# CHAPTER 3: KINDS OF CLASSIFICATION

## Introduction

In the preceding chapter it was indicated that all classifications embody a statement of two kinds of relationships: relations within units which are always those of identity; and relations between units which serve to link classes together into a classification. It is this second category of relationships, those obtaining between classes, that determines the form of a classification and in turn results in kinds of classifications.

Apart from disparate usages of the term classification which effectively create different kinds of “classification,” there is as much confusion evident in the literature, especially the non-archaeological literature, on kinds of classification as on any other aspect of the problem. Basically the confusion stems from treating classification as a single, unitary device, a failure to recognize differing kinds of relationships that can exist between sets of classes.

The tendency to treat all kinds of classification as essentially the same is particularly apparent in the natural sciences. This circumstance usually arises from the selection of one form of classification, perhaps on the basis of successful application, which is then traditionally employed to the exclusion of other forms. There is, of course, nothing intrinsically wrong with this procedure if, and only if, the problems investigated by that discipline are likewise unitary in nature and are of the same kind as the ones responsible for the initial selection. Unfortunately, this latter condition is not always the case. A brief example drawn from the biological sciences may serve to illustrate the point.

Since Darwin, the biological sciences as a whole have been preoccupied with the notion of evolution as the key concept in their theoretical structure for explanation. However, the classificatory devices employed, in particular the notion of species, in large measure antedate this explanatory concept. With the nse in importance of genetics in the biological sciences, the always vague notion of species has been made less vague by defining such units in terms of observed or stipulated genetic disjunctions, be they only regularly breeding populations or populations separated by actual breeding barriers. Importantly, however, the basis for defining species lies in disjunctions. Now, obviously, this notion of species is applicable to modern contemporary populations of animals. Logically, it is applicable to any set of contemporary animals be they in existence at present or at some specified and temporally restricted period in the past. The hierarchic structure in which species were framed by Linnaeus and others had obvious similarities to the picture produced by the notion of evolution and the differentiation of species through time. Thus, in the nineteenth century, when investigators turned their attention to fossil remains, the notions of species and the hierarchic structure went with them-and m applying them to a new kind of problem, serious errors were committed. First, there are serious problems in taking any kind of unit like species and attempting to use it to organize fossil remains for explanation by means of the concept of evolution. Species must involve disjunctions, genetic or otherwise, to bound the units. But evolution assumes that all forms, similar and dissimilar, are linked, not by disjunctions in genetic material, but by continuities. The logical incongruity of the organizing concept and the explanatory concept is apparent; however, in actual practice it was not. The reasons are fairly simple. The fossil record is very incomplete. Real disjunctions in the record occur, though the development of which the remains are a record is continuous. Thus it was possible to assign a given set of fossils to a species without any great difficulty, because it could be separated from other related groups of fossils by gaps in the record (but not in genetic development). Once fossil lines began to be well represented by actual remains, problems began to appear, as the current state of man's own ancestry indicates. One is faced with arbitrary decisions as to whether a given fossil is to be placed in one or another species, solely because the fossil, in its form, lies between two previously created species, defined intuitively on the gap which the fossil in question now fills, thus the nonsense proposition that at some point in the evolutionary line an individual of one species gave birth to an individual of another species.

This example demonstrates other problems that are purely formal in character. The species notion was initially developed for application to whole animals to create an organization for whole animals. Genetics has expanded this to organization, not for individuals but for populations of whole animals. The fossil record unfortunately does not come in the form of whole animals, but pieces of their skeletal structure strongly biased by preservation characteristics in favor of skulls and teeth. For all practical purposes, fossil species are defined on the basis of skulls and teeth, yet the organization is assumed to be for whole animals. Obviously the species of the paleontological past and those of the modern world are not comparable. Further, unless one can posit a direct link between the form of the teeth and skulls of animals in general and the remainder of their bodies, paleontological species must be classes of skulls and teeth, not animals or populations of them.

Neither of these problems, both essentially functions of the relationships obtaining within classes, would have developed in the biological sciences were it not for the hierarchic structure in which the notion of species is embedded and which overtly parallels the notion of evolution. First, in the hierarchic structure only the species has a phenomenological referent; the units such as genus, family, etc., are entirely analytic units which serve to organize species and genera respectively and not real animals, their remains, or populations of either. Again the logical incongruity between the form of the classification selected and the assumed nature of the phenomena to be organized is evident. The analogy between the Linnaean hierarchy and the differentiation of species through time paralleling the notion of evolution is thus misdrawn. Genera do not differentiate into species, but rather a species differentiates into several species.

