the terms used by him; it is, however, certain that he has introduced a number of terms, such as larva, pupa, etc., terms which are still in general use. A more detailed analysis of this terminology appears to be very interesting, especially from a historical point of view (49).

After the definition of the terms used by him, Linnaeus gives the classification of the class of the *Insecta* into the following orders: *Coleoptera* (50), *Hemiptera*, *Lepidoptera*, *Neuroptera*, *Hymenoptera*, *Diptera*, and *Aptera*. The order of the *Aptera* combined the most heterogeneous elements, such as spiders, myriapods, crustaceans, and wingless insects.

The rich contents of this dissertation is supplemented with a number of very interesting data and suggestions, e.g. on the combating of insects with the aid of their natural enemies; on the risk that, when a plant one wants to grow is imported, at the same time the noxious insect feeding on that plant may be imported; on the possible role of insects in the fertiliza-



tion of plants; on the nidification of some tropical ants; and on the location, the structure, and the function of the sense-organs in insects.

Via his pupils Linnaeus received numerous insects from remote parts of the world. The dissertation *Centuria Insectorum Rariorum* (51) contains descriptions of one hundred insects which were largely unknown in those days and which had been sent from the New World. The last zoological dissertation written under Linnaeus's direction contains descriptions of two new genera, one belonging to the order of the *Diptera*, the other to that of the *Coleoptera* (52).

Linnaeus's contribution to entomology, however, did not remain confined to the systematic and taxonomic aspects (52). Already in his *Oratio de Memorabilibus in Insectis* (54) (On the Curiosities of Insects) of 1739 Linnaeus tried to rouse the interest of scholars in this group of animals by pointing out on the one hand the many useful things with which they provide mankind, while showing on the other hand what damage they can cause to property and to the economy. An investigation into the role which insects play according to Linnaeus in the equilibrium of nature would appear to be of interest. A part of this problem is formed by the question how far these dissertations shed new light on such problems and how far older sources have been borrowed from.

Three dissertations are concerned with the occurrence of insects on plants and the damage they cause by it (55). They contain on the one hand lists of plants and on the other hand lists of those insects which occur on those plants. One of these dissertations, the *Hospita Insectorum Flora*, contains a historical survey of the principal authors who have written on the metamorphosis of insects and on the role of insects in the economy of nature. Another dissertation, the *Pandora Insectorum*, gives many details on the progress of the metamorphosis of insects and on those parts of the plant which are visited by the various insects (56).

The dissertation *Noxa Insectorum* (57) goes further into the many possible forms of damage which insects may cause to man's body, his house, garden, fields, trees, cattle, poultry, etc. The forms of damage described are also elucidated from a historical point of view. The dissertation *Miracula Insectorum* (58) is concerned in more general terms with the role of insects in the economy of nature, special attention being paid to the gall-producing insects. The author discusses a number of plant genera which are extremely susceptible to gall production, and he states that most galls on plants have a characteristic form. The dissertation also contains a long discourse on *Furia infernalis*, the insect which was said to

have caused the outbreak of the plague in Finland and Northern Sweden.

As to the uses of insects for mankind, Linnaeus refers to matters such as the production of honey (59) and the role of the insect in the fertilization of plants (60). On the importance of insects in medicine there exists a monograph, *De Meloë* (61), on the oil beetle as a supplier of cantharidin, which is used in the manufacture of blistering-plasters.

The silkworm is treated in a second monograph, *Phalaena Bombyx* (62) with detailed information on rearing and on the introduction of silk-farming into Sweden.

Not a single dissertation pays special attention to fishes; they are only referred to obliquely in dissertations devoted to one of the collections.

The same applies broadly also to the *Amphibia*, among which Linnaeus also reckoned the *Reptilia*, although he did lay the basis for the classification of this group of animals (63). A survey of the whole taxon is given in the dissertation *Morsura Serpentum* (64), a dissertation which is really devoted to snake-poison, its production, its secretion and effect, and to the measures that should be taken against snakebites.

One monograph was devoted to the neotenic *Siren lacertina* (65) from North Carolina, which lives in mud. Linnaeus was not sure whether he had to call this animal with its exterior gills a larval stage or an adult animal.

