LINNAEUS AND HIS TIME

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The eighteenth century was a very successful period in the history of Swedish science, and Carolus Linnaeus was one of its outstanding figures. But how could a small country like Sweden become one of the leading nations in the new sciences and how could an impoverished student like Linnaeus make his way in the world of science so quickly ? I shall try to depict this man both as a scientist and as a representative of his time.

Linnaeus, ennobled as Carl von Linné, was born when Sweden was going through a difficult period. The king, Charles XII, was involved in wars throughout his reign and brought economic ruin to his country. After Charles' death in 1718, power was assumed by the Estates, and the monarch remained only formally the head of the realm. Everything possible now had to be done to repair the economy. The political party that held power from 1739-1765 embraced the mercantilist theories which were popular on the Continent. These implied that the government supported manufacturing industry in order to increase exports and reduce imports, while also protecting the interests of agriculture. In other words, the concern of the government was practical economy. Its ideology may be called a general utilitarianism, but here in the sense that the principle of economic utility was the overall goal. Firm central direction was to determine the detailed course of commercial development. Despite certain drawbacks, there was something new and exciting in this policy, a forward-looking optimism. The emphasis on industry and on the improvement of agriculture also made for a receptivity to modern science. There was an awareness that science could contribute to economic progress.

In the ecclesiastical field, however, policy was traditional and conservative. The orthodoxy of the seventeenth century still dominated

and was even strengthened by new religious laws. A system of censorship monitored the books that were published, and in theological matters the church was the ultimate censoring authority. Theological faculties at the universities intervened on several occasions when doctoral dissertations touched upon religious questions.

Such, briefly, was the social background. Economics and religion came to exert a considerable influence on Linnaeus' career. This was the society into which he was born and he played his part in helping to develop it. When he was twenty-one, in 1728, he came to Uppsala University and but for a few years abroad he lived there until his death in 1778, fifty years later. He had always been interested in botany and very soon he was given the responsability of teaching the students. Both the professors were elderly and rather inactive, so Linnaeus came on the scene at the right moment. Not only was he very talented, he also had ample self-confidence and he had great plans for the reform of the study of natural history, especially botany. But at that time botany was a part of medicine, and to make a career in medicine Linnaeus needed a doctor's degree, which had to be obtained abroad, because it was not yet possible to take a degree of medicine in Sweden. (This situation was to change only a few years later).

So in 1735 Linnaeus went to The Netherlands, where after only one week he took his doctor's degree at the small University of Harderwijk with a dissertation on the subject of ague. He then went on to meet the great Boerhaave, who was very impressed by the young man. On Boerhaave's recommendation, he went to the well-known banker Georg Clifford at Hartecamp near Leiden, where he was placed in charge of Clifford's botanical garden. While working here, he published a large number of books, many of which had already been partially written in Sweden and were now completed and edited for publication.

The most important of these books was *Systema Naturae*, published in 1735 and containing a new classification system for botany. Classification had been a problem in botany since the Middle Ages. Botanists had tried to order the plants according to various characteristics,

such as size or colour, but the imprecise nature of these characteristics caused complications. As knowledge of plants in newly explored parts of the world rapidly grew, it became more and more difficult to classify them. Linnaeus had been quick to realize that plants could be considered from their sexual aspect, and he devised a scheme based on this characteristic.

His classification system, also called the sexual system, took account of the number and arrangement of the stamens and pistils. *Systema Naturae* was a tremendous success and Linnaeus was always busy on new and enlarged editions, no less than sixteen editions being published during his lifetime. It should also be mentioned that the systematization of mineralogy and zoology was less successful. However, Linnaeus was the first to give man the name of "Homo sapiens" and place him among the animals, even though of course at the top of the ladder.

The new classification was what the botanical world needed. It gave botanists a system that was easy to understand and to use, and it gave them a common language. For a long time Linnaeus thought of it as a "natural system", a kind of blueprint of the Creator's work, but eventually he came to the conclusion that it was artificial. Nevertheless, and despite the criticism of some of his colleagues, the system worked, and Linnaeus, still a young man, became a world-famous authority. After three years abroad, however, he hastened home. The reason was important enough : his finacée had promised to wait three years for him. They married in 1739 and Linnaeus worked as a private doctor in Stockholm until he became Professor of Medicine at Uppsala University in 1741.