Further, as will be considered in the body of the chapter, the particular form of classification chosen, irrespective of why it was selected, has inherent qualities rendering it something less than useful for the purposes to which “species” has been applied: namely, that no unit in a hierarchy, or a taxonomy as it is called, can be defined in terms of the phenomena being ordered, but only by inclusion in a higher level of the classification. Definition is by division, not by intersection. Initially this presented no problem to paleontologists because, as has been noted, the incompleteness of the fossil record furnished neatly separated groups which required only labeling. As the fossil record became more and more complete, the intuitive nature of species' definitions, indeed the real lack of definitions, became more and more obvious, and the suitability of “classical taxonomy” was questioned. Today controversy rages over this point in the biological sciences. New means of organizing fossil remains such as numerical taxonomy (not a kind of classification) have made their appearance in an attempt to correct the increasingly obvious inability of “classical taxonomy” to define species in anything but a mystical manner.

The movement to rectify these problems is not without serious errors as well. The protagonists of “numerical taxonomy” themselves often view “classical taxonomy” as the only kind of classification and, while still using the term classification, are attempting to introduce non-classificatory arrangement as a substitute, a device which is equally, though differently, ill-suited to the problem. The Linnaean hierarchy, simply because it has traditionally been the sole form of classification employed, is taken to be the only possible form. Thus, inquiry into different, more appropriate forms of classification has been slowed.

This digression, of course, has been much simplified. It should, however, serve to demonstrate that important kinds of confusion greatly affecting the use of classification do exist in the sciences outside of prehistory. Much of the confusion focuses on the relationships between units, that is, the form of classification. These problems reflect a strong tendency to use classification as a technique rather than as a method. The assumptions upon which it is based are ignored when one learns “how to do it” instead of why it works, what it works on, and what the results mean. Failure to understand the assumptions has led to the application of kinds of classification to problems for which they are not suited. Because the assumptions are not made explicit, the conditions under which specific forms of classifications are applicable are not obvious and, further, no means of evaluating the results are possible. It is the contention in this chapter and, indeed, the volume as a whole, that much of the confusion results. from the misapplication of ·a good method rather than the application of a poor one.

## A Classification of Classifications

It should be obvious that to accomplish the aims of this chapter it is necessary to make use of the very device that is to be examined. Because such is the case, the classification used herein must be sufficiently explicit that it may be identified with one or another of the end products of this examination, and thus itself amenable to evaluation in the terms set forth herein.

In accordance with the discussion in the second chapter, the first step in any classification must be the definition of the field for that classification. In the present case this has already been accomplished, for classification has been defined earlier as the process of creating units of meaning by means of stipulating redundancy. Figure 3 shows its relationship to grouping. The field for the present classification can be taken to be classification as previously defined and as outlined in Figure 3.

In the same chapter it was noted that classifications consist of linked sets of *significata* or intensional definitions. Since the *significata* are the only tangible aspects of a classification, the second step in creating a classification, that of identifying the source of attributes, is relatively simple — the *significata* and their constituent elements are the only possible source. Obviously, some characteristics of *significata*, such as the nature of the constituent distinctive features, would organize classifications into classes based upon the kinds of classes contained within them. Our stated problem, however, is to examine the relationships between classes and the effect these relationships have on the form of classification. Thus, those characteristics of *significata* which are common or can be common to *significata* in general, and not those attending the content of individual classes, are relevant. There are many ways of looking at *significata* which demonstrate this kind of relationship. *Significata* may be differentiated in terms of the relations between constituent distinctive features (e.g.,, some elements in the definition may be more important than others, or they may be of equal weight). They might be differentiated on the basis of the processes involved in definition, the manner in which the *significata* come into being, or the way in which the distinctive features are associated with each other. Ultimately, then, in one form or another, selection of the elements constituting the *significata* is the characteristic useful for organizing classifications for an examination of the relations between classes and the effect this has upon the form of the classification.

In the right arm of Figure 3, which treats classification as of two kinds, these various ways of viewing the selection of features for class definition are summed up in the terms “internal” and “external.” These labels derive from looking at the means by which the features are brought together into a *significatum* from the point of view of the objects included in a class. In one case the distinctive features can be associated directly from the objects considered; in the other case, the association of features is the result of a series of rankings within the classification at levels higher than the end-product classes.

