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WHAT THE PHILOSOPHY OF BIOLOGY IS AND SHOULD BE? *

1. IS THE PHILOSOPHY OF BIOLOGY NECESSARY?

Owing to advances in research works in the last decades biology has changed considerably, taking the foremost place among natural sciences. Great achievements in modern biology, made possible owing to the appearence of new experimental methods and techniques, gave to certain theoreticians a basis for speaking of a second biological revolution, after that started by Darwin, the molecular revolution, and of a beginning of the era of biology. Comparing these two revolutions, marked first by the publication of the evolutionary theory and then by the discovery of the genetic code, M. Ruse (1971, pp. 17—38) stressed that despite differences in orientation and, in part, in methodology, both revolutions influenced in a high degree the change in the mode of approach to the problems of life and the role of biology with respect to other natural sciences and to man. Penetrating ever more deeply and universally into the secrets of life and revealing the ultrastructure and subtle mechanism of vital processes biology is becoming a dominant science, and at the same time, it has assumed a more human or humanized aspects. Through many-sided studies, epsecially in molecular biology, genetics, ecology — biology has opened up new possibilities, among them the possibility of positive intervention

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in the functions of organisms, treatment of various diseases, finding of new sources of food, counteracting of environment degradation connected with technical expansion or wasteful exploitation of natural sources. In short: it ensures the survival of the human species (and not only this one), and provides an understanding of the proper conditions of human life. This shows evidently that biology has marked in a significant way its influence on our life, on our attitudes and our views on the world.

We may consider that biology, like every scientific discipline, has its deep philosophical determinants and implications, and that philosophy is in some way entwined within the biological sciences. The meaning of this statement requires an explanation.

We know now that the development of natural sciences depends not only on the collection and description of empirical data, but also, or even in the first place, on their theoretical processing and meta-objective analyses of methodological, epistemological and philosophical character. This is particularly evident, when the development of physics and related disciplines is considered. These sciences have achieved a high degree of precision, and theoretical perfection owing to such analyses, and have become an example (a pattern) for other disciplines (M. Ruse 1976; E. Hutten 1960; J. H. Woodger 1960; B. Kotowa 1986; E. Pietruska-Madej 1980; W. Krajewski 1982, pp. 305—309). In comparison to physics the biological sciences, despite their present accelerated development, seem to be still in statu nascendi. The unquestionable successes of biology in recent years have not been accompanied to a satisfactory degree by methodologico-philosophical reflection. The biologists themselves are not satisfied with "pure" facts concerning the structural and functional properties of organisms or their evolution, knowing that the scientific value of these facts is determined by such research procedures as the establishing of laws and theories and their justification by explanation and testing. The interpretation of biological data is associated often with questions of a philosophical character, although not always formulated as strictly philosophical. Rosenberg (1985, p. 11) wrote justly that:

> the justification for pursuing the philosophy of biology rest on the fact that biologists cannot avoid the great questions that transcend their day-to-day concern. For if there are correct answers to the questions faced every day

> in the lab and the field, and if the theories biologists propound are definitely true or false as a matter of the objective facts about the way the world works, then there must also be correct answers to the great questions of metaphysics and epistemology as well. If there is objective knowledge in biology, there is objective knowledge in its philosophy as well, for the two subjects are indistinguishable and inseparable.

Similarly, many philosophers — as stressed further by Rosenberg (1985, p. 13) — for many years have turned to biology mainly for assessing whether and in what degree their philosophy of science (formulated on the basis of the research model and reconstruction of physics, that is philosophy of physics with its logic and methodology, its epistemological principles and metaphysical implications) is proving correct in a field as different from physics as is biology at the present stage of its development.

The justification of the need for a philosophy of biology formulated by W. H. Kane (1960, p. 53) is somewhat different; he pointed out that:

> The need for a thorough consideration of the logic of biology is especially great, not only because our biological knowledge is rapidly increasing, but also because it concerns so many of us so intimately as human beings and as students of biology. Moreover, an advancing biology must be brought into relation with other advancing sciences.

On the one hand, various philosophical questions are directed to biology, on the other hand, such questions arise spontaneously with new advances in biology and during research work. Although for the study of biology and other natural sciences it is not absolutely necessary to refer to principles of philosophical thinking, at the present developmental stage the sciences have already evolved their own methods of discovery and justification of knowledge. But for inquisitive persons such tackling of philosophical problems seems unavoidable. Their analysis belongs to the field of philosophy of biology, called, sometimes, biophilosophy. The importance and the necessity of biophilosophical analyses are the result, accorging to Sattler (1986, p. 3), of the fact that:

> It places research into broader perspectives and it provides guidelines for specific research projects. Hence, it is not only important for the generalist and philosopher, but it has also crucial significance for the scientist in the labo-

ratory or the field. Thus, biophilosophy is not necessarily armchair philosophoy of an esoteric nature, as many biologists tend to think, but is of fundamental practical importance because it is at the roots of all research.