The basis of Linnaeus's ornithology was laid down in the dissertation *Fundamenta Ornithologica* (66). In this context it is worth noting that Linnaeus discovered that the feathers of birds are arranged in particular patterns (67). The dissertation opens with a *Historia literaria ornithologorum* with a good deal of historical information, and it also includes a chapter with biographical sketches of ornithologists. In addition information is given about matters such as the importance of birds in nutrition, in the economy of nature, as weather-prophets, and as objects of beauty and delight in the life of man.

Bird migration is the subject of another dissertation (68); in this case it is striking how much Linnaeus knew about the migration of indigenous Swedish birds. He considered lack of food in the breeding grounds to be the principal cause of migration. The return of the birds was more difficult to account for: Linnaeus assumed that the high temperatures in the hibernating areas, combined with a kind of love of the birthplace, were the main incentives. It is striking that this dissertation, in addition to the great amount of exact information, also shows traces of old popular

beliefs. Thus Linnaeus still believed that swallows hibernate on the bottom of the Swedish lakes, a popular belief held since the days of Aristotle.

Linnaeus's monographs on a number of mammals excel in the accurate description of anatomical details and vivid characterizations, especially of behaviour. A good instance of this is the dissertation on the dog: *Cynographia* (69), in which Linnaeus succeeded in showing that all dog-breeds belong to one species, *Canis familiaris*. He was able to distinguish this species clearly from related animals, such as the wolf, the fox, the jackal, etc., on the basis of differences in behaviour and in hair implantation.

The remaining monographs also deal with domestic animals: the reindeer, *Cervus Rheno* (70), in which particularly the usefulness of the animal for man is expatiated upon; the sheep, *Oves Breviter Adnumbrans* (71), including many data on its food and its diseases, especially with reference to the liver-fluke; Guinea pig, *De Mure Indico* (72), including a historical survey of the order of the rodents; the pig, *De Pinguedine Animalis* (73), including an account of its economic importance, its food, movements, behaviour, diseases, excrements, colour, etc.

In the days of Linnaeus the knowledge of the anatomy of mammals was still insufficiently developed for it to serve as a basis for the classification of this taxon. An attempt at classification of the highest representatives of this taxon is to be found in the dissertation *Anthropomorpha* (74), a study dealing with the position of man in the natural system. Linnaeus held that man is hardly to be distinguished from the apes on the basis of exterior features. The dissertation contains many examples of human beings and their properties, who grew up among animals. Linnaeus's conceptions of man recently formed the subject of a detailed study by Dr. Broberg, to which I am pleased to refer, although this work is difficult of access, because it is written in the Swedish language (75).

Since a number of the theoretical and speculative dissertations are to be included in the reprint among the zoological dissertations, I would devote a few words to this group.

As to the theoretical dissertations, in the *Metamorphosis Humana* (76) man's life is divided into 12 periods, on the analogy of the 12 hours of the day and the 12 months of the year. The properties characteristic of each period are described, along with the regimen appropriate to that period. The dissertation *Generatio Ambigena* (77) deals with the problem of spontaneous generation. It contains a discussion on the controversy between the ovulists and the animalculists; Linnaeus refers to

Leeuwenhoek and states that both the exterior form and the specific energy of the vital functions primarily originate from the male component. As Aurivillius states, Linnaeus also makes an attempt in this dissertation to show, on the basis of hybridization experiments between species of the same genus, that all species belonging to one natural genus originate from the same initial species. This may lead to the conclusion that the number of original species need not have been greater than the number of natural genera (78).

In the speculative dissertations it is set forth that, according to Linnaeus, the three kingdoms of nature have been created solely for the benefit of man, since it is given to him alone to use living nature for his benefit. Moreover, according to Linnaeus it was the duty of man to study the works of nature, to the greater glory of his Creator. This must also be regarded as accounting for the fact that man is gifted with reason; the variety of nature serves to stimulate his curiosity and incite him to study natural history.

