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Taxonomy as a critical science

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Abstract

The critical function is an important aspect of the science of taxonomy. Every classification is built upon a critical evaluation and emendation of a previously existing one. Ultimately, this reaches back to pre-scientific classifications which are, like scientific ones, hierarchically structured. The critical function is strongly developed in phylogenetic systematics in which some time-honoured taxa are no longer considered natural groups. Rejection of paraphyletic taxa has given rise to opposition against the phylogenetic methodology. It is suggested that paraphyletic taxa may be retained for administrative reference, but not for scientific evaluation of biogeography and evolutionary differentiation.

Résumé

La fonction critique est un aspect important de la science taxonomique. Chaque classification est bâtie sur l'évaluation critique et sur l'émendation d'une classification préexistente. En reculant, on arrive en fin de compte aux classifications préscientifiques, tout comme celles scientifiques, qui sont hiérarchiquement structurées. La fonction critique est bien développée dans la systématique phylogénétique, dans le cadre de laquelle certains taxa auparavant tenus pour valides, ne sont plus considérés comme étant des groupes naturels. La rejection de taxa paraphylétiques a engendré une opposition à la méthodologie phylogénetique. On suggère que les taxa paraphylétiques pourraient être retenus pour une "référence administrative", mais non pour une étude scientifique de la biogéographie et de la différenciation évolutive.

Taxonomy has many different aspects. One of these is the explorative side: the discovery and description of species and higher taxa new to science. Professor Stock has been very active in this field. In the course of his career he has not only discovered hundreds of animal species, but has also explored almost unknown types of habitat such as deep caves and groundwater wells. Such explorative studies call for taxonomy in the sense of the study of organisms and their characters in order to arrange them in a classification. An important field is the comparative study of adaptation in which characters of organisms are brought into relation with habitats and ways of life. In this short note I want to draw attention to still another aspect, the critical function of taxonomic science.

From an early stage in the development of the discipline, it has been the taxonomist's ideal to classify plants and animals in a natural system. In Linnean times, this was taken to mean a system reflecting the order of creation. When the view that all species were created separately gave way to the idea of evolutionary relationships, the term natural system was transferred to the classification best reflecting evolutionary history. The critical function of taxonomy is often expressed in terms of naturalness. A classification may be criticized because it is allegedly not a natural one.

In actual practice, a classification is hardly ever erected from scratch, but carefully built on existing taxonomies. From its inception taxonomy has always implied a critical evaluation of these. Some elements of the older classification are rejected, others incorporated in the new system. This implies that existing classifications deeply influence the perception of problems and the choice of topics to

study. Of course, new discoveries may guide the development of the science as well.

The early taxonomy made use of pre-scientific classifications. Ethnography has shown that so-called primitive peoples, living in close contact with nature, classify the animals and plants in ways fundamentally similar to the hierarchy in the Linnean system. Among these peoples systems are in use consisting of three, four or even five levels, corresponding to taxonomic categories (Berlin et al., 1973). It is interesting to speculate whether such hierarchical classifications are erected because the human mind works that way or whether the branching course of evolution produces levels of taxa which are clearly recognizable also to those having no inkling of the history of this differentiation (Rosch, 1978).

It was the merit of Linnaeus that he provided a clear and well-defined terminology. Terminological clarification is one of the most useful functions of the critical approach. Since the late eighteenth century, taxonomic literature shows many examples of critical evaluation of existing systems. The technical term for a taxonomic study of a certain group is 'revision', a word which in itself explicitly expresses the critical aspect of the work. However, there is often a great reluctance of taxonomists to incorporate new findings into existing classifications. A new proposal for classification of a certain taxon may be already superseded by still newer studies before it finds its way into textbooks and checklists. This shows that the critical search for a natural system is not the only concern of taxonomists. They also strive for a data storage and retrieval system that is easy to handle and relatively stable.

During Professor Stock's term of office at the Institute of Taxonomic Zoology the most important development of taxonomic methodology was the introduction of phylogenetic systematics. This school of thinking has been more outspokenly critical of earlier work than any other. Particularly the notion of 'overall similarity' was vehemently attacked. In the view of phylogenetic systematics, organisms are not to be classified together on the basis of phenetic correspondence. Ironically, anyone trying to arrange a group of objects is guided at first by overall similarity in doing so. It cannot be denied that early taxonomies almost entirely relied on general similarities. This is completely in line with the character of human perception, illustrated by the way in which humans recognize not only each other, but also many types of organisms in their environment. Such recognition works by a general recognition of pattern without conscious observation of detail (Harmon, 1973). Only after a certain group of phenomena has been isolated from the general environment by overall similarity, a search can be made for characterizing attributes. In the course of this process, it may become clear that some elements were erroneously included in the original group under study. This is still true in a period in which information processing machinery may be harnessed to the aims of taxonomy. Computer evaluation of numerically coded characters may help in forming a preliminary classification which may profitably be used as a starting point for critical phylogenetic work. I conclude that overall similarity has its role to play, but that it is of a preliminary nature.

One of the conspicuous results of phylogenetic analysis of previously well-studied groups is the recognition of time-honoured taxa as paraphyletic groups. Phylogenetic study often reveals that the sistergroup of some taxon is part of another traditional taxon (e.g. the genus *Pan*, part of the traditional family Pongidae, is the sistergroup of *Homo*). Consequently, this traditional taxon is unmasked as paraphyletic. Paraphyletic taxa are never deliberately erected. They 'appear' when increased knowledge is able to fit clearly defined monophyletic groups somewhere in between the members of another taxon.

Many workers have shown great difficulty in recognizing such a taxon henceforth as non-natural. Mayr's (1974) reluctance in accepting the Hennigian method was almost entirely based on precisely this point. Here we see how the conflict between the search for a system best reflecting evolutionary relationships and the search for stability comes to light in theoretical discussions over the most acceptable taxonomic method. The critical attitude calls for rejection of the paraphyletic group, but the interests of stability and ease of data storage

and retrieval resists the many resulting changes. This is most apparent in the taxonomy of large and popularly well-known animals and plants. Often traditional systems have been the basis of much widespread literature and even of conservation legislation. In such cases it may be advisable to retain paraphyletic taxa for non-technical reference. The appendices of the Convention on International Trade in Endangered Species are a case in point. In these lists reference is made to the class Reptilia and the family Pongidae, although these are clearly paraphyletic groups. However, any biogeographical or evolutionary scenario mixing paraphyletic and strictly monophyletic taxa runs grave risks of drawing misguided conclusions.

The critical taxonomist is caught between the progress of his science and the forces of inertia resisting implementation of his insights into the general application of classification. Usually, however, after some time the new classification will be generally accepted and will in itself become the target for critical evaluation. Historically, it was once revolutionary to maintain that whales were no fishes and bats no birds. Critical evaluation of all relevant information has long ago overcome these notions.

The most important function criticism has to perform is to keep taxonomists on the look-out for more natural classifications. It acts as the natural selection in the evolutionary process, producing ever better adapted taxonomies. The best adaptation a classification can show is its power to guide research in other branches of biological science. There can be no doubt that the theoretical developments of the last few decades have meant a good leap forward in this respect.

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