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The theory of biological systematics and phylogenetics. Theoretical background and systematist's descriptive work

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ABSTRACT. From the authors' viewpoint, creating a theoretical background of systematics and phylogenetics requires crossing the border between those branches of science and other areas of knowledge. A new method of describing classification processes and reconstructing phylogeny is necessary. When interpreting concepts of systematics and phylogenetics, achievements of contemporary methodology, history of science, system theory and biological cybernetics should be applied.

The theory proposed is an hierarchical concept associated with the theory of systems and organization levels. It is considered as a new tendency in science. It constitutes an attempt to enrich the Darwinian evolutionary biology with a conceptual framework of a separate and pre-Darwinian origin. The hierarchical structure of the world was one of the greatest generalizations of natural sciences prior to Darwinian revolution. Its main disadvantage was a static understanding. The authors present both the static and dynamic structure of the interdependences between the methods of description and classification in the systematics and phylogenetics.

Key words: Theory, system, model, space of logical possibilities, space of implementation.

INTRODUCTION

An abundant literature was devoted to the problems of methodology and theory of systematics and phylogenetics. Various solutions of separate problems were proposed. Papers by MAYR (1942, 1963, 1965, 1972, 1974, 1974a, 1981, 1981a, 1988), MAYR et al. (1953), SIMPSON (1945, 1950, 1951, 1959, 1961), REMANE (1952, 1956, 1963), SEVERCOV (1945, 1945a, b, c, 1948), SHMAL'GAUSEN (1942, 1960, 1968, 1973, 1983) and other workers formed the way of reasoning of a contemporary systematist. Especially deep changes in systematics took place within the last twenty years. The methodology became extended and enriched, the concepts and methods were modernized and modern informatic methods were introduced and extended. The change turned the anachronic "Cinderella" of biological sciences into a science of great intellectual load and a leading discipline, at least in some countries. These facts resulted in three distinct schools of systematics which correspond to different philosophies. They are trying to create a theoretical framework which systematics missed before (MATILE et al., 1993). These are:

Genealogical systematics - eclectic, based on genealogy, but also on the similarity. When constructing classification, it attributes the greatest importance to the degree of adaptation or rank (HUXLEY 1957, 1958; MAYR 1942, 1974, 1974a, 1981; SIMPSON 1945, 1951). The rank is understood by HUXLEY as an anagenetic unit, that is a certain stage of advancement of evolutionary progress.

Phenetics assumes that phylogeny can not be objectively traced. From the start it bases on informatic and mathematical methods which allow a classification based on the general similarity of objects. It groups together those taxa that have most characters in common, i.e. are the most similar. Theoretically, it considers the maximum number of characters disregarding their evolutionary significance. It is assumed that with increasingly accumulating data significant information becomes somewhat automatically pronounced, while the "noise" is eliminated. Such a method is sometimes the only possible, especially with respect to organisms whose genealogy is very difficult to trace. It is always a better method of classifying than of constructing classification (SOKAL 1968; SOKAL, MICHENER 1958; SOKAL, SNEATH 1963; SNEATH, SOKAL 1973; CAIN, 1954).

Phylogenetic systematics (cladistics) constructs classification based exclusively on the genealogy of species i.e. phylogeny. It takes into account evolutionary significance of characters in order to identify monophyletic lineages, that is clades (HENNIG 1966, 1981, 1983; NELSON 1970, 1972, 1973, 1974, 1978; NELSON, PLATNICK 1981; PLATNICK 1979; CRACRAFT 1974; CRACRAFT, ELDREDGE 1979; ELDREDGE, CRACRAFT 1980; WILEY 1978, 1979, 1981 and many others).

The three philosophies of systematics represented by the three schools of systematics, were characterized very roughly; a more detailed characteristics can be found in the original papers of their proponents and in review articles (BOROWIEC 1989; LONC 1989; POKRYSZKO 1989).

In spite of the diversity of approach described above no theory of systematics and phylogenetics has been formulated, as mentioned by MAYR (1974a). It can be inferred that a new approach is necessary to create a theory of systematics and phylogenetics.

From our viewpoint such a new approach should be the following.

