ORIENTATIONS IN MACROTAXONOMY

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Abstract. The chief task of taxonomy was to classify the living organisms. However, the study of fossils required that these should be classified within the same system as living organisms, and this was going to burden taxonomy with new issues. Macrotaxonomy refers to the delimitation of supraspecific, hierarchical units, which include both the living and the extinct forms. The work points out a series of conceptual – prospective view / retrospective view – and methodological – Linnaean taxonomy / cladistics – contradictions concerning the delimitation of the monophyletic macrotaxa. Linnaean taxonomy highlights the discontinuity in evolution, whereas cladistics emphasizes the continuity in evolution. The problems of macrotaxonomy are mainly related to: 1. the right way of classifying the monophyletic superior taxa within the frame of a direct descent relation (vertical classification); 2. the classification of the intermediate and fossil forms sharing collective characters; 3. the problem of the phylogenetic classification based exclusively on monophyletic taxa and the necessity to retain paraphyletic taxa within the classification; 4. the way in which cladistics can influence and even alter the rules established by the Linnaean taxonomy (clades *versus* taxa). The taxonomic contradictions that are revealed especially by the case of the original forms or of the disappeared ones, which have collective characters, are described by the notion of *relativity of the macrotaxa*. The resolving of these contradictions requires a conceptual shift in the delimitation of the monophyletic macrotaxa, by means of associating the macrotaxa to their own evolution time and identifying the monophyletic taxa of the past.

Key words: Linnaean taxonomy, cladistics, retrospective view, prospective view, relativity of macrotaxa, cladogram, phylogeny, classification system.

Rezumat. Orientări în macrotaxonomie. Taxonomia a avut ca primă sarcină clasificarea organismelor actuale. Studiul fosilelor va impune clasificarea acestora în acelaşi sistem cu organismele actuale, dar acest lucru va ridica probleme noi taxonomiei. Macrotaxonomia se referă la delimitarea unităţilor supraspecifice, ierarhice, ce cuprind atât formele actuale cât şi pe cele dispărute. În lucrare sunt semnalate o serie de contradicţii conceptuale (viziune prospectivă / viziune retrospectivă) şi metodologice (taxonomie lineană / cladistică) legate de delimitarea macrotaxonilor monofiletici. Taxonomia lineană evidenţiază discontinuitatea în evoluţie în timp ce cladistica pune în evidenţă continuitatea în evoluţie. Problemele macrotaxonomiei sunt legate, în special, de: 1. modul cum trebuie delimitaţi taxonii superiori monofiletici aflaţii în raport direct de descendenţă (sau clasificare verticală). 2. clasificarea formelor intermediare şi a celor fosile cu caractere colective; 3. problema clasificării filogenetice, bazată numai pe taxoni monofiletici, şi necesitatea de a păstra în clasificare taxoni parafiletici; 4. modul în care cladistica poate influenţa şi chiar afecta regulile stabilite de taxonomia lineană (clade *versus* taxoni). Contradicţiile taxonomice evidenţiate mai ales de situaţia formelor de origine sau a celor dispărute, cu caractere colective, este descrisă prin noţiunea de *relativitate a macrotaxonilor*. Rezolvarea acestor contradicţii necesită o schimbare conceptuală asupra delimitării macrotaxonilor monofiletici, prin raportarea macrotaxonilor la propriul timp de evoluţie şi identificarea taxonilor monofiletici ai trecutului.

Cuvinte cheie: taxonomie lineană, cladistică, viziune retrospectivă, viziune prospectivă, relativitatea macrotaxonilor, cladogramă, filogenie, sistem de clasificare.

Introduction

Macrotaxonomy is that branch of taxonomy that establishes the rules applying to the classification of superior taxa. The implementation of these rules falls under the charge of macrosystematics. The function of macrotaxonomy and macrosystematics is to emphasize and evaluate macroevolution and the great changes in the composition of floras and faunas.