Whether one considers *significata* in terms of their internal structuring or whether one considers various aspects of their construction processually, a quick conclusion is that in these terms *significata* are of two sorts: (a) *significata* whose constituent distinctive features are equivalent, unstructured, un-weighted, and thus directly associated in analogous attributes of objects (intersection); and (b) *significata* whose constituent distinctive features are non-equivalent, structured, weighted, and thus inferentially associated (inclusion). Employing these two kinds of *significata* as criteria in a classification of classifications results in the recognition of two forms or classes of classification: one here called paradigmatic classification, employing the first type of *significata* (a); and taxonomic classification, employing the second kind (b). The following paragraphs will examine in more detail the characteristics of the two kinds of *significata* and the resulting forms of classifications.

PARADIGMATIC CLASSIFICATION: The concept “dimension” is useful for examining relationships between features in definitions, not only within the context of a single definition but also for classifications in their entireties. A dimension is a set of attributes or features which cannot, either logically or actually, co-occur. If there is one member of the set, then there cannot at the same time and place be any other member of the set. Further, all features belonging to a single dimension share the ability to combine with attributes not of that dimension. If A and B are members of the same dimension and I is a feature from another dimension, and, further, if AI occurs or is possible, then BI likewise must be possible. (Whether the combinations AI and BI actually do occur in the phenomenological realm is not important in assessing whether A and B belong to the same dimension, but, rather, only the possibility of their occurrence is relevant.) A dimension, then, is a set of mutually exclusive alternative features. Red and green are dimensional attributes. If something is red, it cannot be simultaneously green, but anything which is red could also be green. The dimension to which these features belong', of course, is the dimension of color, one which we ourselves use to categorize the phenomenological world.

Now, obviously, all features may be conceived of as dimensional in relation to other attributes, either as belonging to same or different dimensions; however, features may or may not be selected as criteria in a classification because they are dimensional. Dimensionality of the features included in class definitions is one of the important distinctions between the two kinds of *significata* and the resulting forms of classification indicated above. In the case of paradigmatic classification, each *significatum* consists of a set of features, each of which is overtly drawn from a different dimension. In the case of taxonomic classification, the set of features constituting a *significatum* may or may not derive from different dimensions since dimensionality is not considered in their formulation.

The differences become much more apparent when the classifications as a whole are considered. In paradigmatic classification all of the class definitions are drawn from the same set of dimensions of features. Individual classes are distinguished from one another by the unique product obtained in the combination, permutation, or intersection of features from the set of dimensions.

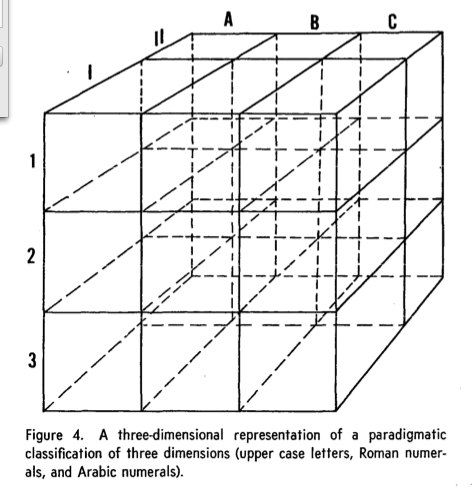


Figure 4. A three-dimensional representation of a paradigmatic classification of three dimensions (upper case letters, Roman numerals, and Arabic numerals).

Figure 4 serves to illustrate paradigmatic classification by means of a simple case. Three dimensions are involved in the classification: a dimension of Roman numerals, a dimension of Arabic numerals, and a dimension of upper-case letters. The first dimension consists of two features I and II; the second dimension of three features 1, 2, and 3; and the third dimension of three features A, B, and C. In each case it is assumed that the dimension is exhausted in the features, that is, that all possible representations of the dimension are covered by one of the features. The resulting 18 classes are simply the product of all possible combinations of these distinctive features, save that, by definition, features from the same dimension may not combine. Dimensionality serves to control the possible definitive sets of features. Individual class definitions will consist of one feature drawn from each dimension, the number of definitive features in each definition being a direct reflection of the number of dimensions used in the classification. The classification as a whole is united into a single system by the universal application of the dimensions. The features are definitive of the classes; the dimensions (as represented by the features) are definitive of the classification. Paradigmatic classification, when employed in this essay, is thus to be understood as dimensional classification in which the classes are produced by intersection.