Let us now consider certain philosophical problems related to biological researches and try to determine the mode of understanding of the philosophy of biology taking as example certain selected authors and problems.

2. SURVEY OF SOME CONCEPTS OF THE PHILOSOPHY OF BIOLOGY

The extension and the assortment of the problems which constitute the philosophy of biology are very broad and varied, depending on how a given author understands the science itself and what is his concept of philosophy.

There is an almost general agreement on one point, that is that the philosophy of biology ought to analyse the structure of biology and the procedures of explanation, verification and prediction used in it. One of the authors exceptional in this respect was, in his times, L. von Bertalanffy (1932, v. I, p. 6) who maintained that not the philosophy of biology but theoretical biology "is a theory of knowledge and methodology of the science of life". We shall see that this view is unacceptable presently.

Apart from methodological analyses the philosophy of biology involves various types of philosophical problems in a strict or broad sense, for example, mechanism, vitalism, reductionism, organismalism, determinism, causality, finality, wholeness, evolutionism etc. Sometimes, they are covered by one term: philosophical problems (aspects) of biology [1]. From the standpoint of epistemology these problems are highly diversified and belong thus to different sciences.

Take for example the concept of mechanism. Its historical understanding was either ontological or methodological (A. Synowiecki 1969, p. 16, pp. 66—67). On the former understanding mechanism was either a theory of structure of material objects, stating that bodies (wholes) constitute sums

[1] Such definitions are encountered in the title of many books and papers, e. g. *Philosophical aspects of biology* (Problems of the contemporary world no. 27, Moscow 1980, USSR Academy of Sciences); G. A. Jugaj: *Philosophical problems of theoretical biology* (Moscow 1976, Izd. Mysl); *Philosophical problems in biology*, ed. by V. E. Smith, New York 1966, St. John's Univ. Press; M. A. Simon, op. cit.

of unchangeable and externally interconnected parts, or a theory of events understood as a mechanical movement of parts of material systems. In the second, methodological, understandig mechanism postulated explication through reduction of descriptions and scientific laws to the concepts and laws of mechanics. Thus, mechanism may belong either to ontology or methodology.

Quite similarly, teleology is understood either as a view according to which living structures are constructed purposefully and vital processes are aimed at predetermined purposes already in their nature (E. Mayr 1976; Thorpe 1978) or as a postulate (directive) of teleological explanation of biological structures and processes (J. Canfield 1964). Again, according to A. Oparin (1967, pp. 22—23; 1977, pp. 3—5) purposefulness is a universal elementary feature of life, explained as a result of the action of natural selection and the cooperation of the organism with the environment. It seems thus that teleology may belong either to ontology, or to methodology or to theoretical biology.

Some philosophers assume that the main and perhaps the only subject of the philosophy of biology is the analysis of reductionism and the relation of biology to physics (M. Ruse 1971b, 1973; D. Hull 1972, 1974, 1976; K. K. Schaffner 1967, 1969, 1976). However, most authors seem to envisage the subject of this science too broadly, including in it not only the study of the structure of statements and theories but also considerations of e. g. relations between matter and life, mind and body, brutes and men, or problems of e. g. perception, bioethics, human values and philosophy of man (M. Grene 1974; M. A. Simon 1971; F. Wuketits 1983; R. Sattler 1986). Here we meet strictly biological notions (grasp) as well as methodological, ontological and metaphysical problems, often in connection with historical analyses. In view of considerable differences in the methods of analysis and in the levels of cognition their merging into a whole and calling it the philosophy of biology does not seem valid.

An interesting concept of the philosophy of biology was put forware some years ago by E. Callot. In his *Philosophie biologique* (Paris 1957) he set apart the methodology and the epistemology of biological sciences. However, although he discussed correctly the former, in the epitemology the discussed successively the nature of life, the manifestations of life, and the origin and evolution of life in a way characteristic of

theoretical biology. Thus, the difference between biology and its philosophy become blurred.

3. TOWARDS AN ADEQUATE UNDERSTANDING OF THE PHILOSOPHY OF BIOLOGY

Nearly 20 years ago D. Hull (1969) analysing philosophical papers on evolutionism answered the question: what the philosophy of biology is not? Certain suggestions concerning a positive answer developed later on by Hull (1974) indicated that the object of the philosophy of biology included analysis of the structure of biological laws and theories in a methodological aspect, mainly in relation to physicochemical laws and theories.