There are four of these speculative dissertations. *Cui Bono* (79) (What is the good of it?) contains the familiar suggestion to use carnivorous insects to combat their noxious congeners (80). In *Curiositas Naturalis* (81) the central problem is man as a part of Creation; in this it is also stated in what way the Book of Creation should be read. According to Linnaeus the study of nature must lead automatically to knowledge of God, and the study of natural history should therefore be considered as one of the most important occupations of the human mind. In the *Politia Naturae* (82) the problems of equilibrium and struggle for life in nature are illustrated by means of examples taken from the interrelations between plants and insects. It is explained that in nature everything is connected with everything else, and that each organism has its own specific significance within the whole system. In the dissertation *Oeconomia Naturae* (83), finally, the cycles within the mineral, vegetable, and animal kingdoms are discussed, and general biological concepts such as design in nature, cycles, reproduction, adaptation, dispersion, struggle for existence, etc. are discussed.

### *Notes and references*

1. Quoted by Goerke, p. 132, after Afzelius, A., 1826: *Linnés egenhändige Anzeichnungen über sich selbst mit Anmerkungen und Zusätzen* (Berlin). (esp. p. 81). Goerke, H., 1966: *Carl von Linné. (Grosse Naturforscher, Band*

- 31) (Stuttgart). A very interesting Linnaeus biography, because it gives much information from Swedish sources.
2. The first edition of his *Systema Naturae* contains 549 species of animals, ed. 7: 1174; ed. 10 (1758): 4386; ed. 11 (1766): 5897. A great part of these animals was described by Linnaeus himself.
  3. Cf. Soulsby, B. H., 1933: *A catalogue of the works of Linnaeus ... preserved in the libraries of the British Museum and the British Museum (Natural History)*, ed. 2, 246 p. (London).
  4. The dissertations appeared as independent pamphlets, bearing the name of the pupil as the respondent and the name of Linnaeus as the president.
  5. The *Amoenitates academicae* appeared between 1749 and 1790 in 10 vols. During Linnaeus' lifetime already 7 vols. were published between 1749 and 1769 (Linnaeus-edition). After his death 3 more volumes were added, containing those dissertations which appeared after 1768 (Schreber edition).
  6. Although Linnaeus must have had a great influence on the dissertations of his pupils, it remains impossible to trace exactly what has been the input of the defendant and what are Linnaeus's own words. On account of style and contents, it seems likely, that in the majority of the dissertations the student's share has been financial only, but sometimes the input of the student might have been somewhat greater and in some cases the student even may be considered as the author and the professor as the editor. Cf. Stearn, W. T., 1957: *An introduction to the Species Plantarum and cognate botanical works of Linnaeus*, 176 p. (London); and Ramsbottom, J., 1959: *Caroli Linnaei Pan Suecicus* (*Trans. Bot. Soc. Edinburgh* vol. 38: 151-167).
  7. Of course, it is not always easy to decide whether dissertation has to be included in the zoological or in the botanical part. For practical reasons, all the entomological and the greater part of the contemplative dissertations have been included in the zoological series. The botanical volumes are to be edited by F. A. Stafleu, the zoological volumes by P. Smit.
  8. For instance, publications on type-specimens of snakes, birds and reptiles; on Linnaean collections of shells, fishes, snakes, Amphibia, non-marine Mollusca, etc.; on the species of Lepidoptera, Echinoidea, etc. described by Linnaeus, etc. For a review, see, e.g. Soulsby, l.c. and some titles in the list of references of W. Blunt's *The compleat naturalist: a life of Linnaeus*. (London, 1971.)
  9. Nordblad, Ericus And., 1759: *Instructio Peregrinatoris*, cf. Soulsby, 2022-2029.
  10. In his public oration of 1741, dealing with the importance of travelling through one's own country (*De necessitate peregrinationum intra patriam*), Linnaeus gives a lot of practical information. So the traveller had to pay attention to such matters as: the exploration of the natural resources; local diseases and the remedies employed; agricultural implements, the way of manuring the fields, etc.
  11. Pulteney, R., 1805: *A general view of the writings of Linnaeus*, 596 p. (London). Also in French: *Revue générale des Ecrits de Linné*, 2 vols. (Paris, 1789).

