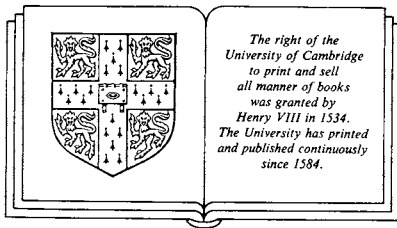


Transformed cladistics, taxonomy and evolution

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INTRODUCTION

For over twenty years the world of taxonomy has been riddled with controversy. This might be interpreted as a healthy state of affairs in any scientific discipline: but it is only recently that the debate has had significant repercussions for Neo-Darwinism in general. Doubt has been cast on the view that the history of life, as indicated by the fossil record, is consistent with the evolutionary process of genetic mutation, guided towards the adaptation of populations by natural selection. More specifically, a small group of taxonomists, known as the 'transformed cladists', have questioned Darwin's fundamental assumption in *The Origin* that the natural hierarchy in nature was evidence for evolution. Claims that Darwin got it wrong have abounded,¹ and have been enhanced by findings from other areas such as developmental biology, macroevolutionary theory, and analysis of speciation models.

For the Neo-Darwinian, insult has been added to injury by the re-emergence, especially in the USA, of creationist doctrines, which attempt to challenge evolutionary theory on scientific grounds,² interpreting well-established scientific facts in a manner that is consistent with creationist thinking. Not surprisingly, amidst all this turmoil, accuracy of fact and argument have been traded off against sensationalist media coverage.³

Some have welcomed taxonomy's entry into the limelight, others have been horrified at the prospect of the disappearance of long cherished traditions, such as the role of paleontology in evolutionary studies. The status of evolutionary theory is apparently at stake. Clearly there is a need to separate picturesque distortion from hard analysis, to reappraise the arguments raised in the taxonomic controversy, and to examine the implications for Neo-Darwinism. Taxonomy's methodological disarray over the past two decades

makes this enterprise all the more pertinent. For this reason, some attention must be paid to historical detail. But before outlining the historical development of the contemporary schools of taxonomy, the precise boundaries of inquiry must be delineated.

The boundaries of inquiry

Several preliminary definitions are relevant to the discussion as a whole. The biological discipline known as systematics deals with the theory and practice of capturing orderliness in nature. Systematics may be defined, following Simpson, as

the scientific study of all kinds and diversity of organisms and of any and all relationships among them.⁴

Taxonomy, on the other hand, has a more restricted meaning and is concerned with the theory and practice of classifying organisms. Explicitly,

Taxonomy is the theoretical study of classification, including its bases, principles, procedures, and rules.⁵

There is some overlap between taxonomy and classification in that the activity of classification is consistent with taxonomy, given a basic definition of classification as the ordering of organisms, both living and dead, into groups (or sets) on the basis of their similarities and relationships. But even this definition of classification requires some clarification. Hull has suggested three meanings for the words *a classification*;

At one extreme, a classification is nothing but a list of taxa names indented to indicate category levels. Others would also include all the characters and the taxonomic principles used to construct a classification as part of the classification. At the other extreme, some authors use the words *a classification* to refer to the entire taxonomic monograph.⁶

Hull's point is that when we use the term 'classification', two modes of use are possible – firstly, in referring to the act of classifying, which involves the ordering of organisms into groups, and secondly, in referring to the finished product of the classifying activity, the classification. For the most part, we will be concerned primarily with the former sense, but when reference is made to the classification as a finished product, only the restricted definition of a classification, as a list of taxa names indented to indicate category levels, will be employed.

In addition to this process-product distinction, there is a further dichotomy within the process of classification, between the formation of a system of classes and the process of assigning additional, unidentified objects

to these classes. The latter is more commonly known as diagnosis or identification in contradistinction to the process of classification.