1. It is necessary to cross the borders to other areas of science;

2. A new way of describing classification process and phylogeny reconstruction is necessary.

Such an approach is justified in relation to methodology, history of science, system theory and biological cybernetics, when interpreting concepts of systematics and phylogenetics. It is a logical continuation resulting from traditional opinions -

Table 1. Development of descriptive biology; change of paradigms and modes of thinking

Epoch	Basic cognitive problems	Problems of organism as entity	Paradigms and their change	Mode of thinking
Description (end of XV - beginning of XVII c.)	First period: translating and commenting on ancient author's papers		Recognizing papers of ancient authors as a pardigm Normal science	
	Second period: developing descriptions of plant and animal species	Organism as a whole (phenomenological description)	Crisis Description paradigm Normal science	
Classification (XVII--XVIII c.)	First period: producing keys	Organism as a set of systematic characters	Crisis	Sharp deterministic
	Second period: classification based on Linnean papers		Classification paradigm Normal science	
Evolutionary theories (XIX c.)	First period: describing and classifying plant and animal species according to external and anatomical characters	Organism as a functioning system	Normal science Crisis	Sharp deterministic
	Second period: development of systematics and phylogenetics based on Darwinian's theory; constructing phylogenetic trees	Organism as a set of ancestral and derived characters	Evolutionary paradigm Normal science	Credible in theory of evolution; sharp deterministic in systematics and phylogenetics
Development of systemic concepts of evolution (XX c.)	First period: development of microevolution science, describing, classifying, phylogeny reconstruction with traditional methods; recognizing problem of entity in ontogeny and phylogeny	Organism as a whole in ontogeny and phylogeny	Crisis	Credible in theory of microevolution; sharp deterministic in systematics and phylogenetics
	Second period: describing, classifying, phylogeny reconstruction with traditional and modern methods; using computer, solving methodological problems of systematics and phylogenetics	Organism as a developing system in ontogeny and phylogeny; synthesis of evolutionary theory and biocybernetics		Start of transition to systemic--credible mode of thinking in systematics and phylogenetics

the idea of organism as an entity in the process of historical development (SHMAL'GAUSEN 1968).

Scientific reflection constitutes the key to creating the theory of systematics and phylogenetics. In this paper we propose to scientists-systematists such a reflection on their activity within biological systematics and phylogenetics. MAYR (1974a) argues that systematists usually reveal only the final outcome of their work, neglecting the way in which they have reached their conclusions. According to that author they reach their results intuitively. GAUSE (1934) expressed a similar opinion - "I've got the result, but still I don't know how to obtain it". This is why MAYR (1974a) states that attention should be paid to how the systematist reaches his conclusions. His conviction agrees with the general tendency in the present development of science. BIBLER (1975) formulated the following statement: "In the mid of XX c. it was first of all the theoretician (most obviously physicist and mathematician, and certainly most sharply - logician, and generally humanist) who solved the studied paradox. In many sciences almost simultaneously it became apparent that further development (and the mere existence of theoretical cognition) depends on the solution of a single problem: the theoretician should be able to logically justify formation and transformation of the logical beginning of his thinking. Otherwise such a beginning can not serve as a basis for subsequent logical steps". It follows from this conviction that the necessity for a methodology of scientific research in systematics and phylogenetics is an expression of the general rule of cultural development in the second half of our century.

I. METHODOLOGICAL JUSTIFICATION OF THE THEORY OF SYSTEMATICS AND PHYLOGENETICS

I.1. Problem of method in the systematics and phylogenetics

CLASSIFICATION OF METHODS

The subject of systematics is sufficiently well defined: systematics is a knowledge of diversity of organic world (MAYR 1974a). Phylogenetics considered as a self-standing science should be defined as a knowledge of the evolution of such a diversity (PARAMONOV 1945).

Methods of systematics and phylogenetics, traditionally beginning with HAECKEL (1939), are considered as methods of various biological sciences applied to construction of classifications and phylogeny reconstruction. In HAECKEL's time these were methods of comparative anatomy, embryology and paleontology, today - methods of many biological disciplines (physiology, biochemistry, molecular biology etc.). Accordingly, classifications of such methods are proposed, including separate methodologies. Hence with this approach systematics and phylogenetics lose their own specific methods. We propose the following way of classifying methods which results from the essence of those sciences.

Method of systematics - method of describing and classifying biological species (adopting the way of taxonomic solutions).

Method of phylogenetics - method of describing archetypes and reconstructing their origin (adopting the way of phylogenetic solutions).

Each of those methods can be subdivided into subordinate methods. Their classification is presented in fig. 1.