Paradigmatic classes have some important characteristics which derive from definition by intersection of dimensional attributes. Firstly, all of the definitive criteria are equivalent; that is, none is or can be weighted over any other. In the example of Figure 4, Feature A is on a par with and cannot be included in Feature 1. The only weighting of attributes and dimensions that can be effectively accomplished is that of the selection of attributes and dimensions relevant to the problem for which the classification is intended (in Figure 4 the dimension of lower case letters has been excluded and thus one might talk about the weighting of Roman numerals, Arabic numerals, and uppercase letters, as more “important” than other possible dimensions). This weighting, however, is done outside of the classification itself, and thus the choice of the particular dimensions employed can be phrased as an hypothesis, indeed must be so phrased, or completely ignored, and as such is amenable to testing, evaluation, acceptance, rejection, and revision. However, should it be deemed relevant to the problem attended by the classification in Figure 4 that the dimension of lower-case letters be considered, it would be added on a par with the other dimensions. A second important characteristic of paradigmatic classes is that they are unambiguous, both in terms of their internal structure and in terms of their application as a means for creating groups of phenomena. This results from the dimensional characteristics of the features used in definition. All the features of a single dimension are mutually exclusive. Further, the combination or intersection of attributes to form definitions by dimensions prevents internal contradiction (e.g.,, that an object must be both green and red at the same time to satisfy membership conditions) from appearing in class definitions. From the standpoint of assigning phenomena to paradigmatic classes, the dimensionality of the defining features assures that, given adequate definitions of the features, each and every object or event for which the classification is relevant can be unambiguously assigned. X is either A or not A.

A third characteristic of paradigmatic classes is that they are comparable with all other classes in the same classification, and that the basis of comparability is explicitly established by the form of the classification. Paradigmatic classification, by virtue of being dimensional, considers only alternative manifestations of the same and specified dimensions. It is thus possible to characterize the relationships that obtain between classes in paradigmatic classifications as equivalent non-equivalences, that is, the structure of paradigmatic classification always specifies that all classes within it differ from one another in the same manner.

The field of a particular classification, of course, must be established prior to the formulation of the classification. In the case of paradigmatic classification, the field is often termed the root of the paradigmatic. The root is simply a statement of what the classes are classes of, and it is usually expressed as a feature or set of features common to all the classes within the paradigm. When this feature or set of features is added to the distinctive features which constitute the class definitions, it permits identification of the classification from which a particular class is drawn. It is important to remember, however, that the root or common feature in a class definition is not a product of the classification but is a symbolic record of one of the decisions made prior to the construction of the classification. All of the classes are defined within the classification. The root is not.

The number of dimensions employed in classification of this sort is determined by the problem for which it is being created. Obviously, the larger the number of dimensions and the larger the number of features in each dimension, the smaller the “space” covered within the field by each class. The number of classes will be increased. There is no limit beyond practicability to the number of dimensions and features within them that can be employed. In the case of features within a dimension, a dichotomous opposition (A and Ā) is a minimal number. For graphic presentation such as used in Figure 4, the use of three dimensions is an obvious limit. However, simple listing of class definitions, or the use of graphic devices which do not use one dimension of space for each dimension of features, removes this apparent limit. As in the case of features, the minimal number of dimensions required is two, for without two dimensions intersection is not possible. It is, however, useful to consider as a special-case paradigmatic classification the index, treating it as a paradigm with a single dimension of features. The features in the dimension that constitutes the index are mutually exclusive, as is the case with other paradigms, and thus the classes formulated are unambiguous. The necessary and sufficient conditions for membership in such a class will be one in number; the number of features in a given definition is a reflection of the number of dimensions used in the classification. Since with but a single dimension classes are not formulated by means of intersection, indices are often treated as a separate kind of classification; however, because all of the differences between indices and paradigmatic classification relate to a single feature-the number of dimensions used-it is useful to think of indices as special-case paradigms.

In the practical business of formulating classifications this conception of the index is helpful. Each dimension of a paradigmatic classification is, in fact, an index, and such classifications are built up dimension by dimension. A major use of the index is the exploration of dimensions of features for paradigmatic classifications. Indices are capable of producing only simplistic orderings, and for this reason they are most commonly used for cataloguing and manipulating units (e.g., numerical and alphabetic orders) or for general problems requiring few classes (e.g., the classification for animals based on food-getting habits mentioned earlier, or the present classification of classifications based upon kinds of *significata*).

In employing paradigmatic classes to categorize things or events, identifying groups analogous to classes, the dimensional nature of the defining criteria is a definite asset. The necessary and sufficient conditions for membership registered as class definitions provides all that is required, and the only additional operation is the identification of features as attributes of objects or events. An event or object will be unambiguously assigned to one and only one class, or it will be found that the classification is irrelevant for the object or event (an expression of the fact that the instance lies outside the field of the classification).

