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LINNEAUS'S LEGACY

Systematic Challenges, Past and Present

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ABSTRAK

Tulisan ini menyampaikan perkembangan ilmu sistimatik. Pandangan Linnaeus menyerupai pandangan Aristotle dalam hal mengelompokkan organisme mengikuti *Scala Naturae* yaitu berdasarkan kemiripan. Namun pendekatannya berbeda, Aristotle lebih menekankan bahwa karakter yang berkaitan dengan gaya hidup organisme seperti bentuk tubuh sangat penting untuk klasifikasi. Sedangkan menurut Linnaeus justru karakter yang tidak terlihat, tetapi sangat penting dalam mempertahankan hidup sehari-hari justru jauh lebih penting. Saat ini kita menyusun organisme berdasarkan pohon filogenetik dengan cara mengelompokkannya kedalam kelompok monofiletik atau disebut juga kelompok alami yaitu dimasukkan kedalam suku (famili), ordo dan filum. Jenis-jenis yang termasuk kelompok tersebut harus berasal dari nenek moyang yang sama. Perbedaan yang terjadi pada bentuk tubuh atau fungsi bagian tubuh dipaparkan dengan ,cladistic'. Perkembangan pesat di bidang biologi molekuler termasuk tehnik-tehnik DNA dalam beberapa dasawarsa terakhir ini sangat membantu mengurai persoalan rumit yang dijumpai dalam melakukan klasifikasi.

Key words: Linnaeus, Linnaeus's legacy, Aristotle, systematic challenges, scala naturae, similarity, phylogenetic tree, monophyletic, DNA techniques.

At the time of Linnaeus the prevailing view of the natural world was similar to that of Aristotle. Organisms were organised according to the Scala Naturae. Linnaeus wanted to place all organisms into the positions on the Scala Naturae, relying on similarity. Aristotle considered characters associated with the lifestyle of an organism, like shape of the body, to be most important for classification. Accordingly, he classified dolphins with fish. Linnaeus, on the other hand, was of the opinion that characters that were not obviously important for day to day survival, like the number of stamens and pistils, to be most important. The approaches of Aristotle and Linneaus are fundamentally different, as similarity may be caused either by homology, i. e. similarity due to shared ancestry, or parallel evolution, i. e. similarity caused by selection for similar traits when organisms have similar ways of life. In modern systematic practice only homologies are used for classification. For example for plants living in the desert, it is very advantageous to be able to retain water in their leaves for a long time; so there has been strong selection for tick succulent leaves. For plants living in the rain forest, this is not a problem, and succulent leaves are rare in the rain forest. When Linnaeus sorted species, he tried to order them in a linear fashion, according to the Scala Naturae. Today, we want to organize species in phylogenetic trees. First of all, we want to make sure, that we organize them in monophyletic groups, also called natural groups. The only groups we put names on, like families, orders and phyla, are such natural groups. The species in these groups must all have descended from the same ancestor, and all the descendants from this ancestor must be part of the group. Theoretically, this is not a problem, but in practice it is not always easy to differentiate between homologies and similarity due to parallel evolution.

So how do we tell the difference? Consider fishes and dolphins; they look similar in shape, but the structure of their internal organs differs markedly. Using morphological characters, you can agree with Aristotle that "fish shape is very important and should be the basis for classification", and group the dolphins with the fish. On the other hand, you may compare the internal organs offish and dolphins, and find differences like lungs and gils , and you can decide that dolphins are not fish. However, unless we have additional information, these two positions may theoretically be considered matters of opinion. To further complicate things, homologous characters may be very different, due to selection for different life styles. For example the flippers of whales and wings of birds are both homologous parts of the body, the anterior extremities, but are adapted for very different ways of life. This illustrates how difficult it is to determine which characters are homologous. It will be the task of the systematist to evaluate the nature and usefulness of the characters, but our bias and prejudice may lead us down the wrong path. Also, the evidence from one character may be in conflict with evidence from others. Cladistic analysis is one way to overcome this.

There are many examples of how organisms have been grouped in non-monophyletic groups based on similarities having evolved from very different ancestors. One such example is the American vultures and Condors. These are similar to Old World vultures in general appearance and life style. Apparently, birds that feed on carcasses benefit from having a strong hooked bill, few feathers on the head and neck, and long broad wings. In Africa, the Marabou Stork illustrates this to some extent. It feeds on dead animals, and is similar to vultures in having long broad wings and few feathers on the head and neck. However, unlike the storks living in America, that evolved so many similarities with vultures that they were until recently believed to be birds of prey, the Marabou Stork has a bill that is very different from vultures. Why didn't it evolve to become like a perfect vulture? Because evolution does not proceed towards any specific goal. Instead, organisms are under a constant preassure from selective forces that favours individuals that are best equipped for the prevailing circumstances, while those slighlty less well adapted are at a disadvantage. Furthermore, the ancestral species is characterised by certain traits, which may be modified by selection. These are the raw material for evolution to work with, and are sometimes easily modified to new uses, but are sometimes restricted by the genetic composition. Also, a character may be important in more aspects than one. If we consider the bill of the Marabou Stork, it is possible that selection has promoted large size rather than a hooked tip. The latter may be good for tearing flesh apart, but a huge bill may be good for fighting. Perhaps it has been more important for the Marabou Stork to be able to defend its food, rather than to efficiently rip it apart.

This example illustrates how difficult it is to judge which characters to rely on for systematic practice. Luckily, the advances of DNA techniques in recent decades provides a way to come to conclusions that are not biased by our preconceived opinions. When DNA data are used to evaluate the phylogenetic position of the American vultures, Old World vultures are shown to be birds of prey (Accipitrinae) that have evolved specialisations for finding and feeding on carcasses, while American vultures, that live just like Old World vultures, are in fact storks (Ciconinae) having evolved similar specialisations, are to use molecular evidence.