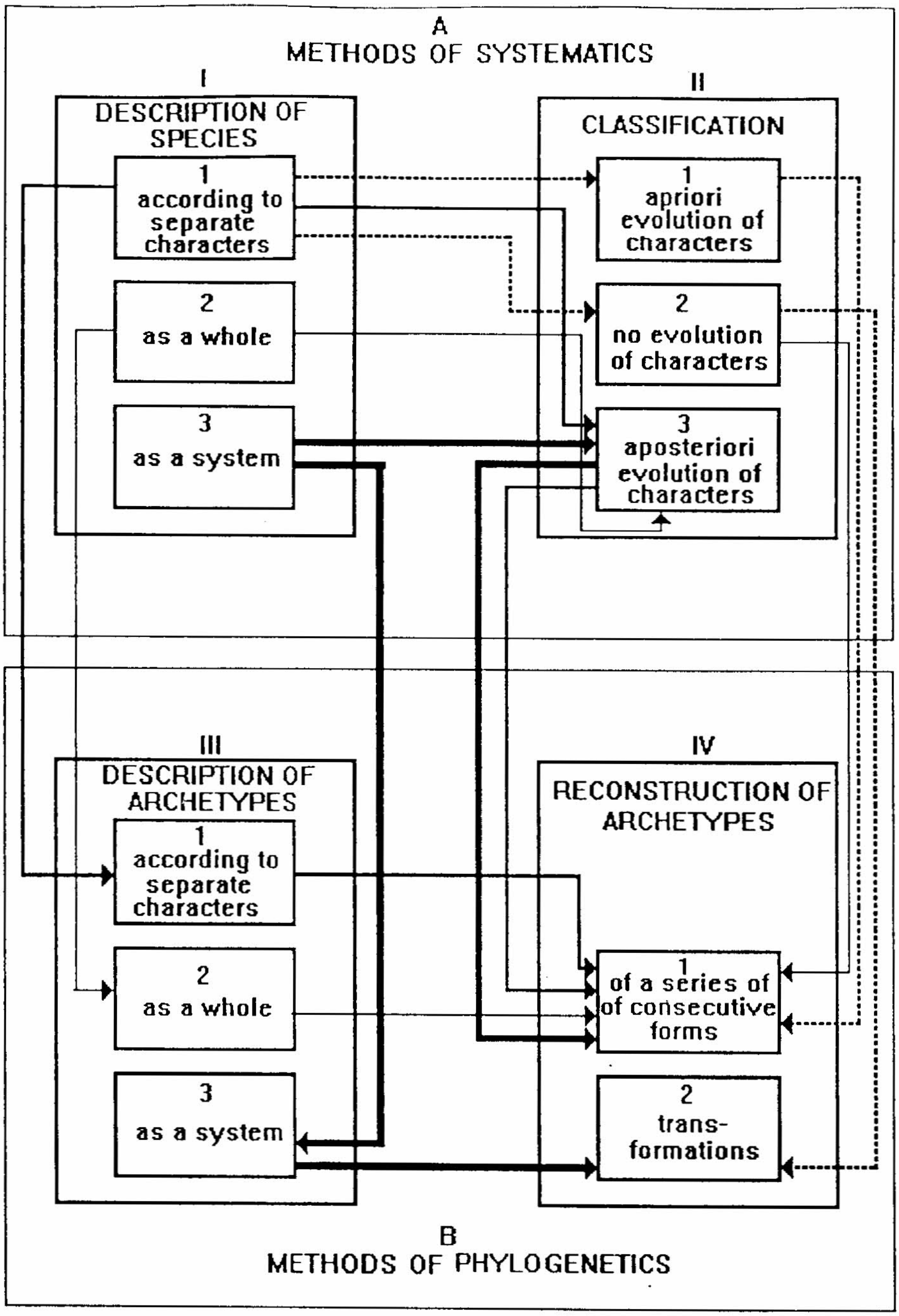
Considering the diagram (fig.1) it is worthwile to pay attention to the following peculiarities of the presented approach to the method problem in systematics and phylogenetics.