Aside from the four sets of assumptions required of all classifications (scale, field, features, and criteria), paradigmatic classification, including the index, requires no further assumptive or inferential input. Paradigmatic classification is for this reason the most parsimonious kind of classification available, for, as will be shown, taxonomic classification requires additional assumptions. The use of paradigmatic classification requires only that there be a stated problem which in tum enables: (1) the definition of the field and the level at which organization is intended; and (2) the statement, in the form of a hypothesis, of the relevance of the definitive features to the problem. Once the relevance of the criteria to the problem has been stated, the classification is subject to evaluation through the hypotheses on which it is based. Most importantly, in the use of the units so produced, distributions and correlations have specifiable meanings. The investigator is not faced with a problem in which sets of units are found to bear certain relationships to one another but still lacking a means of stating the significance of the correlation or why they correlate. If the units are the product of a properly executed paradigmatic classification — i.e., all possible meanings that any correlations the units might have are known-they are overtly built into the units. The application of the units in a practical problem constitutes the testing of the hypotheses made in the classification. Unfortunately, far too little concern is given the formulation of classes. Thus classifications are rarely evaluated but rather become matters of convenience or opinion and the problem of what correlations and distributions mean must necessarily be treated as inference.

TAXONOMIC CLASSIFICATION. The familiar hierarchic structure of the taxonomy is, by implication from the preceding consideration, based upon non-dimensional distinctive features, at least as far as an entire taxonomy is concerned. (Portions of taxonomies may be considered dimensional.) A taxonomy is an ordered set of oppositions or contrasts which amounts to a division of the field of the classification into classes, sub-classes, and so on. Figure 5 illustrates the simplest form of taxonomy in which the contrasts are dichotomous oppositions. Classes, as defined units, may be formulated not only at the lowest level but at any or all intermediate nodes of opposition. The definition of any taxonomic class (taxon) is a record of the series of oppositions leading from the field to the class. From the point of view of any class, the definition derives from the inclusion of the class in a series of super-classes at higher and higher levels culminating m the field. As a result, the means by which the various elements or features in the definition of a taxon come to be associated (inclusion) contrasts with intersection in the case of paradigmatic classification. The features which make up the *significata* of individual taxons reflect the series of oppositions from field to class as a serial order, again contrasting with the unordered arrangement of features in paradigmatic definitions. The net effect of this serial ordering of the features of taxonomic definitions is to restrict the range of the features constituting an opposition to a portion of the classification. In Figure 5, for example, the opposition d-b is relevant for the Superclass 1 on the left-hand side of the diagram. This does not mean that objects or events which might be assigned to VIII will not display attributes assignable to a or b, but that since they display Attribute 2, Features a and b will not be considered. This serial ordering of oppositions represents judgments as to the importance of the various sets of defining criteria. In Figure 5 the opposition between 1 and 2 is considered more important, more “basic” to the field, than the opposition between c and d or III and IV. Viewed again from the *significata* of individual classes, the various features that constitute a *significatum* are weighted from most important to least important. It is this weighting of features which is responsible for the serial ordering of features within *significata* and oppositions within the taxonomy. Ultimately, this weighting of features is the genesis of the hierarchic structure characteristically displayed by taxonomies.

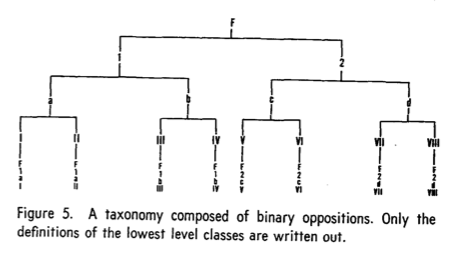


Figure 5. A taxonomy composed of binary oppositions. Only the definitions of the lowest level classes are written out.

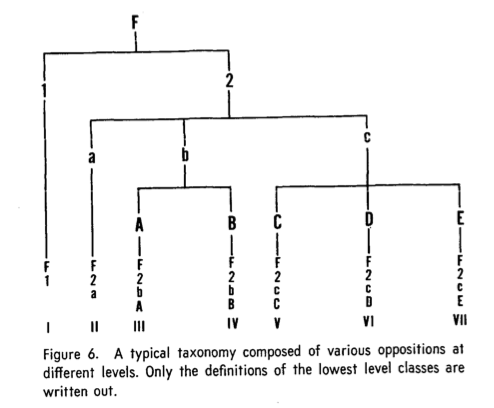
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Figure 6. A typical taxonomy composed of various oppositions at different levels. Only the definitions of the lowest level classes are written out.