12. Hultman, David, 1753: *Instructio Musei Rerum Naturalium*, cf. Soulsby, 1770–1778. German translation: Murr, C. G. von, ed., 1771: *Abhandlung von Naturalien Cabinetten*, 72 p. (Leipzig). Pulteney, l.c., p. 392 writes: "This little tract has been published in Holland for the use of merchants dealing in subjects of natural history." Up to now it is not clear whether a Dutch translation exists.
13. Tonning, Henricus, 1768: *Rariora Norvegiae*, cf. Soulsby, 2381–2384.
14. The list of plants contains a number of alpine plants, not known of the Swedish flora. The dissertation also contains a section devoted to Lichen islandicus and its medical application; this is the subject of A. H. Berlin's dissertation: *Usus Muscorum* (1766).
15. According to Tønning, leprosy should be caused by the Hair worm (*Gordus aquaticus*); cf. I. Uddman's dissertation: *Leptra* (1763).
16. Hagen, Johannes Henricus, 1757: *Natura Pelagi*, cf. Soulsby, 1962–1965.
17. Cf. my address on Linnaeus and Holland (also delivered at the symposium).
18. Sparrman, Anders, 1968: *Iter in Chinam*, cf. Soulsby, 2393–2396.
19. The most important and most extensive cabinet visited by Linnaeus during his stay in Holland is that of Albert Seba. In my paper on Linnaeus and Holland more details have been given.
20. "Linnaeus (wrote Linnaeus) had brought natural history in Sweden from the lowest place to the very highest, because it was loved and cultivated by the great in the land, and even by royalty." (Quoted after Blunt, l.c., p. 205.)
21. Among the most famous and extensive Swedish collections were those of King Adolph Fredrik and of Queen Louisa Ulrike. The King's collection was described by Linnaeus in 1754: *Museum S. R. M. Adolphi Friderici*; it is the first work in which Linnaeus used the binominal nomenclature. The catalogue of the queen's collection appeared in 1764: *Museum S. R. M. Ludovicae Ulricae* a substantial catalogue of 720 pages, of which about two-thirds are devoted to the Insecta.
22. Balk, Laurentius, 1746: *Museum Adolpho Fridericianum*, cf. Soulsby, 1443–1446. The greater part of this dissertation is devoted to the Linnean class of the Amphibia and gives excellent descriptions of *Chamaeleon*, rattlesnake, and *Amphisbaena*. Some *Rana*-, *Testudo*-, *Lacerta*- and *Coluber* species have been described. Also descriptions of, e.g., the marsupial *Didelphus*, the armadillo, the squid *Sepia officinalis* and the nudibranch *Aphrodita aculeata*. Interesting are the references to Seba's *Thesaurus*.
23. Sundius, Petrus, 1748: *Surinamensis Grilliana*, cf. Soulsby, 1486–1489. Descriptions of 26 zoological specimens, collected at Surinam by M. Gerret—a Surinam missionary—and sent to Mr Clas Grill of Stockholm.
24. Odhelius, Johannes Laurentius, 1754: *Chinensia Lagerströmiana*, cf. Soulsby, 1844–1847. Magnus Lagerström fostered, that to each vessel of the Swedish East-India Company, a naturalist has been added for exploration purposes. He was an ardent collector of natural curiosities, particularly from China and the East Indies.
25. Hast, Barth. Rudolph, 1745: *Amphibia Gyllenborgiana*, cf. Soulsby, 1413–1416. This dissertation is the first specimen of Linnaeus's method of de-