Let us consider as the starting point for our discussion the statement of Grene (1974, p. VIII) that although there is no absolute dividing line between conceptual analysis and empirical studies, but rather certain interrelationships and mutual influence, nevertheless, they constitute two different manifestations of human cognitive activities. A philosopher is unable to indicate methods for solving biological problems, a biologist cannot cope with philosophical problems since these are for him meta-problems.

The philosophy of biology belongs to the philosophy of the natural sciences which is a part of the philosophy of science called also the science of science or general epistemology. The philosophy of biology is not an object science (objective science — grade I science), its object of study is not the living world but the biological knowledge as such. It treats the biological sciences as its research object and source of cognition, and thus it is a meta-science, or metabiology [2] (as it was called by Pavese), which studies the nature and value of biological knowledge, and the character and effectiveness of the methods and tools of research used in biology. It deals thus with the logico-methodological and epistemo-

[2] R. Pavese (*Filosofia e biologia. Lineamenti di metabiologia*, Padova 1961, Cedam) this term used, however, in a too broad meaning, covering certain ontological implications resulting from biological studies, e.g. transcendentality of life. Others define philosophy of biology as "biological philosophy" or "philosophical biology", e.g. E. Callot: *Philosophie biologique*, Paris 1957, Doin; F. Dagognet: *Philosophie biologique*, Paris 1955, PUF. M. Jeuken in his article *A Note on model and explanations in biology*, Acta Biotheoretica 18 (1969) pp. 284—290, spoke of philosophical biology, but included it together with mathematical biology into theoretical biology.

logical problems connected with the laguage of biology, with the methods and bases of biological sciences, and with the analysis of the most general results of these sciences [8].

On the basis of these general considerations four divisions (parts) may be discerned in the philosophy of biology which are studied separately or in combination depending on the actual needs or interests of the theoreticians dealing with them. They are: 1. logic of biological language, 2. methodology of biology, 3. theory of biological knowledge (gnoseology), 4. epistemology of biology. The problems in each of these divisions will be briefly outlined.

3.1. LOGIC OF THE BIOLOGICAL LANGUAGE

The language used in biology comprises a system of signs in the form of observational concepts as well as theoretical concepts and sentence expressions composed of them. The analysis of the logical structure of concepts and sentences is the task of semiotics, which includes syntactics, semantics and pragmatics. Syntactics describes the structure and form of expressions and their transformation by means of rules, e. g. of detachment or substitution. Syntactics may be formal or logical, depending on whether it relates to formal language or to the meaning of expressions. In the analysis of biological language logical semantics with the rules of combination of expressions to form larger units may be useful, with further transformation of them in such a way that they would not lose their defined features.

While syntactics deals with intralinguistic relations between signs, semantics describes the relations between sings and reality, that is the relations between language concepts and expressions and the objects or states of things designated by them (J. Lyons 1977). Typically semantic are the notions of denotation, designation, definition, truth. Pragmatics is concerned with the relations between language and those who use it, that is the relations of communication, understanding, asserting.

In the philosophy of biology little attenion has been given

[8] R. Sattler (1986, p. 6) defined philosohpy of biology as "the analysis of biological statements including the reasoning through which they have become established" but he was aware that this was a provisional definition since the notions "philosophy" and "biology" are ambiguous and the notions such as law, theory, explanation may be variously understood.

as yet to syntactic analyses and to discussion of the functions of semantic expressions used in biology. The works of Woodger, Beckner, Riedl, Wuketits, Ruse, Grene, Nagel have contributed greatly to the development of a more strict and precise biological language by elimination of concepts and expressions which wer ambiguous, unclear, imprecise or incoherent. As in every science, in biology also empirical data and generalizations in the form of laws, hypotheses, and theories are expressed in a special language formed from concepts and expressions in accordance with syntactic-semantic rules. The difference of the biological language in relation to the languages of other sciences, which has its roots in the complexity and variability of the forms, structures and organizations of living organisms, is reflected in a logical specificity of concepts. According to Beckner (1959, pp. 16—25; 1972, pp. 312—314) there are specifically biological concepts showing three logical features, not possessed by non-biological concepts, which are of decisive importance for the specificity of laws and explanations in biological theories. They are: historicity, functionality and politypy, and in our opinion also — relationality. They may be defined briefly as follows:

Historicity is a property of biological concepts such that in their definitions we use those states and features of biosystems which are unique, irrepeatable and transient. History is, so to speak, incorporated into the structure, functions and behaviour patterns of biosystems, because their full and proper definition is not possible if they are isolated from a historical context.

Functionality denotes the logical property of a biological concept such that when this concept is used in relation to some process or structure it indicates its function in a biosystem and the role of this function in the maintenance of biosystem functioning.