1. Systematics and phylogenetics are considered within a single science. As is seen in the diagram, all the four subsystems (**I-IV**) are variously interconnected. Because of this describing species according to separate characters (**I**, **1**) permits only a corresponding reconstruction of archetypes (**III**, 1), and methods **I**, **2** and **I**, **3** enable the respective archetype description (**III**, **2** and **III**, **3**). Areas **I** and **II** are also interconnected; in the process of traditional classification, described as a result of different description methods **I**, **1** - **I**, **3** are subject to analysis and estimate of characters (estimating rank of character) (**II**, **3**). Areas **I** and **IV** are also interconnected, since classification based on an a posteriori estimate of characters and arranging them in subsets makes it possible to reconstruct consecutive archetypes in the process of phylogeny (connections **II**, **3** —> **IV**, **1**). Connections between areas **III** and **IV** are the following: describing archetypes according to separate characters (**III**, **1**) and their organisation as a whole (**III**, **2**) enables a reconstruction of separate stages of phylogeny as a result of the presented classification. Modelling archetype organisation (**III**, **3**) makes it possible to present their dynamic transformations.

2. The presented classification is constructed on a single basis - concept of the whole organism - and separate methods correspond to various levels in the concept: in groups **I** and **III** methods of description distinguish between the transition of a systematist from a fragmetary description to a systemic description. In group **II** methods are divided according to the procedure of estimate of characters: only classification based on an a posteriori estimate of characters and their ordering through subordination (method **II**, **3**), in contradistinction to methods **II**, **1** and **II**, **2**, makes it possible to classify descriptions of species and not sets of their characters. In group IV two methods are presented: one (**IV**, **1**) makes it possible to present consecutive archetypes, the other (**IV**, **2**) enables presenting such a sequence as a process of transformation of one type into another. The possibility to view phylogeny in its dynamics was presented by us on a film ("The first attempt at phylogeny modelling") during conferences devoted to the theory of classification, problems of zoology and paleontology.

3. The presented classification is significant since it contains the development component - in his activity the systematist passes from the first to the third contour.

4. The classification is a three-level statistical system.


A
METHODS OF SYSTEMATICS
I
DESCRIPTION OF SPECIES
1 according to separate characters
2 as a whole
3 as a system
II
CLASSIFICATION
1 apriori evolution of characters
2 no evolution of characters
3 aposteriori evolution of characters
III
DESCRIPTION OF ARCHETYPES
1 according to separate characters
2 as a whole
3 as a system
IV
RECONSTRUCTION OF ARCHETYPES
1 of a series of of consecutive forms
2 trans-formations
B
METHODS OF PHYLOGENETICS

1.2. Systematist's work in terms of developing systems

Many scientists were of opinion that the work of a systematist presented a comparatively simple process, requiring only a thorough knowledge of the material. The image has begun to change recently. ROZOVA (1986), studying classification methods in various sciences, demonstrated the consciousness of classification as an important component of any human activity - first of all scientific. However, because of the lack of distinct concept of classification as a general cognitive phenomenon, there is a need for a gnostical analysis.

Below, the classification process is considered as a complex system of analytic and synthetic processes, executed by scientists when analysing objects, constructing their classification and reconstructing phylogeny. The process is executed cyclically, each new cycle beginning with a new description. It is diagrammatically represented in fig. 2. The diagram demonstrates at the same time the process of systematist's work and development stages of that science.

The classification of methods in systematics and phylogenetics presented in fig.1 represents the static aspect of classification. In fig. 2 the classification is presented dynamically (EPSHTEIN, 1993). Some peculiarities of the scheme should be explained.

1. Systematics and phylogenetics, like in the previous scheme, are regarded as one science. Its necessary objective is to present objects in their development. Description area can be considered as comparatively unseparated entity (**C**), classification as analysis (**A**), development reconstruction as synthesis (**S**);

2. At each new stage of his studies, the systematist retrospects, reflects and uses the past in the new image. In this way past and future in his work are interconnected in both directions.

3. All the three study areas are of equal importance; each of them is necessary for the studies on various taxa and in each new methods of studies can be used when elaborating the obtained data. At present systemic methods opening new perspectives in all the three areas are of separate significance.

I. 3. Historical-scientific bases of the methodological scheme of systematist's work

VERNADSKII (1978, 1981) demonstrated that the interest in history is obligatory in scientific activity: knowledge of the past is necesary to understand the present,