It is not necessary, and in fact it is uncommon, that a taxonomy should display the symmetry of the example in Figure 5. Figure 6 presents a more realistic situation in which the series of oppositions leading to particular classes are not parallel in either number or kind. This diagram clearly illustrates the non-dimensional character of taxonomies and the restrictions placed upon subsequent oppositions by prior ones in defining taxons. In the case of Taxon I, a single feature serves to distinguish it from all other members of the field (I is, of course, redundant), whereas two features are required to differentiate Taxon II, three to distinguish III through VII. Ordinarily only the lowest level of classes need have empirical referents, that is, be designed to order phenomena, while the other taxons at higher levels serve to organize taxons at lower levels. An excellent example is the monotypic family as used in zoology in which the animals are categorized as members of a species rather than the family directly; the species in turn is the sole member of a genus which is the sole member of the family. This device is used to express a “degree of structural similarity” to other organisms in the Linnaean hierarchy, here suggesting that members of the species in question are not closely related to other living organisms.

Taxonomy, then, is to be understood as non-dimensional classification in which classes are defined by means of inclusion. The relationships obtaining between classes are not uniform throughout a given classification. They differ from level to level (some classes include others) and also within each level. Thus the non-equivalent relationships which serve to separate classes are themselves non-equivalent and contrast with the equivalent non-equivalent relationships of the paradigm. There are additional characteristics of taxonomies which need to be considered, all of which derive directly from the defining characteristics noted above. It will be useful to examine these further aspects of taxonomies in conjunction with analogous features of paradigms where applicable.

Firstly, as a consequence of employing non-dimensional features for the definition of classes, the various distinctive features employed by a given taxonomy need not be mutually exclusive. Since the definition of a taxon involves not only a set of features, but also the serial ordering of those features based upon their “importance,” it is quite possible (and not infrequent in practice) that distinctive features in one part of a taxonomy overlap features in another part. In Figure 5, for example, a and c can overlap each other without creating any ambiguities in the definitions so long as 1 and 2 are mutually exclusive. The opposition registered as a/b might represent a division of color into reds and blues with a encompassing everything from orangeish-yellows to reds and b encompassing the other end of the spectrum from greenish-yellows through violets. The opposition c/d might also register color, this time as violets and non-violets. Obviously there is substantial overlap in the coverage of a and d; however, insofar as the a/b distinction is made prior to the a/b/c/d distinctions there is no internal inconsistency. Further, as was touched upon earlier in the discussion, the a/b and c/d oppositions may represent different dimensions and thus may not be strictly comparable. In the above case, for example, the a/b distinction may represent colors while the c/d distinction represents textures. Any object which has color likewise has texture. If, however, the 1/2 distinction has been made prior to a/b/c/d distinctions, the former opposition will establish the relevance of one or the other of the lower-level distinctions and thus avoid any incongruence in the classification or ambiguity in assignments.

The non-dimensional character of taxonomies produces substantial potential for ambiguity in the assignment of objects or events. Taxons are unambiguous if, and only if, the serial order of the defining features is treated as a program for identification. The simple identification of a distinctive feature in a given instance is insufficient; the relevance of that feature is determined by all antecedent oppositions in the taxonomy. Perhaps the single greatest problem in utilizing taxonomies lies in this very thing. Unless the serial order of the defining features is stated, it is quite possible to make wrong assignments, or, worse yet, to be faced with an object which apparently belongs to two or more classes.

A second characteristic of taxonomies, one which also derives from the ordered nature of the defining features of the taxons, is that taxonomies have a non-permutable order. Since relationships between classes are not the same throughout a taxonomy, classes cannot be moved in relation to one another without altering the structure of the classification and necessitating changes in the definitions of other classes. Only the taxons arranged as members of the same superclass at the next highest level may be changed without changing the remainder of the classification. This contrasts with paradigmatic classifications which do not have any order in the defining criteria. There the classes may be changed in relation to one another without changing the classes or the structure of the classification. Figure 7 represents a three-dimensional paradigm displayed graphically so as to be comparable to a taxonomy and a comparison with Figure 5 clearly illustrates this difference. If the distinctions registered as 1 and 2 are exchanged for those registered as a and b there will be no resultant change in the number of classes or in their definitions. The lowermost diagram represents a three-level taxonomy made up of dichotomous oppositions for the sake of simplicity. If the distinctions registered as 1 and 2 are exchanged for those registered as a and b, an entirely new classification will result. Neither the number nor the definitions of the new classes will be the same as in the initial classification. For this reason taxonomies are frequently referred to as non-arbitrary or natural in distinction to paradigms characterized as arbitrary and artificial. In this kind of discussion “arbitrary” is clearly being used in a sense different from that previously employed herein. It simply means that the position of any given taxon in the overall structure of taxonomy is fixed by the serial ordering of the defining criteria. The position of a given class is nan-arbitrary within the structure of the taxonomy; the entire taxonomy, however, is arbitrary m the four respects that all classifications are arbitrary. Likewise, the feeling of “naturalness” that is imparted by taxonomies derives from the fixed order of taxons within the classification, for no classification is natural in the sense that the sets of equivalences and non-equivalences embodied in it are the only ones possible or even the best ones for all problems. While the non-permutable nature of taxonomies does not affect the pragmatic assignment of objects or events to taxons, it doed tend to stifle evaluation of the classes and the classification; however, as is the case with the potential for ambiguity that inheres in taxonomies, intelligent use of this kind of classification, with any understanding of its limitations, can overcome the tendency for taxonomies to go without evaluation.