The third distinction dates back to the modern synthesis of the 1940s, in which questions concerning classification centred on two different aspects – the ‘species problem’, and how such species were to be classified into higher taxa such as genera, families and orders. These two aspects survive today in the fields of microtaxonomy and macrotaxonomy.

The species problem is tackled in microtaxonomy and this concerns ‘the delimitation of species with the analysis of the genetical and ecological barriers between populations and with the investigation of the ranges of morphological and genetic variability of populations in relation to their environments.’⁷ In addition to delimiting taxa of specific rank, microtaxonomy confronts the problem of classifying groupings of populations at the infraspecific level. Of direct relevance here are the results of experimental taxonomy, which focuses on patterns of variation at the infraspecific level.⁸ Microtaxonomy, therefore, embraces a wide range of views and this is in sharp contrast to macrotaxonomy, which deals specifically with the grouping of species into higher taxa. In this book I will be concerned with macrotaxonomy alone.

It is clear that macrotaxonomy is likely to be sensitive to the results of microtaxonomy, and while this is certainly apparent in the direct relevance of speciation modes to macrotaxonomy, there is some evidence that the contact between the two fields is not as close as it might be. Indeed, the results of macrotaxonomy appear to be of little relevance to microtaxonomy, indicating that the disputes in macrotaxonomy are too divorced from an experimental basis. Certainly this is true of all cladists’ dismissal of the results of population genetics.⁹

Historical order of appearance of the schools

Four contemporary schools of taxonomy are generally recognised: evolutionary systematics, phenetics, phylogenetic cladistics, and transformed cladistics. This diversity of opinion can be traced back to two phases of development in the continuing debate over the proper methods and foundations of biological classification. During each phase, the emergence of a new school of thought increased the urgency of the various disputes by clarifying some of the important issues at stake. In the late 1960s the first phase was initiated by the arrival of the phenetic school of taxonomy, as typified in Sokal & Sneath’s *Principles of Numerical Taxonomy*,¹⁰ which concretised issues over the relationship between classification and phylogeny (the reconstructed history of life). Pheneticists advocated the grouping of

organisms together on the basis of their similarity, whilst rejecting the use of phylogenetic information in the construction of such groups. The increasing use of computers also added force to the desire to explicate and quantify taxonomy than had hitherto been done before. Classics such as Simpson's *Principles of Animal Taxonomy*,¹¹ and Mayr's *Principles of Systematic Zoology*,¹² which outlined the field of inquiry of the evolutionary systematists, typically came under fire. For their part, the evolutionary systematists argued for a taxonomy that represented groups of organisms which were a product of evolution, and that classifications, therefore, should be based upon all aspects of phylogeny.

During this period, the English translation of Hennig's *Phylogenetic Systematics*¹³ was picked upon by a few devotees, e.g. Brundin,¹⁴ and through such commentaries grew in stature. Hennig's book formed the basis for cladistics, which advocated a taxonomy that mirrored evolutionary branching sequences. Classifications were based on genealogy (relationships of descent) alone. Such views gained acceptance by the early 1970s, and set the stage for the second phase of thinking – an examination of the precise relationship between classifications and evolutionary theory. The focal point was a questioning of the validity of evolutionary assumptions in the procedures of classification. This problem was highlighted in the split between the phylogenetic cladists, who rigidly adhered to the basic postulates of Hennig, and the transformed cladists, who attempted to pick out the kinds of patterns that Hennig viewed as evidence for evolution, whilst abandoning interest in the branching sequence itself. The recently emerged transformed cladists, led by Nelson,¹⁵ Patterson¹⁶ and Platnick,¹⁷ not only dropped the evolutionary portion from their classifications, but also hinted at an anti-Darwinian element in suggesting a return to pre-Darwinian classifications based on recurrent patterns in nature. These claims meant that the debate in taxonomy took a radical turn¹⁸ because not only were the use of evolutionary assumptions in classification called into question, but also Darwin's point, concerning the evidential priority of the natural hierarchy in evolutionary theory, was highlighted.