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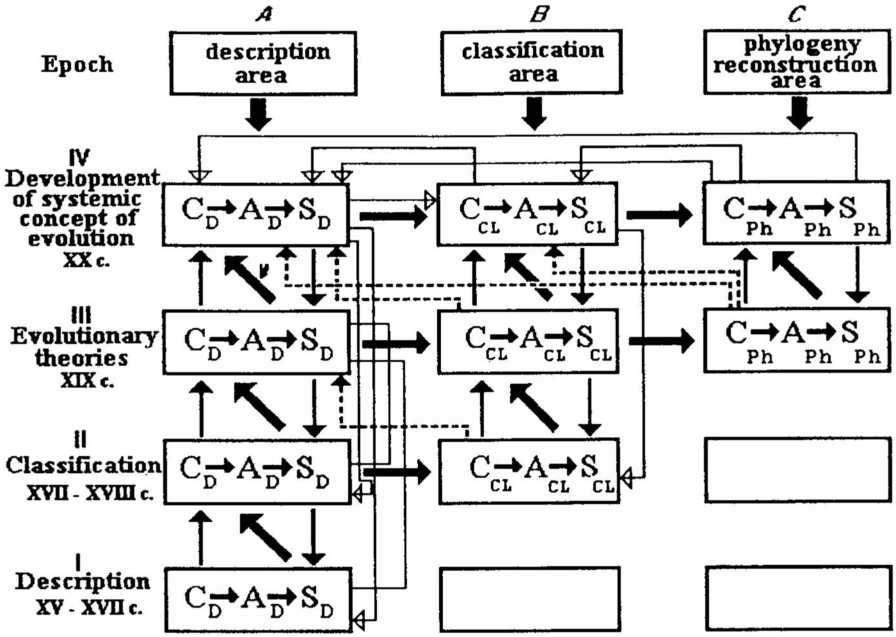
1. Classification of methods of systematics and phylogenetics: Medium line (first contour) **I, 1 —> II, 3; I, 1 —> III, 1; III, 1 —> IV, 1; II, 3 —> IV, 1;** thin line (second contour) **I, 2 —> II, 3; I, 2 —> III, 2; III, 2 —> IV, 1; II, 3 —> IV, 1;** thick line (third contour) **I, 3 —> II, 3; I, 3 —> III, 3; II, 3 —> IV, 1 —> IV, 2; III, 3 —> IV, 2;** broken line shows that classification based on an a priori estimate of separate characters or attributing equal value to all characters yields little information for constructingclassification and reconstructing phylogeny (in such a situation contour does not exist).



2. Systematist's activity and history of contempotrary descriptive biology as developing systems: *A*-*B*-*C* areas of systematist's activity; C-A-S: C - object considered as comparatively unseparated entities; A - analysis; S - synthesis. C_D-C in description area, C_{Cl} - in classification area; C_{Ph} - in phylogeny area. The symbols are used to denote analysis and synthesis process in those areas. In description area: C - real object, A - establishing its characters, S - description. In classification area: C - multitude of descriptions, A - establishing systematic characters, S - classification. In phylogeny reconstruction area: C - classification, A - establishing ancestral and derived characters, S - describing development process (phylogeny reconstruction). Connections between the subsystems are marked with arrows: medium arrows denote connections between C, A and S in each block of analysis and synthesis process; thick arrows denote sequence of events (simple connections between stages within each area and between the areas); thin arrows denote retrospection, thinking over and entering a new image (back connections within each area and between the areas); broken arrows - back connections playing a part of future, directed stimulators

and each generation of scientists discovers in a sense for themselves in the past new qualities characteristic of their own time.

The methodological scheme of the systematist's work (fig. 2) proved useful when interpreting the development of contemporary descriptive biology, the scheme suggesting some unconventional solutions, e.g. distinguishing three paradigms in the history of biology, distinction between normal science and crises, variability in thinking styles in biology etc. (Kuhn 1968, Urbanek 1973, 1991) (tab.1).

The peculiarities of the scheme listed above, referred to biologist's activity in the systematics, pertain also to the history of science. Systematics and phylogenetics are presented within one science. Feedbacks between the present and past (formalization of the "congruence principle") are clearly visible in the history of systematics:

even metaphysical view on the unchangeability of nature does not emerge as completely separate; it enters the present science - in the process of classification objects are considered statically. The equivalence of the area of study in the history of science appears clear enough - each new stage and each scientific revolution begins in the description area. The systemic approach to the problems of systematics presents itself as one of the fundamental peculiarities of science of the second half of our century.

Between the scientist's activity and the history of science there is shown a parallelism (figs 1, 2, tab. 1).

II. Systematist's work in the area of description

The diagram - fig. 2 - presents selection of strategy of the systematist's studies. The systematist can choose his work within the area of description; based on original descriptions he can construct a classification; propose new principles of classification etc. A definite work corresponds to stage **IV** ***A* - *B* - *C***: firmly establishing systemic studies in the areas of description, classification and phylogeny reconstruction; working out proper methods, most of all methods of mathematical modelling and their implementation exemplified by a real taxon - leeches of the family *Piscicolidae*, which are the subject of our studies. We ascribe to this a high significance since in the literature there are many theoretical papers whose results are not applied when constructing classifications and reconstructing phylogeny of actual taxa.