Whereas microsystematics deals with the identification and classification of species – the basic taxa of systematics, macrosystematics has in view the delimitation of macrotaxa based on the knowledge about living and extinct species. An essential difference between these two approaches of taxonomy resides in the fact that

microsystematics operates with real units, which are identifiable in nature – *species*, while macrosystematics classifies relative units, which reflect only a certain kin relationship (based on the common origin) and whose delimitation can be done differently, according to the outlook, the criteria, the method or the amount of data that are used. There are today two methods, each having its particular outlook, of classifying superior taxa – Linnaean taxonomy and cladistics. Each of these methods has its own advantages and disadvantages (Grant, 2003). We would like to point out here the fact that certain macrotaxonomic questions, such as the classification of primitive forms that present collective characters, require, in addition to methods, an outlook shift as to the relative significance of the content value and the rank of the macrotaxa.

Views in macrotaxonomy

In a long series of taxa connected by a more or less direct descent relation (a well documented evolutionary line), the delimitation of supraspecific taxa may be influenced by the type of view employed, retrospective or prospective. Within the *retrospective view* (looking from the present to the past of evolution), the older taxa are related to the newer ones, hence the ancestors are classified depending on their descendants. The retrospective view (from the living forms to the fossil ones) suggests a systematics of the ranks (Linnaean), in the sense that it identifies the discontinuities among the macrotaxa.

Within the *prospective view*, the newer, descendant taxa are related to the older ones, in a past-to-present view on evolution. The prospective view (from the fossil ancestors to the living forms) suggests a systematics of the lines (clades). These two types of view influence above all the systematic incorporation of the intermediate forms.

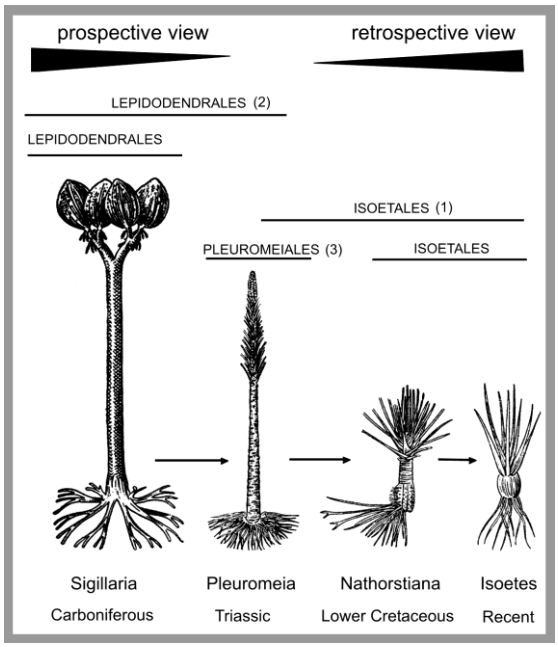

Figure 1. Classifications of the genus *Pleuromeia* (Triassic) according to the view employed, retrospective (1) or prospective (2). A compromising solution would be to designate a specific order for this genus (3).
1. Order Isoetales, Family Pleuromeiaceae;
2. Order Lepidodendrales, Family Pleuromeiaceae;
3. Order Pleuromeiales, Family Pleuromeiaceae.

Example no. 1. Figure 1 presents an evolutionary series of the lycopsids, in which is illustrated the passage from an arborescent size of the *Sigillaria* type (dating from Carboniferous period) to a reduced, herbaceous form represented by the living genus *Isoetes*. Within the frame of this evolutionary line, the genus *Pleuromeia*, dating from the Triassic, occupies an intermediate position (in point of structure as well as in regard to the

time of existence). From a retrospective view, *Pleuromeia* appears to be an ancestor of *Isoetes* and could be included into the order Isoetales as a more primitive form (Grauvogel-Stamm & Lugardon, 2001). On the contrary, according to the prospective view, *Pleuromeia* is a descendant of the *Sigillaria* (the order Lepidodendrales) and could be included as an advanced form of the order Lepidodendrales. Those who do not admit either of these two views prefer to delimit a specific order for the *Pleuromeia* – Pleuromeiales. We are not suggesting here that one view is supposed to be better than the other; we are merely stating that a particular outlook is bound to influence the classification of the superior taxa.