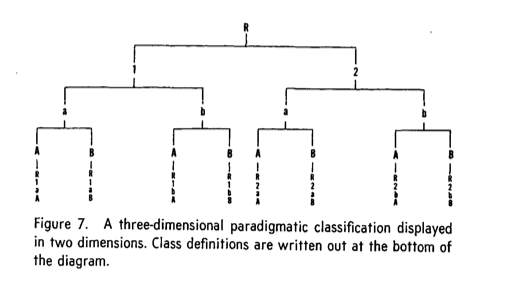
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Figure 7. A three-dimensional paradigmatic classification displayed in two dimensions. Class definitions are written out at the bottom of the diagram.

The third and final important characteristic of taxonomies is the assumptive or inferential input required in their construction. As has been pointed out, the serial order which is manifest in the overall structure of the taxonomy as a hierarchy involves ordering the oppositions by level and, by virtue of not being universal within the classification, some ordering in terms of positioning within a level. Only the initial opposition, the set of distinctions drawn at the highest, most general level, affects the entire classification. Subsequent ones are restricted to portions of the classification. For all sets of oppositions, an assumption of “importance” must be made to determine the order in which they are to occur. Further, for all but the initial opposition, an assumption of relevance must be made to position subsequent oppositions, those at lower levels. Since the various oppositions within a -taxonomy are not dimensional, not mutually exclusive by definition, each specific opposition requires its own assumptions. The net effect is quite obvious. Taxonomies require a large number of assumptions as initial input for their construction in addition to the basic assumptions made by all classifications. In Figure 5, for example, 13 additional assumptions are required to determine the level and position of the seven oppositions. In larger, more realistic taxonomies the number of additional assumptions becomes proportionately larger. This situation is in direct contrast with paradigmatic classification which requires no further assumptions beyond those required of all classifications. Thus taxonomies cannot be considered parsimonious in relation to paradigms.

Given an alternative in the form of paradigmatic classification, it is reasonable to query how taxonomy is useful. If assumptions had to remain as assumptions, perhaps taxonomy would not be a useful device; however, if the assumptions are phrased as hypotheses which are testable and which upon testing have a high degree of probability, then the taxonomy becomes a much more parsimonious device. Unfortunately, this is not often done in practice and thus the intuitive qualities often ascribed to taxonomy. Indeed, this feature of taxonomy lies at the root of the controversy between “classical taxonomists” and the “numerical taxonomists” in biological circles today. Given that taxonomy can be made more parsimonious than its structure initially suggests, it is useful to note the consequences of so doing. If the assumptions required by taxonomy must be phrased as tested hypotheses before taxonomy can be an effective alternative to paradigmatic classification, this means that, essentially, the outcome of the classification must be known beforehand.

If the classes must be known before a taxonomy can be constructed, serious limitations are placed on the utility of taxonomy. Taxonomy obviously cannot be employed to order a field of phenomena which is unknown in important respects. Further, of course, the assumptions must be capable of testing and positive verification, and this is not always possible even when a field is well known. Paradigmatic classification, on the other hand, is not faced with this problem because of its greater parsimony. For these reasons legitimate usage of taxonomies is restricted to didactic purposes, explaining in an elegant fashion a set of classes arrived at through some other means. Paradigmatic classification can then be regarded as appropriate for heuristic purposes, for the exploration and categorization of unknown or relatively unknown fields.