II.1. Traditional methods of describing taxa

In the class of leeches (*Hirudinea*) descriptions of most groups are insufficient. Morphometry is limited to the information on the length and breadth. Anatomical characters are not examined, and when they are known, their systematic significance is not understood. We will thus present a standard description based on characteristics of species contained in the papers of other authors and our original studies. The description contains morphometrical data, external morphological data (annulation, eyes, segmental eyes, eye spots, papillae, respiratory vesicles), characters of alimentary tract and reproductive system, and also information on the host and localization. Most species of fish leeches *(Piscicolidae)* of the Palaearctic (10) are described based on this standard (EPSHTEIN 1984, 1985, 1987, BIELECKI, 1992). At present in our studies all the species at our disposal are examined considering the standard. Recently we have added the mathematical model of the body form to the description, and results of histological examination of lacunar system.

II.2. Systemic methods of species description

Systemic studies are always based on the results of traditional studies. With accumulation of data a necessity appears to connect the data and find relationships between them. The process is diagrammatically presented in tab. 2.

Table 2. Scheme of the process of elaboration and application of systemic models, organization of biological species.

traditional examination —> of actual objects	objective formulation —>	model construction —> according to the model	description of actual objects -->
—> systemic analysis —> of the model	constructing space of —> logical possibilities	constructing implementation space	

Systemic mathematical modelling was first used by RAUP (1966, 1967, RAUP et al. 1973) who described in this way spirally coiled shells of fossil and extant invertebrates.

In our studies the same method is applied, the object of modelling being the body form of leeches. This object i.e. body form was selected for the following reasons.

1. It is a significant ectosomatic character;
2. In some taxa within the class of leeches it is of phylogenetic significance;
3. It decsribes the limits of space within which topographical changes of internal organs take place;
4. The body form in leeches is easily formalized.

Recently the model has been supplemented by BIELECKI (1992, 1993) and considers all characters of external leech morphology used by systematists. Thus

Table 3. Space of logical possibilites and space of implementation of leech body form:

D_2/D_1 \ D_2/N_2	$D_2/N_2 = 1$	$D_2/N_2 > 1$	$D_2/N_2 < 1$
$D_2/D_1 = 1$	"cylinder"	"tape"	prohibited
$D_2/D_1 > 1$	"retort"	"leaf"	prohibited
$D_2/D_1 < 1$	prohibited	prohibited	prohibited

modelling of external morphology of leeches at a given stage of studies can be regarded as completed. At present A. UTEVSKII and S. UTEVSKII (Kharkov University) have started to model the internal structure of leeches, first of all their skin and muscles (epithelium, external mesenchyme, circular, diagonal and dorso-ventral muscles). Literature data and earlier data from our original studies reveal a significant diversity of the above structures and associations of such a diversity with the size and body form of the leeches which result from their peculiar ecology (see below).

II.3. Construction, description and application of the model

The model proposed for describing the leech body presents the leech body on a plane, as two ellipses (suckers) and trapeziums situated between them (anterior body part - trachelosoma - two trapeziums; posterior body part - urosoma - four trapeziums). Besides, transverse sections through the trachelosoma and urosoma are considered as two ellipses (fig. 3-8). An abundant material provides evidence that the model permits a sufficiently exact decsription of the body form of various leech species.

The model is constructed according to the following parameters:

1-4/ Parameters describing form of anterior sucker: horizontal diameter - C'_1; vertical diameter - C_1; length of anterior part of sucker - R_1; length of posterior part of sucker - M_1.

5-12/ Parameters describing form of trachelosoma: breadth at the sucker junction - d_1; in the place where outline breaks - d_2; on the border with urosoma - d_3; the greatest breadth of trachelosoma - D_1; the greatest height - N_1; height of the first trapezium - S_1; of the second - S_2; trachelosoma length - $L_1 = S_1 + S_2$.

13-25/ Parameters describing form of urosoma: breadth in places where outline breaks (bases of trapeziums) - d_4, d_5, d_6; breadth at the sucker junction - d_7; the greatest urosoma width - D_2; the greatest urosoma height - N_2; heights of trapeziums - S_3, S_4, S_5, S_6; urosoma length - $L_2 = S_3+S_4+S_5+S_6$; distance from d_3 to $D_2 = K_1$; distance from D_2 to $d_7 = K_2$.