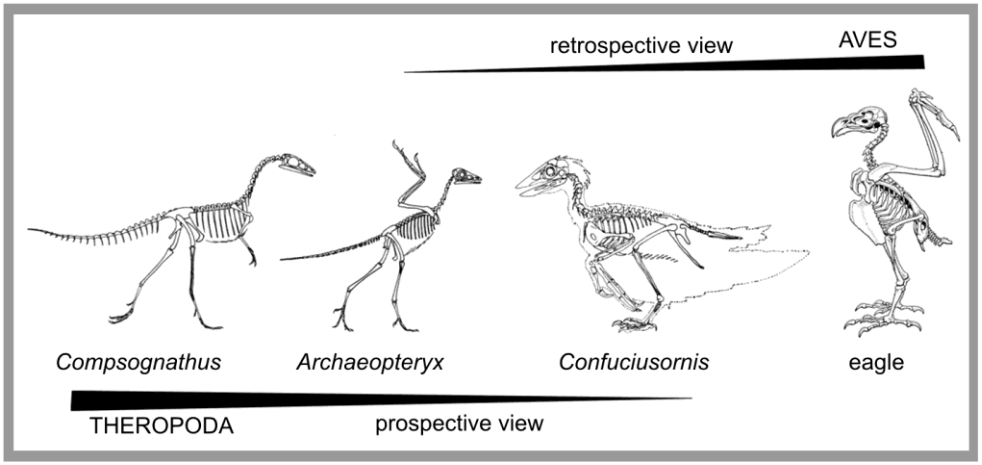

Figure 2. Taxonomic view in the classification of birds. According to the prospective, cladistic view, the first birds appeared as advanced theropods, remaining within the Class Reptilia. In the retrospective view, birds are separated from the reptilian dinosaurs, being given their own class – Aves. Irrespective of the view taken, both dinosaurs and birds belong to the branch of the archosaurs (Diapsida, Archosauria).

Example no. 2. Another example illustrates the way in which a particular view can influence the delimitation of two classes of tetrapods: the birds and the reptiles (Fig. 2). It is a generally acknowledged fact that birds are a specialized line of theropod dinosaurs (the order Theropoda). According to cladistics, the birds are dinosaurs, although they make up a separate class from reptiles, as they have acquired numerous individual characters (autapomorphies). Within the retrospective view, an intermediate form like *Archaeopterxy* is associated to the Aves class. Systematic paleontologists, who see classification as part of an evolutionary, prospective outlook, suggested by cladistics, perceive birds as being nothing more than a group of theropod dinosaurs. In this particular case, the taxon of birds (Aves) is seen as a reptilian taxon (dinosaurian, to be precise). The prospective view of cladistics describes the progress of evolution and the descent relationships, but does not classify and cannot provide the clues according to which two taxa of equal rank can succeed one another within the same evolutionary line.

This view that diverges from the classical Linnaean systematics appears for instance in the title of a paleontology paper published by Chiappe *et al*. in 1999: “Anatomy and Systematics of the Confuciusornithidae (Theropoda: Aves) from the Late Mesozoic of Northeastern China”. In the systematics admitted by all paleontologists, the taxon Theropoda has the rank of an order, whereas the taxon Aves has the higher rank of a class. The formulation “Theropoda: Aves” appearing in the above-mentioned title shows

that the taxon Aves is systematically subordinated to the taxon Theropoda; in other words, a taxon of a higher rank, the class, is systematically subordinated to a taxon of a lower rank, the order. This systematic subordination of a great macrotaxon to a lesser one does not pertain to the logic and practice of the classical Linnaean systematics, being one of the abusive applications of the cladistic prospective view in the field of macrosystematics. There is no doubt that the terms "Theropoda" and "Aves" were used with the meaning of clades engaged in a direct relationship of evolutionary descent – Aves from Theropoda; however, taxonomy employs taxa, not clades.