Both phenetics and phylogenetic cladistics have undergone substantial modifications in response to the sometimes cumbersome attempts of the fourth, and oldest school – the evolutionary systematists – to stave off their polemical attacks. These changes have not always been very explicit, with frequent arguments concentrating on questions of terminology. Nowhere is this greater than in the shift from phylogenetic cladistics to transformed cladistics. Often the arguments have grown out of all proportion to their actual content, so that the underlying issues have remained shrouded in ter-

minological confusion. The diversity of opinion and difficulty in defining a common ground has often meant that 'definitive' definitions and straw men abound. If these tendencies are to be avoided a sympathetic and realistic account of the issues involved must be given, with a view to confronting problems that are relevant to all schools of thought.

Relevant issues

The issues that will be confronted in this book can be put under four general headings

- (i) What are the aims and purposes of classifications?
- (ii) Are these aims sensible? Are they worth pursuing? Emphasis will be placed on the justification of these aims and purposes.
- (iii) What methods do we use in constructing a classification?
- (iv) Are such methods concordant with the aims? Do the techniques employed actually achieve what they are meant to? What are the limits of these aims and methods?

Any careful comparison of the issues raised in the 1960s and the 1970s will show up similarities, implying that the debate in the 1970s is a re-run of some of the problems raised a decade earlier. This is especially the case when questions concerning the storage of information in classifications and the removal of bias in classification construction, are confronted. Both the pheneticists and transformed cladists advocate the removal of bias, while all four schools claim that their respective classifications maximise the storage and retrieval of information. In considering the limits of each school's aims and methods, inconsistencies in argument are apparent, and the resulting conclusions can help to answer questions concerning the validity of such aims. In this way, each school is examined with respect to its *own* standards and norms, thereby avoiding over simplification. Discussion of the problems faced by all four schools will constitute the main body of the book, and emphasis will be placed on possible reasons for the shifts in taxonomy. In the case of transformed cladistics, and its possible relevance to Neo-Darwinism, some authors¹⁹ have claimed that current research from the history and philosophy of science has prompted this situation. This is incorrect. The current controversy in taxonomy, and evolutionary thinking in general, is not due to philosophy, but stems from specific problems within these areas.

I will begin my account in Chapter 1 with a general discussion of a fundamental difference of approach between the four taxonomic schools. This difference is best explicated through the distinction between descriptive and theoretical 'attitudes' in taxonomy. The former attempts to do away with theoretical assumptions in classification, while the latter relies heavily on

theoretical inference. There is a limit to the degree to which these attitudes can be pursued, and at each extreme, philosophical problems are encountered. Part II explores the problems encountered by the evolutionary systematists (Chapter 2) and phylogenetic cladists (Chapter 3). In both cases, the problems are examined in the context of information content in classifications, and their shortcomings are discussed in terms of the theoretical attitude. In Part III, the limits to the descriptive attitude are explored. Thus, in Chapter 4, phenetics is examined in the context of the descriptive attitude, and limits to the elimination of bias in classification construction are explored. The discussion of transformed cladistics in Chapter 5 emphasises similarities and dissimilarities with phenetics, and concludes that the transformed cladists inadvertently incorporate a Platonic world view. In the final chapter, the problem of removing evolutionary assumptions on the basis of methodological considerations alone is examined, and it is argued that if the transformed cladists wish to avoid Platonic assumptions, then their methods are only intelligible in the light of evolutionary theory. I conclude that transsound, and it is doubtful whether it directly challenges the present view of evolution since it is still susceptible to change in evolutionary thinking itself.

A final word of explanation is necessary over the structuring of my account. While the distinction between the theoretical and descriptive attitudes is described in Part I, and then used as a basis for examining the merits of each taxonomic school, the argument in this book should not be construed as *circular* in any way, since the basis for drawing the two attitudes is rooted in the general descriptions of the activities of each school given in the respective chapters.