Taxonomy would be relegated to a minor role in scientific endeavor were it not for some advantages that it displays over paradigmatic classification. Firstly, it is a much more sophisticated device, capable of displaying more complex relationships between classes than ·paradigms. If a particular problem demands an organization of superclasses, classes, and sub-classes, paradigmatic classification cannot be employed, whereas taxonomy can. In fact, in any case in which non-equivalent relationships must be shown, taxonomy is the only classificatory system which can be used. The main advantage, however, is that taxonomies are far more elegant than paradigms. In the case of paradigms the dimensions of features are simply permuted for all possible combinations. Under practical circumstances this procedure will generate a larger number of classes than is required. Many classes may have no *denotata*. The delineation of those features which logically may be found in combination as opposed to those which actually combine with each other in the phenomenological world is certainly one of the major products of paradigmatic classification. However, for treating those classes which do have *denotata*, paradigms may be, and usually are, inefficient, creating a larger number. of classes than required by the phenomena. A taxonomy, which restricts the combinations by ordering the oppositions of features, offers a way to generate those classes and only those classes which have *denotata*. The paradigm offers the means of determining what classes are required; the taxonomy provides the elegant means to arrive at definitions of those classes. However, without paradigmatically defined classes as a base, taxonomy remains an intuitive, unparsimonious device more often suspicious in character than not, and relatively useless without blind faith on the part of the user. Without paradigmatic classes as a starting point, the derivation of taxonomic definitions is a matter of faith, for there is no way to justify the choices made in its structuring.

## Summary

There are two distinctly different kinds of classification which differ from one another in the relationships between classes and thus in the structure of the classification itself. In the first, paradigmatic classification, the classes are defined by means of unordered, unweighted, dimensional features; while in the second, taxonomic classification, classes are defined by serially ordered, weighted, non-dimensional features. The relationships between paradigmatic classes are equivalent nonequivalences. Thus all of the classes in a given paradigm are comparable with each other in a strict sense and, further, there is no inherent ordering among the classes, no fixed position which they bear to one another. Because no weighting, no internal judgments of “importance” are required by paradigmatic classifications, only the minimal number of assumptions required of all classifications are necessary. Thus paradigmatic classification is the most parsimonious form available, and it is particularly well-suited for heuristic uses, constructing initial classifications for given fields of phenomena. Further, since the assignment of objects to paradigmatic classes requires only the identification of attributes analogous to the distinctive features employed in the definition, this form of classification has the least potential for ambiguity in its application. Taxonomic classification, on the other hand, stipulates specific non-comparable relations among the included classes, producing the characteristic fixed hierarchic structure of the taxonomy. Since the features comprising the *significata* of the taxons must be weighted relative to one another, internal judgments of “importance” must be made to determine level within the structure and internal judgments of relevance must be made to determine position within level for all but the initial or highest level. Because of these judgments, the number of assumptions involved in taxonomic classification always, and usually greatly, exceeds the minimum number required of classification. Thus, taxonomic classification is the least parsimonious form of classification; however, this more sophisticated form of classification can embody more complex relationships than paradigmatic classification and provides an elegant form for generating a specific set of classes required for a problem or only those classes which have *denotata*. Taxonomy is legitimately limited to didactic applications where a solution reached through other means is to be presented in the most efficient manner. It cannot, by virtue of its lack of parsimony, be used initially to create a set of classes.

Criticisms currently leveled at classification are concerned almost invariably with taxonomic classification as outlined here. It has hopefully been shown that taxonomy can be a useful form of classification, though rather limited in terms of application. The reaction against taxonomy as employed in the evolutionary biological sciences stems from the misuse of the device and not from any flaw in the device itself. A common point of departure for such criticisms of “classification” (meaning taxonomy) is that it is subjective and intuitive. This aspect has been shown to derive from the large number of assumptions required to create levels and positions of oppositions within the hierarchic structure. The only possible means of making taxonomy more parsimonious is to be able to treat each of the assumptions as a demonstrated hypothesis, and this, of course, implies that the classes are already known from the outset. Without being based on prior paradigmatic classification, taxonomy is subjective, for the means of arriving at the classes is covert and untestable. In cases in which taxonomy has been so misapplied, it is likely that the investigator who has established the taxonomy had covertly employed paradigmatic classification to arrive at the set of classes embodied in the taxonomy.

Distinguishing between paradigmatic and taxonomic classification is then of considerable utility. Forms of classification which differ in terms of the assumptions required for their construction affect their range of applicability and the means by which they may be evaluated. This distinction between the unordered paradigmatic class and the serially ordered taxonomic class (taxon), and between the equivalent non-equivalences of the paradigm and the non-equivalent non-equivalences of the taxonomy, will be dealt with in the second part of this volume in examining the role, use, and misuse of classification in prehistory.