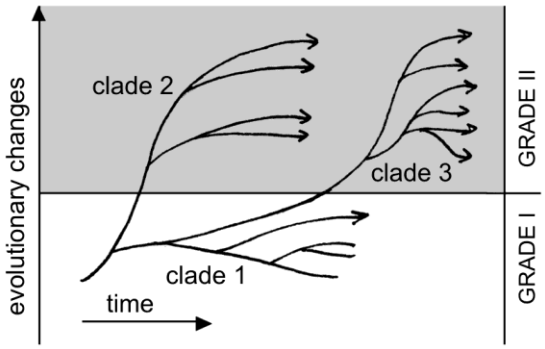

Figure 3. Phylogenetic tree divided in clades and grades. Clade 1 has the value of a monophyletic taxon on the level of its time of existence. After the occurrence of clade 3, clade 1 becomes the equivalent of grade I and stands for a paraphyletic taxon from a taxonomic point of view. On the time level of clade 3, clades 2 and 3 remain monophyletic taxa of grade II.

Linnaean taxonomy

Linnaean taxonomy operates with a *limited* number of taxa having *hierarchical* ranks, from species to regnum. Any addition to the taxonomic ranks would make the classification system confusing and inoperative. At the same time, the species are organized in *equivalent* macrotaxa (Bănărescu, 1973). For instance, if there is within a phylum a new species, of a new type, that cannot be associated with any order of that phylum, then that species will be attributed all the superior taxa of compulsory rank: a family, an order, a class, possibly a subphylum. Linnaean systematics is a *systematics of ranks*, as it is based on identifying those discontinuities that allow the organization of species in superior hierarchical units.

The delimitation of the supraspecific hierarchical units is grounded on two criteria: the *evolutionary criterion* and the *organizational criterion*. The evolutionary criterion refers to the delimitation of monophyletic taxa based on the common origin of species. In this respect, the main task of the systematist is to establish homologies. The organizational criterion aims at defining the organizational characteristics common to the representatives of a macrotaxon. Based on this criterion, and in contrast to cladistics, Linnaean taxonomy retains the paraphyletic taxa as well, which are characterized by a common level of organization. However, the component species can exhibit certain variations from the common organizational frame. The great systematic units, such as the phyla, are characterized by a body plan. The origin of a body plan from another does not necessarily presuppose a systematic subordination as well. For instance, birds and mammals form independent classes of vertebrates, as do reptiles, from which they derived.

Linnaean macrotaxa are firstly organization units and secondly evolutionary units. This is the reason why Linnaean systematics retains numerous paraphyletic taxa (based on symplesiomorphies) as organizational levels, of a high rank (as for instance the Gymnospermae phylum, the Reptilia class, etc.) or of a lesser rank (the order Condylarthra, the order Chondrostei, etc.).

Linnaean systematics highlights the *discontinuity* in evolution, whereas cladistics emphasizes the *continuity* in evolution. The monophyletic taxa that have recorded over time the same level of evolutionary changes belong to the same *grade*. A grade can include one or several clades (monophyletic macrotaxa) (Fig. 3).

Cladistics

Also called phylogenetic systematics, cladistics is the method of describing the hypothetical kin relations among taxa starting from the recent synapomorphies (Lipscomb, 1998). The cladogram, or cladistic tree, is made up of branches (clades) that represent taxa or evolution lines. The cladogram is a timeless ramification, as it does not relate to the time axis.

The utilization of cladograms in the field of macrosystematics has a series of limitations: the cladogram fails to indicate the original taxon at the level of the nodes, where are always found unknown ancestors; cladistics cannot estimate the rank of the descendant macrotaxa, but merely the ramification pattern of the evolution lines; cladistics offers a *prospective* view on evolution, suggesting the formation of monophyletic taxa of an ever lesser rank. At the same time, the cladistic trees evoke an additional number of taxonomic ranks, corresponding to almost every node. It is not advisable to introduce a new taxonomic rank at each node of the cladogram, as this is bound to create a cluster that would make the classification system heavy and even unintelligible. Cladistics and the Linnaean taxonomy share a number of similarities (the importance of monophyly, for instance), but are at the same time differentiated by several discrepancies (cladistics produces branches, and not hierarchical categories; it also rejects paraphilia) (Grant, 2003, Cojocaru, 2004).

We can conclude from all that has been mentioned above that the information the cladograms offer has to undergo two major conversions: the first one refers to the conversion of the cladogram into phylogeny; the second one, to the conversion of the cladogram and the phylogeny into a classification system (Linnaean).