- scription. The collection consists of rare Amphibia, Insecta, corals and minerals.
26. Of these four dissertations, three were published before the *Museum Adolphi Friderici* (1754) and consequently do not adopt the Linnaean binomial nomenclature, but follow the traditional custom by giving a genus name followed by a short description of the main characteristics.
  27. Linnaeus's second public oration, delivered at the occasion of his appointment to the post of professor in anatomy and medicine at Uppsala University on October 27, 1741. Cf. Soulsby, 1354–1368. English translation in: Stillingfleet, B., 1759: *Miscellaneous tracts relating to natural history, husbandry, and physick, with notes*. (London), p. 1–30.
  28. Hesselgren, Nicolaus L., 1749: *Pan Suecicus*, cf. Soulsby 1565–1584<sup>a</sup>. English translation: The Swedish Pan, cf. Stillingfleet, l.c., p. 184–210; also: Ramsbottom, cf. note 6. Also in French: Buc'hoz, P. J., ed., 1801: *Pan Suecus*, in: *Traité, ou Manuel vétérinaire des plants, qui peuvent servir de nourriture et de médicamens aux animaux domestiques*, ed. 2, part 3, p. 311–345. German translation in Hoepfner, E. J. T., 1776–1778: *Des Ritters Carl von Linné auserlesene Abhandlungen aus der Naturgeschichte, Physik und Arzneywissenschaft*, 3 vols. (Leipzig), vol. III, p. 271–331.
  29. Holmberger, Petrus, 1774: *Esca Avium Domesticarum*, cf. Soulsby, 2432–2433. Supplementary to these observations of Hesselgren and Holmberger is P. G. Tengmalm's study: *Pan Suecus emendatus et auctus*, published in the *Amoenitates*, vol. 10, no. 1. Appendix, p. 132–172.
  30. Aphonin, Mattheus, 1766: *U'sus Historiae Naturalis*, cf. Soulsby, 2329–2334. English translation in: Brand, F. J., 1781: *Select dissertations from the Amoenitates academicae*: a supplement to Mr Stillingfleet's tracts, relating to natural history (London), p. 1–70. German translation by I. K. H. Boerner, 1774, in *Sammungen aus der Naturgeschichte*, vol. 1: 76–156. Aphonin's dissertation gives a review of a great number of earlier theses dealing with the same subjects.
  31. Karamyschew, Alexander de, 1766 (1764): *Necessitas Historiae Naturalis Rossiae*, cf. Soulsby, 2259; 2323–2328. This dissertation also contains a list of Siberian plants, extracted from some manuscripts in the possession of Linnaeus.
  32. Nyander Johannes C., 1757: *Exanthemata viva*, cf. Soulsby, 1970–1973. Roos, Johannes Carolus, 1767: *Mundus invisibilis*, cf. Soulsby, 2348–2352. Hult, O. T., 1934/35: Om Linné och den osynliga världen. (*Svenska L. Årsskr.* 17: 118–128; 18: 16–22.) (Quoted after Goerke.) Cf. also the dissertation of Sidrén, Jonas, 1750: *Materia Medica in Regno Animali*, Cf. Soulsby, 1605–1611. The greater part of the dissertation *Mundus invisibilis* deals with the question, whether the dust of Fungi should be very small animals or not, for doubts had arisen whence Fungi should be arranged in the plant or in the animal kingdom.
  33. The author is convinced that a species of the genus *Acarus* causes dysentery and in the *Systema Naturae* this species is described as *Acarus Dysenteriae*.
  34. Adler, Carolus Frid., 1752: *Noctiluca marina*, cf. Soulsby, 1673–1677.