26-29/ Parameters describing form of posterior sucker: horizontal diameter - C'_2; vertical diameter C_2, length of anterior part of the sucker - M_2; length of posterior part of the sucker - R_2.

The model is described by 19 non-metric indices (invariants).

1. Index describing relative body length - L/D_2;

2-5. Indices describing anterior sucker: ratio of horizontal diameter of sucker to trachelosoma breadth at the sucker junction - C'_1/d_1; of horizontal diameter of sucker to the greatest breadth of trachelosoma - C'_1/d_1; of dorsal part of sucker to its ventral part - R_1/M_1; of horizontal diameter of sucker to its vertical diameter - C'_1/C_1;

6-8. Indices describing trachelosoma: ratio of trachelosoma length to its greatest breadth - L_1/D_1; of the greatest trachelosoma breadth to its greatest height - D_1/N_1; index describing the position of the greatest width of trachelosoma - S_1/S_2;

9-11. Indices describing urosoma: ratio of urosoma length to its greatest breadth - L_2/D_2; of the greatest urosoma breadth to its greatest height - D_2/N_2; ratio describing position of the greatest breadth of urosoma - K_1/K_2;

12-15. Indices describing posterior sucker: ratio of horizontal diameter of sucker to urosoma breadth at the sucker junction - $C^1{}_1./d_7$; of horizontal diameter of sucker to the greatest body height - $C^1{}_2/D_2$; of dorsal part of sucker to its ventral part - R_2/M_2; of horizontal diameter of sucker to its vertical diameter - $C^1{}_2/C_2$.

16-18. Indices describing relations between urosoma and trachelosoma: ratio of urosoma length to trachelosoma length - L_2/L_1; of the greatest breadth of urosoma to the greatest breadth of trachelosoma - D_2/D_1; of the greatest height of urosoma to the greatest height of trachelosoma - N_2/N_1;

19. Index describing proportions of suckers: ratio of horizontal diameter of posterior sucker to such a diameter in anterior sucker - $C^1{}_2/C^1{}_1$.

Using the model in computer with graphic display a large number of pictures of leech specimens was obtained, as a result of their measurements and also statistical analysis of data for two species of *Acanthobdelidae* and 11 species of *Piscicolidae*.

II.4. Model of leech body form as a system

The model described is considered in agreement with basic systemic concepts. The figure describing the leech body form characterizes it as a whole and constitutes a system, composed of mutually related subsystems: anterior sucker, trachelosoma, urosoma and posterior sucker. Based on the pictures obtained the following invariants (structure components) are distinguished:

1/ $D_1/N_1>1$; $D_2/N_2>1$. Trachelosoma breadth and urosoma breadth equal or exceed the height of those body sections;

2/ $D_2/D_1>1$; $N_2/N_1>1$. Urosoma breadth and height equal or exceed the greatest breadth and height of trachelosoma.

3/ $D_1/N_1=D_2/N_2$; $D_1/D_2=N_1/N_2$. Transverse sections of urosoma and trachelosoma are similar. When sections of trachelosoma and urosoma are similar, only three values can change independently - form of transverse section (D_2/N_2), relative size of transverse section of urosoma and trachelosoma (D_2/D_1) and relative body length (L/D_2) (programme components). The total of possible theoretical connections between those components illustrates the space of logical possibilities (tab. 3). They can be also presented within the picture of three-dimensional block-diagram; then each point corresponds to one of theoretical possibilities of body form. Such a block-diagram includes not only body-forms characteristic of *Piscicolidae* and *Acanthobdelidae*, but also of other leech groups and other types and classes of "worms" (*Turbellaria, Monogenea, Trematoda, Cestoda, Nemertini, Polychaeta, Oligochaeta*).