Problems of macrotaxonomy

As we have already mentioned, the first task of taxonomy was to classify living forms. With time, the knowledge about fossils constrained to the insertion of the latter into the same classification systems, alongside with the present forms. As a result, macrotaxonomy had to adopt a *retrospective view* on the biological diversity, analyzing evolution from present to past. At the same time, the main macrotaxa were delimited around some living forms, the fossil forms being related to these, and not the other way round. To what extent does such an approach reflect evolution? Ironically, some delineations of macrotaxa have been made possible and several classification difficulties have been avoided due precisely to the scarcity of the paleontological data, to the natural voids occurring in the documenting of the evolutionary series. With the accumulation of more data regarding the evolution of several groups and the introducing of new ways of evaluating kinship, macrotaxonomy has been forced to deal with new and particularly challenging problems. Some of these were predictable. The overcoming of this deadlock requires not so much a methodological shift, but rather a *conceptual* one, a change of *vision*. The problems of macrotaxonomy are chiefly related to:

- the way in which should be delimited the monophyletic superior taxa within a direct descent relation (which is known as *vertical classification*);
- the classification of the intermediate and fossil forms sharing collective characters;
- the problem of the phylogenetic classification, based solely on monophyletic taxa, and the necessity to retain paraphyletic taxa within the classification;

- the way in which cladistics, the most objective method used in establishing phylogenetic relations, may influence and even alter the rules set by the Linnaean taxonomy (clades *versus* taxa).

Intermediate forms and the relativity of macrotaxa

The classification of the intermediate (and original) forms in supraspecific taxa is usually made by grouping these forms together with their descendants. During their lifetime, the intermediate or original forms would have been classified together with their related or ancestor forms, as they would not have received this status of "intermediate or original forms". For instance, each ancestor species of the extant orders of the hoofed animals, terrestrial carnivorous or marine mammals would have belonged to a different order during its lifetime.

Example no. 1. In order to conceptually tackle this issue, we would have to transfer ourselves to a certain extent to the realm of imagination. For instance, the investigation of the remains of the *Moeritherium* (Upper Eocene), considered nowadays one of the ancestors of the proboscideans, revealed, based on several anatomical details, features that are fully developed in the present-day proboscideans: the second pair of elongated incisors, a slightly broadened and posteriorly displaced nasal opening (which indicates the presence of a small proboscis), an elongated mandibular symphysis, the configuration of the molars, etc. This association of the *Moeritherium* to the elephants was possible due to the fact that elephants are *already* known to us. If we had analyzed the genus *Moeritherium* during its lifetime, when the configuration of the proboscideans was not yet defined, we would have certainly made a systematic association with its ancestors and living relatives, classifying it within an order that would not have been called "Proboscidea". On the other hand, an investigation of the genus in question during its lifetime could not have given us a perspective on the way in which its anatomical modifications were to advance throughout evolution. Systematics evaluates characters, not their potential tendencies. Tapirs, for instance, have been having an incipient proboscis for over forty million years, a proboscis that did not change into an elongated, proboscidean-like trunk; they had a more conservative evolution than proboscideans. The delimitation of the monophyletic superior taxa based on intermediate forms continues to raise problems for systematics, which is oftentimes forced to select conventional criteria for their dissociation.

Example no. 2. Another illustrative example of systematic relativity is provided by the evolution of the cetaceans. The oldest direct ancestor of the cetaceans, *Pakicetus* (Low-Middle Eocene, 53 million years ago) (Gingerich & Russell, 1981), a terrestrial animal (Fig. 4) having the size and the aspect of a wolf, has been included into the Order Cetacea. The problem is to decide if this original form of the cetacean line should be classified within the same order (Cetacea) alongside all its descendants or should be assigned a specific order. One must keep in mind the fact that the genus *Pakicetus* is connected to its ancestors by far more synplesiomorphies than the few autapomorphies (the auditory bulla is formed from the ectotympanic bone only) that suggest its evolution along the cetacean line. According to the current data (provided by paleontology and molecular biology), the ancestors of the cetaceans were terrestrial hoofed animals of the archaic artiodactyl type (Thewissen *et al*., 2001), closed related with the Mesonychidae**,** with whom they still shared some dental similarities (such as the triangular teeth).