- Pulteney summarizes Adler's conclusions as follows: "Then it was found to be owing to an inconceivable number of these minute 'insects'. One of these insects is here completely described, with a figure, augmented by the microscope. It stands in the *Systema* under the name of *Nereis noctiluca*."
35. In the *Systema Naturae*, ed. 10, the Vermes have been divided in the following taxa:  
*Intestina*: solitary animals, nude, without extremities.  
*Mollusca*: solitary animals, nude, with extremities.  
*Testacea*: solitary molluscs with calcareous shell.  
*Lithophyta*: compound (in colonies living) Mollusca, building up a hard construction.  
*Zoophyta*: growing plants with animal flowers.
  36. Murray, Adolphus, 1771: *Fundamenta Testaceologiae*, cf. Soulsby, 2405–2410. German translation: Schröter, J. S., 1782: *Des Ritters Karl von Linné Termini Conchyliologici* (Weimar).
  37. With Linnaeus, the Mollusca comprise a variety of animals, such as: *Nereis* (Annelida); *Sepia* (Mollusca); *Medusa* (Coelenterata); *Asterias* (Echnodermata). For his definition of the Mollusca, cf. note 35.
  38. Fougé, Henricus, 1745: *Corallia Baltica*, cf. Soulsby, 1401–1412. English translation, cf. Brand, l.c., p. 457–480. German translation, cf. Hoepfner, l.c., vol. III, p. 89–126. Fougé's dissertation is the first study on corals of the Northern waters and a first attempt to classify them.
  39. Bäck, Albertus, 1759: *Animalia composita*, cf. Soulsby, 2036–2039. The compound animals are characterized by being connected together by one common base or support.
  40. It must be noticed, that the sponges are wanting in *Systema Naturae*, ed. 10. In the 12th edition they are classed in the taxon of the *Zoophyta*. The *Zoophyta* are classified as compound animals, which reveal themselves like plants; they can be divided in moving and sedentary animals. To the moving specimens belong, e.g., *Taenia*, *Volvox*, *Hydra*.
  41. Whereas the *Animalia composita* propagate, not only by eggs, but also by budding, progressive extension and ramification, they seem to unite—according to Linnaeus—both the powers of the animal and the plant kingdoms.
  42. Cf. note 32.
  43. Dubois, Godofredus, 1748: *De Taenia*, cf. Soulsby, 1507–1513. German translation, cf. Hoepfner, l.c., vol. II, p. 101–140. As to the systematic position of this animal, cf. note 40.
  44. According to the author, each internode should have its own mouth; probably he is mistaken by the opening of the uterus, lying on the ventral side of each internode.
  45. Weser, Daniel, 1764: *De Hirudine*, cf. Soulsby, 2281–2284.
  46. In the last edition of the *Systema Naturae* prepared by Linnaeus, 14 species of leeches have been enumerated.
  47. Bladh, Andreas Johann, 1767: *Fundamenta Entomologiae*, cf. Soulsby, 2367–2371. English translation: Curtis, W., 1772: *Fundamenta Entomologiae* or, *An*



- Introduction to the Knowledge of Insects*, etc. (London). For a critical examination of Linnaeus's contributions to entomology, cf. Aurivillius p. 24 ff.
48. Mentioned are Maria S. Merian and Jac. Hoefnagel.
  49. The names of the various body parts have been used consequently in the *Systema Naturae*. In the descriptions on species level some more terms have been used, not mentioned in this dissertation. According to Aurivillius, p. 29–30 it is striking that in Linnaeus's entomological system "mixed genera" hardly occur.
  50. With Linnaeus the order of Coleoptera included the *Orthoptera*, which later on were considered as an independent order; they differ in their metamorphosis.
  51. Johansson, B., 1763: *Centuria Insectorum Rariorum*, cf. Soulsby, 2251–2254.
  52. Dahl, Andreas, 1775: *Bigae Insectorum*, cf. Soulsby 2455–2456. Cf. also: Shillito, J. F., 1974: "Paradoxum insectum"—Linnaeus in Diopsis (Insecta: Diptera). (*Biol. J. Linn. Soc.* 6: 277–278.)
  53. Linnaeus describes his interest in insect life in the following words: "Insects have been the greatest of my pleasures ever since I lived in Upsala as a young man in the years 1728–1734 and I devoted all my free time to collecting, studying and describing them." (After Bryk, F. 1924: *Linné als praktischer Entomologe.*) (Stockholm), p. 21.
  54. Linnaeus, C., 1739: *Tal om märkvärdigheter uti insecterna*, cf. Soulsby, 1341–1353. English translation in Brand, l.c., p. 309–343. German translation *Von den Merwürdigkeiten an den Insekten* (*Allgem. Magazin der Natur, Kunst und Wissenschaften*, vol. 2, p. 328–353, 1753). It was Linnaeus's first public oration.
  55. Forsskåhl, Jonas Gustav, 1752: *Hospita Insectorum Flora*, cf. Soulsby, 1707–1715. English translation in Brand, l.c., p. 345–368. French translation by Buc'hoz, l.c., part 3, p. 346–380. This dissertation particularly deals with the problem that some insects have certain food plants and he made a study of the damage these plants undergo by the insects. Rydbeck, Ericus Ol., 1758: *Pandora Insectorum*, cf. Soulsby, 2008–2012. This dissertation gives more detailed information about the parts of the plant on which the insects live, and about larval and pupal stages. Söderberg, Daniel Henr. 1771: *Pandora et Flora Rybyensis*, cf. Soulsby, 2303–2304. Probably this is one of the scarce dissertations written by the respondent himself.
  56. Both in the *Fauna Suecica* and in the *Systema Naturae* for each herbivorous insect the plant on which it feeds is also mentioned. Further, Linnaeus has pointed out by means of examples that many insects feed on only one plant species, whilst other insects, in the absence of a particular plant, feed on another, and that sometimes it is even possible to get a hint, through insects, of the close relationship between two species of plants, despite great morphological differences (cf. also Aurivillius, l.c.).
  57. Baeckner, Michaël, A., 1752: *Noxa Insectorum*, cf. Soulsby, 1829–1738. English translation in Brand, l.c., p. 369–411. German translation in Bryk, F. ed., 1924: *Linné's gesammelte Schriften entomologischen Inhaltes*, p. 49–66. This dissertation has served as an example for forthcoming dissertations in the