Linnaeus was not only a successful scientist, he was also a good organizer. In Stockholm he was one of the founders of the Royal Swedish Academy of Sciences (in 1739) and he became its first president. The Academy played an important role in the growth of science in the whole country and formed a body for international contact and collaboration. Back in Uppsala, Linnaeus soon became one of the

leading professors. Uppsala was then - as it still is - a university town. Since its founding in 1477 the University had had its ups and downs. During Linnaeus' time it grew into an international university of good European standard. Linnaeus' was not the only famous name. Among his colleagues we find, for instance, Rosén von Rosenstein, the father of pediatrics, the mathematicians and astronomers Klingenstierna and Celsius (the inventor of a thermometer), and the chemists Wallerius and Bergman. In the expectation of economic benefit it seemed that all the fields of science could be developed, even in a small country of limited resources.

Linnaeus was an industrious worker. He restored and enlarged the botanical garden (the one now known as "the Linnaeus Garden" and maintained in the order that he first prescribed), he published books regularly, and he lectured to and made excursions with a steadily growing number of students. At the request of the Estates he made a series of journeys to differents parts of the country, the purpose being to inventory useful plants and other natural resources. He also organized a network of international journeys of exploration, sending out his "disciples" to nearly every corner of the world. In this connection he collaborated with the Swedish East India Company, and many of his students were employed as ship's chaplains although their real mission was to collect and describe plants and other specimens for the master in Uppsala. Linnaeus was convinced that it was possible "in principle" to find and list every plant in the world, and he could do this through his disciples; every new finding was of course put in its correct place in his System of Nature. He was happy when he received a tea plant from China but unfortunately it did not survive for very long in the Nordic climate. Nevertheless what he received was enough. Reports and collections came from Iceland and Australia, from China, America and South Africa. Through his disciples, in fact, he learned to know the whole world.

If Linnaeus' first great contribution to botany was the classification system, his second was "the binomial nomenclature" presented in his book *Species Plantarum* in 1753. The principle was that every plant should be identifiable by using just two names, as a person is identified

by a first name and a family name. Earlier, plants had been known by the specific name followed by a long description of their characteristics. Now it was possible to define a plant by two words, the first giving the genus and the second the species : e.g. Linnaea borealis; Sinapis arvensis. The book contained a list of all the world's plants then known, a total of about 8000.

A third contribution was that Linnaeus succeeded better than anyone before in defining the species and he introduced a standard terminology for all parts of a plant that were essential for its definition. He had a sharp eye for distinctions and his descriptions were always clear and concise; with a few words he expressed what was important to know. Even modern botanists recognize his influence in this respect.

Linnaeus has been called "the Prince of Botany", and in Sweden he became a kind of national hero. He began to acquire this status during the Romantic era, when God and Nature were leading ideas among philosophers. Linnaeus was the right man for such a view of the world and a phrase was coined : "God created Nature and Linnaeus ordered it." But there is another aspect to the picture. Some critics have said that Linnaeus very soon became deskbound and abandoned his empiricism. He had a great gift for marshalling facts and impressions, for grouping them and making distinctions. But this led him to fanaticism. He wanted groups, catalogues and systems for everything. With this he moved farther and farther away from empirical science and became an abstract constructor. He showed no interest in experiments and modern science, the most important task continuing to be the classification and labelling of plants. He worked with Aristotelian logic and was scholastic in his method. In his personal relations, too, he had difficulties. He was very generous and helpful to his students as long as they listened to him and shared his views, but he was self-centered and did not like criticism. "Heretics", he called those who did not follow his scientific methods and pursue his scientific goals.

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Linnaeus, the man and scientist, cannot be described in a simply way. He was aware of and influenced by traditional cultural factors as well as new intellectual currents. He embraced the utilitarian spirit of the mercantilic politics with enthusiasm, but he refused to have the universities bound by a centralized political power. He was free from Christian dogmas and in that sense an enlightened philosopher, but in other respects he was deep down in mysticism and popular prejudices. One part of his soul Linnaeus had in the Enlightenment's belief in reason, another one in its opposite obscure superstition.