In our opinion, it is not recommended to ascribe the name "cetaceans" to the entire evolutionary line of these aquatic mammals, starting directly from the oldest known terrestrial ancestors. *Pakicetus* could be included into the superorder Cetartiodactyla, but does not belong into the Order Cetacea; however, mention must be made of the fact that it is the starting point toward the new Order Cetacea. Here becomes obvious the

contradiction between the systematics of the lines (branches), suggested by cladistics, and the systematics of the ranks (Linnaean). There is no doubt that a macrotaxon can expand its value content in the presence of new discoveries, but up to what point? Would the *Pakicetus* have been considered a cetacean during its lifetime, in a classification made in the Middle Eocene epoch?

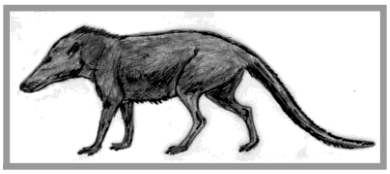

Figure 4. *Pakicetus* Gingerich & Russell, 1981 (Eocene), the direct ancestor of the cetacean line (redrawn based on Carl Buell, http://www.neoucom.edu/Depts/Anat/Pakicetid.html). In the prospective view suggested by cladistics, the same order, Cetacea, includes both the *Pakicetus* (pictured here), and the whale. Can Linnaean taxonomy classify them together as well? To what extent can change occur in the diagnostic of a macrotaxon that maintains its rank?

The relativity of the macrotaxa. The possibility of an original species – which is at the same time an intermediate form – belonging to two different macrotaxa according to the time of evolution had in view by the classification can be defined by the concept of *relativity of the macrotaxa* (Cojocaru, 1994, 1995, 2004, 2005). This relativity suggests the conceptual contradictions occurring in the field of macrotaxonomy, the fact that the delimitation of the same macrotaxa can be made depending on the level of the evolution time (Fig. 5). From a methodological viewpoint, classical systematics, which illustrates the discontinuity in evolution, enters into a formal contradiction with cladistics, which emphasizes continuity.

Rule no. 1: *the only valid delimitation of macrotaxa is the one related to the present of their evolution time*. Any given classification system is worked out and considered accurate solely in regard to a certain time of evolution, namely *the present of the evolution time*. The first consequence of this practical constraint is the fact that the hierarchical classification system comprises species that are contemporary to one another, the result being a *horizontal classification*. The fossil forms, which are included with a certain amount of relativity within real species (as reproductive isolation cannot be proven), are associated to the systematic units established based on the knowledge about the living forms. As a result, within the frame of the retrospective view, even when dealing with the same taxonomic composition, the macrotaxa of a certain evolution line will be delimited differently, according to the section of the evolution time taken into consideration. For instance, in the case of the evolutionary line of the eutherians (Eutheria) during the period between the Paleocene and the Recent, the classification in orders and families for the Paleocene period will differ from the one corresponding to the Oligocene period, while this latter will in its turn be different from the classification corresponding to the Recent epoch.

Rule no. 2: *taxa that are genetically and phylogenetically close will be classified together within the same macrotaxon*. This is the way in which are grouped together the contemporary species within the horizontal classifications.

Rule no. 3: *ancestors are classified together with their descendants*. The hierarchical Linnaean classification is grounded on the criterion of the common descent from a single ancestor (*monophyly*). As a result, any macrotaxon will have to include, in addition to all the known living and fossil species, the *original species* as well. For instance, although it has numerous dinosaurian features, the *Archaeopteryx* is classified alongside its descendants – the birds.

Rule no. 4: *it is possible to classify two closely related ancestors within different macrotaxa in the case in which they are associated with their descendants* (according to rule no. 3). During the lifetime of an original species, that macrotaxon of a certain rank that would be derived from it did not yet exist, and that species belonged, at the time of its existence, to a different macrotaxon, one that was equal in rank with the macrotaxon it would give rise to during evolution. The insertion of the original species into a *vertical classification* including all its known descendants separates, from a systematical viewpoint, the original species from its closest relatives that have initiated other evolutionary lines rich in species.