- field of applied entomology. It consists of eleven sections, each considering one of the ways in which insects cause damage to Man. It contains descriptions of the most common insects in house and garden. It gives for many animals the relevant passages in Linnaeus's own writings.
58. Avelin, Gabriel Emanuel, 1752: *Miracula Insectorum*, cf. Soulsby 1722–1728. English translation in Brand, l.c., p. 413–436. German translation in *Allgemeines Magazin der Natur, Kunst und Wissenschaften*, vol. 9., p. 321–350.
  59. The production of honey has never been the central theme of one of the Linnean dissertations, but has been the subject of a prize-essay, entitled *Pan Apum*, written by J. O. Hagström, one of Linnaeus's pupils.
  60. The problem of the fecundity of plants was discussed, for instance, in G. Hegard's dissertation *De Ficu*, 1744, cf. Soulsby 1389–1394; and in J. G. Wahlbom's dissertation *Sponsalia Plantarum*, 1746, cf. Soulsby, 1447–1460; and in B. M. Hall's dissertation *Nectaria Florum*, 1762, cf. Soulsby, 2206–2213. German translations of the relevant passages in Bryk, l.c., p. 34–37.
  61. Linaeus, Canutus Aug., 1762: *De Meloë vesicatorio*, cf. Soulsby 2219–2222. Many arguments have been summed up to prove that the Chinese species *Meloë Cichorii* is the true *Cantharis* of Dioscorides. Cantharidin is normally derived of the Spanish fly (*Cantharis vesicatoria*).
  62. Lyman, Johannes, 1756: *De Phalaena Bombyce*, cf. Soulsby 1931–1935.
  63. Linnaeus himself seems to have had little interest in this group, for in the tenth edition of his *Systema Naturae* he speaks of "These foul and loathsome animals, . . . abhorrent because of their odd body, their offensive smell, terrible venom, etc., so that their Creator has not exerted his powers (to create) many of them". Cf. Porter, K. R., 1972: *Herpetology*, p. 1–4. (Philadelphia.)
  64. Acrell, Joh. Gustavus, 1762: *Morsura Serpentum*, cf. Soulsby, 2169–2173. English translation by Brand, l.c., p. 265–308. Two more dissertations deal with the venomous bites of serpents, viz., those of J. A. Darelius and of J. Kiernander. Darelius, Johannes Andr., 1749: *Lignum colubrinum*, cf. Soulsby, 1531–1537. German translation: Hoepfner, vol. III, p. 216–240. Kiernander, Jonas, 1749: *Radix Senega*, cf. Soulsby, 1545–1554. German translation: Hoepfner, l.c., vol. III, p. 152–174. Full botanical and medical account of the plant *Polygala Senega*, or milk-wort.
  65. Österdam, Abrahamus, 1766: *Siren lacertina*, cf. Soulsby, 2335–2338. Cf. also: Lönnberg, E., 1909: Carl von Linné und die Lehre von den Wirbeltieren esp. p. 39 (Jena).
  66. Bäckman, Andreas Petrus, 1765: *Fundamenta Ornithologica*, cf. Soulsby, 2285–2288.
  67. This discovery induced Linnaeus to constitute the science of pterography.
  68. Ekmarck, Carolus Dan, 1757: *Migrationes Avium*, cf. Soulsby, 1936–1942. English translation: Brand, l.c., p. 215–263. German translation: Hoepfner, l.c., vol. II, p. 269–309. In this dissertation the author has brought together all the then known species of migratory birds, whether exotic or indigenous in Sweden. Much information on the time of migration, the places where food is to be found, etc. Linnaeus also explains that some birds can pass the