Linnaeus was a loyal supporter of the utilitarianism of his time. He was one of the leading scientists who founded the Academy of Sciences. As has already been mentioned its purpose was first of all practical and economical; the ambition was to serve people with scientific and technical innovations in order to give economic assistance to the nation. Linnaeus participated with enthusiasm in this work.

On the other hand, Linnaeus did not go too far. When in 1750 a commission for research and higher education suggested that the universities should be governed by the politicians in Stockholm, Linnaeus reacted. The idea was to organize the universities in detail and adapt them to the economic and commercial market. Linnaeus and his colleagues protested very sharply. They had never meant it this way. The economic use as a program should be for the nation in general, and for the future. Short-sighted adaptations to economic life were doomed to fail, since it was impossible to predict the future in details. According to Linnaeus economic use and academic freedom were not antitheses.

Still more complicated was Linnaeus's relation to the Church and the religion. He often expressed a deep religious feeling, but he critizised the dogmas and the powerful position of the Church. In the middle of the eighteenth century the Swedish Church tried to grasp the philosophical situation more than before. Linnaeus himself had his clashes with the theologians. He was critized when he expressed too free an opinion on the subject of the Creator and his intentions; only a practised theologian was allowed to pronounce on such weighty matters.

Linnaeus had his own way of expressing his feelings. In Nature he saw the eternal, omniscient, omnipotent God "from behind". He traced God's footsteps across the fields and observed, even in those which were scarcely discernible, "an infinite wisdom and might, an inscrutable perfection". The whole of nature bore the divine stamp and it had been given to Linnaeus to interpret the gospel. The study of nature became an act of devotion and a religious ritual. But he did not only read the Bible; he was also familiar with the classics. He often quoted authors such as Aristotle, Pliny, and Seneca, even when he was conveying his ideas about the way the world came into being and about its Creator : "If one will call him *destiny*, one is doing no wrong, for all things hang from his finger; if one will call him *providence*, one is also right, for all things happen at his sign and at his will."

That Linnaeus was in a way deeply religious is so apparent as hardly to need mentioning; he believed in God, in the Bible as the Word of God, and in himself as God's interpreter of Nature. It is also well-known that he was very conversant with the Old Testament and quoted from it frequently. But this does not mean he was an orthodox Christian. The aphorisms on Destiny and Nature bore the imprint of pagan philosophy and were scarcely looked upon kindly by orthodox theologians. Nor, for his part, was Linnaeus particularly well disposed towards them. Wherever one may think and write as he will, study flourishes, he declares as early as 1733 : "Where religion is free, the land flourishes. Where theology reigns, there is nothing but wretchedness."

Consequently, Linnaeus did not rely only upon the Bible but also upon human reason. And so he says about the process of Creation : "That the wondrous edifice of the earth was brought forth and shaped by the eternal Master, we are told not only by the Holy Scriptures, but also by common sense." Even more frequently he expresses his constant admiration for the all-wise order of nature, which does more than anything else to point to a higher power as the origin of all things. By the agency of the Creator the grass has appeared which feeds the cattle; fish, which do not have the warmth to be viviparous, have instead "by the providence of the Creator" been made capable of producing roe. Nature

exists to show us the genius and greatness of our Lord; this is its main business. All is done to the glory of God, which is attested not only by moralists and theologians, but also by nature herself, and man has been put here to reflect this his Creator's wisdom. Here we meet the well-known physico-theological philosophy of the period; one should prove God's existence and greatness by studying nature and its complicated coherence. Linnaeus also sees clear signs of the hand of God in the chain of being which fills the whole of nature. One link differs so little from the next that if one could see the whole chain at once it would hardly be possible to distinguish them. All levels and forms of life, the manifoldness and the variety, were necessary expressions of the omnipotence of God.

Linnaeus often talked about what he called *oeconomia naturae*, the economy of nature, by which he meant a kind of balance or harmony in nature. There was always a war going on in nature, between individuals and groups. No plant or animal was allowed to grow too fast, because it would disturb this balance. There was a plan made by God to keep everything in nature in harmony, and this view has been said to be a sign of what we call ecological insight, and perhaps this is right because Linnaeus was also aware of what man could do to nature.