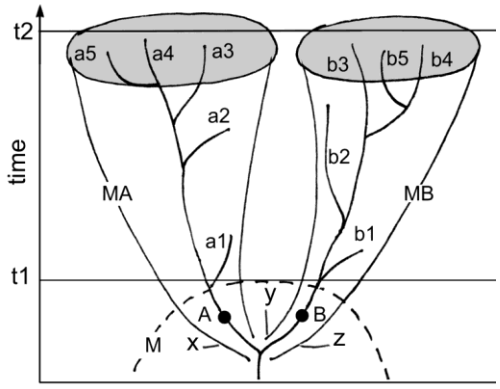

Figure 5. Relativity of the macrotaxa. The monophyletic macrotaxa MA and MB are delimited in relation to time level t2 and have their origin in the related species A and B, respectively. On the time level t1, the ancestral species A and B could have belonged to the same macrotaxon M. Although species A and B are closer to each other that A is to a5, for instance, or B is to b5, the systematics of time t2 groups within the same macrotaxon species A and a5, and B and b5, respectively. The classification system is relevant only if we have in view the present of the timeline of evolution (t2 in this example). The ancestral forms x and z, together with the forms sharing collective characters, y, are part of the monophyletic taxon M related to t1 (after Cojocaru, 2005, with additions).

Macrotaxonomic contradictions. Rule no. 4 points to a macrosystematic procedure that conflicts with rules 1 and 2. Rules 1, 2, 3, and 4 are valid when considered separately; taken together, however, they are partly contradictory, which supports the concept of relativity of the macrotaxa (Fig. no. 5). The contradictory content of the systematics of intermediate forms derives from the dual nature of the species, which is both outcome and stage of evolution. As outcome of evolution, the species of intermediate forms belong to a macrotaxon, whereas as stage of evolution they can belong to a different macrotaxon of an equal rank.

For example, Wilson (1971) described the progressive evolution within the primitive selenodont artiodactyls, where populations of the original species gave birth successively to representatives belonging to various genera and families. The conclusion was that the original species of two different but related families were more similar to each other than to the living forms of their own families, forms that they have generated. This fact is conflicting with the hierarchy of the classification system, which is based on the gradual accumulation of differences with the passage towards taxa of an ever higher rank.

Another consequence of the relativity of the macrotaxa is the fact that a clade that is delimited at a certain time of evolution may become grade and paraphyletic taxon as its descendants undergo significant evolutionary changes. As paraphyletic taxon, the old grade becomes “visible” within a retrospective view.

The taxonomy of archaic forms sharing collective characters. The concept of systematic relativity could be used for dealing with macrotaxonomic issues related to the impossibility of including the intermediate forms or the forms sharing collective characters within the macrotaxa. In order to succeed in including these forms into the macrotaxa, the best solution would be to include them into the monophyletic macrotaxon of their time, while keeping in mind the fact that this macrotaxon is no longer “visible” within a retrospective view. By analyzing figure 5, we notice that taxa A and B are inserted into different macrotaxa (MA and MB, respectively) at time t2, as original forms of these. In those cases in which we deal with forms sharing collective characters situated on the time level t1 (of the y type), which cannot belong to either MA or MB, as they are equally close to A and B, we suggest that they should be included into the taxon M, which is only valid for the time level t1.

This compromising solution involves an argument and a counterargument. The argument is that at the time level t1 the forms in question could have really made up a monophyletic macrotaxon (clade), so a natural one, the macrotaxon M.

The counterargument is that in this way a macrotaxonomic rule is being broken (the above-mentioned rule no. 3): the original forms are classified alongside their direct descendants in the cases in which the latter are known. However, this infringement is compensated by another rule (the above-mentioned rule no. 2), which states that those forms that are genetically (and phylogenetically) closer are classified together, rather than alongside forms that are more distant from a genetic and phylogenetic viewpoint. The dilemma arises from the fact that no matter how much information we gather on the forms sharing collective characters, they will always have the same *status* of *forms sharing collective characters*. In this case, their classification from the viewpoint of the present time, t2 in the diagram, remains perpetually uncertain. There are numerous cases in which occurs this double taxonomic belonging.