- winter, because they can find their food even under the most severe circumstances, such as the woodpecker. The author is remarkably well informed in the migration routes for about 100 species of birds.
69. Lindecrantz, Ericus, 1753: *Cynographia*, cf. Soulsby, 1793–1798. Appeared in the *Amoenitates* under the title *Canis familiaris*.
  70. Hoffberg, Carolus Frid., 1754: *Cervus Rheno*, cf. Soulsby, 1823–1827. Appeared in the *Amoenitates* under the title *Cervus tarandus*. English translation in Brand, l.c., p. 167–214.
  71. Palmaerus, Isacus, 1754: *Oves breviter adnumbrans*, cf. Soulsby, 1828–1831. Appeared in the *Amoenitates* under the title *Ovis*. The dissertation contains a list of 140 plant species which sheep do not eat; some of the plants are highly noxious or even poisonous.
  72. Nauman, Johan Justus, 1754: *De Mure Indico*, cf. Soulsby, 1833–1837. Appeared in the *Amoenitates* under the title *Mus porcellus*. German translation in Hoepfner l.c., vol. I, p. 135–154. As to the use of guinea pigs, we read, that they afford pleasure and that they are very delicious when prepared for dinner.
  73. Lindh, Jacobus, 1759: *De Pinguedine Animalis*, cf. Soulsby, 2100–2103. Appeared in the *Amoenitates* under the title *Sus scrofa*.
  74. Hoppius, Christianus Emmanuel, 1760: *Anthropomorpha*, cf. Soulsby, 2124–2129. German translation in Hoepfner, vol. I, p. 57–70.
  75. Broberg, G., 1975: *Homo sapiens L. Studier i Carl von Linnés naturuppfattning och människolära*, 320 p. (Lychnos-Bibliothek). English summary, 287–293, extensive bibliography, p. 294–314 and Index.
  76. Wadström, J. A., 1767: *Metamorphosis Humana*, cf. Soulsby, 2372–2375.
  77. Ramström, Christianus Lud., 1759: *Generatio Ambigena*, cf. Soulsby, 2082–2086.
  78. Cf. Aurivillius, l.c., p. 41.
  79. Gedner, Christophorus, 1752: *Questio historico naturalis: Cui Bono?*, Soulsby, 1691–1706. English translation in Stillingfleet, l.c., p. 128–162. German translation in Hoepfner, l.c., vol. I, p. 109–134.
  80. German translation of the relevant passage in Bryk, l.c., p. 48.
  81. Söderberg, Olaus, 1748: *Curiositas Naturalis*, cf. Soulsby, 1500–1506 a. This dissertation aroused a storm of criticism from the side of the theologians, cf. Hagberg, K., 1964: *Carl Linnaeus. De bloemenkoning*, p. 218–219. (Amsterdam.) French translation in Jasmin, B., ed., 1972: *C. Linné. L'équilibre de la nature*, p. 125–144. German translation in Hoepfner, l.c., vol. III, p. 127–151.
  82. Wilcke, H. Christ. Daniel, 1760: *Politia Naturae*, cf. Soulsby, 2104–2110. English translation in Brand, l.c., p. 129–166. French translation in Jasmin, l.c., p. 103–122. German translation of the entomological passages in Bryk, F. 1924: *Linnés samlade skrifter entomologiska Innehåll*, p. 71–76.
  83. Biberg, Isaac J., 1749: *Oeconomia Naturae*, cf. Soulsby, 1514–1530. English translation in Stillingfleet, l.c., p. 31–108. French translation in Pulteney, l.c., vol. 2, p. 216–297, and in Jasmin, l.c., p. 57–102. German translation in Hoepfner, l.c. vol. II, p. 1–56, and for the entomological parts in Bryk, l.c., (note 82), p. 41–47.