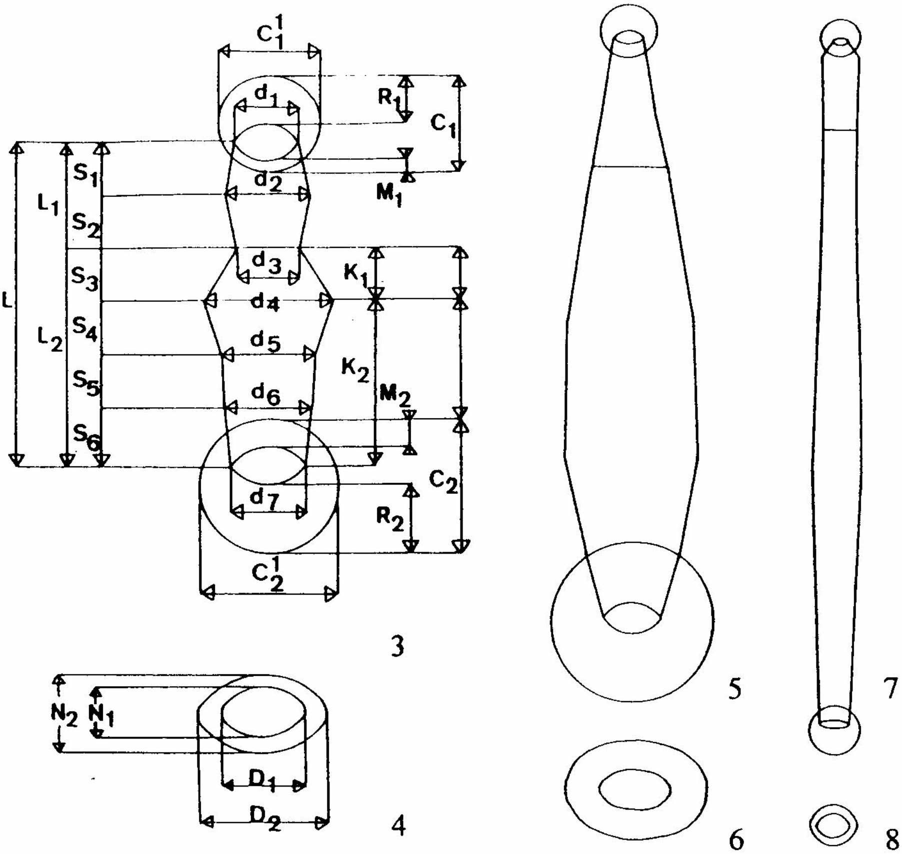
Implementation ranges proposed for various leech groups characterize their life forms distinguished according to the way of translocation of these animals and position of their body relative to the substratum. It appears that within the space of logical possibilities there are four areas (implementation areas) corresponding to (Epshtein 1992, Bielecki 1993):

1. very long, worm-shaped leeches (long cylindrical body, "cylinder"), crawling like oligochaets;

2. leeches with a comparatively long, flattened, tape-like body, able to swim ("tape");

3. leeches with cylindrical body of medium size - parasitic leeches not attached to the host with the entire body surface;

4. leeches attaching to the substratum or host with the entire body surface - leaf-shaped body ("leaf").



3-8. Model of body form in leeches (3,4) and examples of two species (5-8)

Within the space of logical possibilities implementation areas can be also distinguished corresponding to many taxa. For example *Acanthobdelidae* use only the third area, flat leeches - *Glossiphoniidae* - the fourth, *Arhynchobdellea* - the first and the second. The implementation area for the fish leeches (*Piscicolidae*) of the Palaearctic is drop-shaped, the upper part being situated in the first, and the lower in the fourth area. No leech has a retort-shaped body ("retort"); this is characteristic of some parasitic phytonematods. Though in some leech species with flattened body and partly or completely accreted intestinal caecum, allowing them to take up large amounts of blood, the body assumes a nearly retort-like form when the alimentary canal is filled. As the leech uses the blood from the caecum, the body returns to the previous form.

CONCLUSIONS

Methodological and historical-scientifc studies demonstrate that the systemic approach to the problems of systematics and phylogenetics is a necessary stage in the development of traditional approach in those sciences.

The systemic approach to congnition of living organisms (description area) implies presenting their organization within the quality of the system and distinguishes systemic concepts (subsystems, structure, programme, space of logical possibilities, implementation space, objective aspect).

Implementation of the systemic approach as a supplement to traditional approach makes it possible to:

- distinguish in the infinity of systematic characters those that are necessary and sufficient for species description at a given stage of science development;
- use a complex of characters as a standard of description, using which specialists can present comparable descriptions which is necessary for implementation of systemic approach in areas of classification and phylogeny reconstruction;
- present the whole object using a number of characters;
- prognose theoretically acceptable forms by constructing space of logical possibilities (systemically credible way of systematist's thinking within the description area);
- perfect analysis of adaptation processes by comparing space of logical possibilities with implementation space (objective aspect of systematist's studies).

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