When it comes to antagonism between religion and the Enlightenment, geology can be said to be of special importance. This was very natural. The geologists tried to give a scientific explanation of the same period talken about in Genesis. Linnaeus did not recognize the biblical Flood as a geological event and he was not satisfied with biblical chronology. In his autobiography, he makes a remark which has often been quoted without ever really being elucidated : "Linnaeus would gladly have believed that the earth was older than the Chinese had claimed, had the Holy Scriptures suffered it." According to Chinese history, China would have been not merely inhabited but even a kingdom several hundred years old before Noah's Flood. As we know, Christian chronology was thinking in terms of a total period of 6000 years, 4000 having passed between the Creation and the birth of Jesus. This time

table did not fit the Chinese chronology, and it did not fit Linnaeus' ideas either.

Time is a key concept in Linnaeus' outlook on the development of the earth's surface, as it was in his later doctrine of the formation of the species, when the species was characterized as the child of time, *temporis filia*. It was no coincidence that he was inclined to credit the earth with a longer history. When he contemplates nature, he is more than conscious of all the forces which affect and alter the face of the earth, provided there is enough time. He is fascinated and becomes lyrical when he examines the rock strata in the south of Sweden, and he thinks of the age which has been required for this work : "I feel dizzy when I stand upon this hill and look down upon the long period of time which has passed like waves in the Sound, leaving behind only these faintest traces of the former world, and which can now only whisper when all else has become still." This was new and radical thinking in eighteenth century geology. His insight into the importance of the time factor points ahead to the geological theories of the nineteenth century. And it becomes clear that he disregarded the Bible completely as a scientific textbook.

Here Linnaeus holds a position as an enlightened philosopher, guarding the scientific principles. It was not always in the way, neither for him, nor for his contemporaries. We have several examples of how new ways of thinking could run foul of older ones. One such question concerned the transformation of cereals. According to popular tradition, oats could be transformed into rye under certain conditions; various experiments appeared to confirm this state of affairs. The scientists said no; Linnaeus maintained that species had been constant since the Creation and that such a metamorphosis was unreasonable according to the laws of science. There were other problems. Another folk tradition stated that swallows wintered by sleeping on the bottoms of lakes. Here it happened that Linnaeus was on the opposite side, believing steadfastly that this was just what swallows did. But the versatile professor Johan Leche, of Turku, Finland, pointed out that it was physiologically impossible for a creature with lungs like the swallow to survive on the bottom of a lake.

Leche deemed such an idea to be "an absurd fable" and its dissemination to be an epidemic delusion, *error epidemicus*. It was the duty of science to expose popular prejudices and, by careful experiment and with the aid of physics and mathematics, to build up a view of the world founded on facts.

Other examples could be mentioned. In his anthropological writings Linnaeus also seemed very much to alter between standpoints of reason and folk tradition. As mentioned before he named man Homo sapiens and so he saw man as belonging to animals, as a part of nature. He also rejected all the rumours about the seven-headed hydra, which was said to be found somewhere in Holland; this was all nonsense, he declared. At the same time he had a lot of ideas about the hottentots, about troglodytes, tailed men and other curious forms of creatures between animals and man. They were all taken from folk tradition or from the literature, Linnaeus being not critically enough to have all these tales proved. Of course he had not himself seen these creatures.

In his old days he wrote down his reflections upon life, under the title of *Nemesis divina*. Here he gave expression to a very pessimistic view of life. He collected examples (meant for his son) from the Bible, classical literature and his own time, to show what would happen if you acted in a wrong way (and indirectly what would happen if you acted right). This was also a kind of harmony, of balance in the world, but in a moral and social meaning; the economy of nature also existed in the human society. Everywhere Linnaeus saw the traces of Nemesis divina, the punishing God, and he saw them mostly in his surroundings, among his colleagues and enemies. He mixed his personal feelings with folk tales, biblical stories and a general religious morality. In this case he could not make a clear distinction between scientific arguments and his own antipathies.

We have seen some examples of the complexity of Linnaeus. In the time of the Enlightenment, in the clash between old traditions and new ideas he was sometimes on one side, sometimes on the other. There

were even open conflicts, between people and between groups, but the most serious conflicts probably took place within himself.

Further readings in English

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