For instance, the Devonian fossil forms sharing characters with both the Arthropsida and the Filicopsida (*Hyenia*, *Calamophyton*, *Cladoxylon*) gave rise to many difficulties when it came to their classification in relation to their descendant forms (Kenrick & Crane, 1997; Taylor *et al.*, 2009). There are authors who classify the Devonian genera *Hyenia* and *Calamophyton* as ancestors of either the arthropsids or the filicopsids. Given the fact that these forms having collective characters are part of the basic stock of both extant classes (Arthropsida and Filicopsida), the best solution would be to maintain them within the same Devonian macrotaxon (Primofilicidae, for instance) that made up a monophyletic group during the time of their existence.

Among the taxa with double belonging to different macrotaxa, we can also mention: the genus *Calamophyton* (Devonian), classified within either the order Hyeniales, or the order Cladoxylales; the genus *Pleuromeia* (Triassic), classified within either the Lepidodendrales, or the Isoetales; species of the genus *Cooksonia* (Upper Silurian), divided between two great evolutionary lines – Rhyniophyta and Lycophyta, etc.; in the case of these archaic cormophytes, a taxon of the type “Psilopsida”, related to the evolution time, would seem the most appropriate, although it was given up under the influence of the cladistic models.

The relating of these forms having collective characters to the macrotaxon of their time of existence seems to be, at least temporarily, an appropriate solution for maintaining the cohesion of a classification. We cannot admit considerations stating the

formal character of a classification or another, given the fact that the forms in questions could be subject to other manners of classification as well.

Conclusions

From all that has been mentioned above we can assume the following:

1. There are two methods of delimiting macrotaxa, Linnaean taxonomy and cladistics, each of them bringing a different contribution to the field of systematics. Cladistics is a relatively precise and objective method, which could be tested independently by other specialists as well; it does not deal with taxa, but with clades. In other words, cladistics "describes" evolution, provides phylogeny with ideas, but does not make classifications.

2. Linnaean taxa do not necessarily coincide with the clades of cladistics; they can equally correspond to some evolutionary levels (grades), being paraphyletic.

3. The forms sharing collective characters or the intermediate, original ones are subject to a systematic relativity. This relativity is the consequence of a specific view (retrospective or prospective) upon the delimitation of the macrotaxa, as well as of the type of the relation to the time of evolution. When related to a certain time of its evolution, a monophyletic taxon can become paraphyletic, after its descendants would have evolved, or can even become "invisible", being "dismembered" among the macrotaxa of the descendant forms.

4. A natural classification of the forms having collective characters can be achieved only when these are grouped together within a *monophyletic taxon corresponding to the time level of their evolution*, making abstraction of their descendants. This approach presents two possibilities:

4a. The macrotaxon of the forms having collective characters will receive a specific name, derived from the name of a type taxon; for instance, the order Pakicetiformes – from *Pakicetus*.

4b. The other possibility is to give to the macrotaxon of the forms with collective characters the name of the macrotaxon having the highest rank, which also includes their descendants, from a retrospective view; for instance, the *Superorder* Cetartiodactyla, which includes the extant orders Artiodactyla and Cetacea, as well as the form with collective characters *Pakicetus*, will become the Order Cetartiodactyla, related to the evolution time (Eocene) of the *Pakicetus*. Both these possibilities establish that the genus *Pakicetus* having collective characters should not be included into the order of its descendants – Cetacea.

5. The solving of certain systematic uncertainties, such as those related to the ancestral forms having collective characters, can be achieved through the delimitation of monophyletic taxa from the viewpoint of their time of existence, even though these are "invisible" when looked upon retrospectively. For example, in figure 5, the taxon M can appear when considered from a present (retrospective) view as either a "visible" paraphyletic taxon or an "invisible" monophyletic taxon; it can appear as monophyletic and visible only when it is related to the time of its evolution (t1 in the diagram). This solution stands for the objectification and the actualization of a past systematic reality, which is nevertheless the only relevant one in what the field of macrotaxonomy is concerned.

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