Polytypy as a logical property of biological concepts is defined as follows: a given class of individuals is politypical in relation to a certain set of features if each individual in this class has many features from this set and each feature of the set is found in many individuals of this class. A peculiar instance of a fully polytipical class in relation to a given set occurs, if in a given set of features no feature is present whih would not belong to all individuals in this class (Beckner 1959, pp. 22—25).

Relationality is a logical property of a biological concept

which means that it is impossible to be independent in defining and describing the parts, structures and processes of lower type of those of higher type or of the whole organism. A well defined concept is relational in the sense that it relates a given component or part to a whole, and a lower whole to a higher one.

In describing a structure or a vital process being a component of a structure or process of higher order (level) a biologist uses so to speak "extrinsic" concepts, that is those related to a higher level, thus he forms concepts which are relational and, at the same time, polytypical and historical (and often also functional) in comparison to all "intrinsic" properties of the described object or process.

Contrary to the supposed suggestion of Sattler (1986, pp. 82—84) these are not kinds of biological concepts but their logical properties, and the more completely they characterize them the more evidently they manifest themselves and are used in conjuctions. A single feature may be given to non--biological concepts. Conceptualization as a process of formation of concepts and giving them possibly most precise meaning is an important factor in the development of the biological sciences and in their theoretical maturation. This goal is to be achieved by means of the discussed division of the philosophy of biology.

3.2. METHODOLOGY OF BIOLOGY

This may be understood and pursued as one of the methodologies of exact sciences (methodics), and then it is a part of biology as a mother science, or as a division of general methodology which is the science of the efficient achievement of cognitive aims. In the latter sense, accepted here, it is closely connected with logic and includes various activities of discovery (conquering) and justification of biological knowledge. In its basis characteristics the preparatory activities, that is collecting of empirical data through observation, experimet, and then foundation and verification (various types of inference drawing), are common to all empirical sciences. However, in view of the specificity of objects, functions and biotic structure various procedures and logical operations are used in biology which are different from the methods used in other sciences.

In the context of discovery, for example, the method of comparison of organisms and species, with each other, is used,

besides observations and experiment, as a source of empirical data and descriptive statements. Consequently, this method leads to the establishment of similarities and differences between objects, individuals and structures. E. Caspari (1964, p. 134) called the comparative method an "order-analytical method" in contrast to the "causal-analytical method" seeking through experiment to discover the causal relationships between processes. The comparative method is used also in physicochemical sciences, but in biology it is an integral part.

In the context of justification the specificity of the procedures of testing and explanation in biology becomes more evident. In the biological sciences non-biological explanation is used, in which the explanandum is a biological fact, and the explanans is composed of facts e. g. physicochemical facts, such as in reductionistic explanation (E. Pakszys 1980, pp. 107—108), as well as strictly biological explanation, e. g. genetic, teleological. Despite divergent opinions on the character of biological laws and their role in biological explanation, most authors agree that such laws are formulated in biology, but in view of the specificity of biotic processes their character is statistical. Similarly, a strict definitions of the detailed conditions is not always possible and thus biological explanation may correspond to the probalistic version of Hempel's model (Hempel 1966). Apart from this model certain hypothetical explications explaining a given fact by a hypothesis requiring confirmation are available. Despite a weak explanatory power of such explanations they contribute to the development of biology.

The division of the mentioned kinds of explanation in biology was based on a logical relation between the explanans and the explanandum. Assuming as a basis for this division a temporal relationship it is possible to discern structural, causal and teleological explanations. The characteristics of these types of explanation is not the aim of our discussion. We stress only that structural-systemic explanation is based on isochronous and coexistentional relations and aims at cognition of the organization of biosystems on the basis of structural laws. In causal explanation the contents of the sentences of the explanans is related to phenomena earlier in relation to the phenomena in the explanandum. This type of explanation in biology assumes, most frequently, the form of genetic and historical explanation. The former explanation answers the question about the material from which an

object has been formed or what been its preceding state forming a chronological genetic chain with causal relations (J. Topolski 1973, pp. 512—515). Historical explanation describes the whole set of factors leading to the arising of an object in its present form. It answers the question, how a given object has evolved, ascribing definite meanings and explanatory arguments to various temporal points and stages (T. A. Goudge 1967, pp. 73—75). Both procedures are very similar and, in view of this, some authors accept that genetic explanation is a subclass of historical explanation, others accept the presence of only one combined historical-genetic explanation (E. Mickiewicz-Olczyk 1976). This kind of explanation is connected with the already mentioned problem of the presence and character of historical laws among the sentences of the explanans. Such laws are regarded usually as generalizations relating certain occurrences or features to a definite developmental sequence of events. Some authors, in agreement with K. Popper, e. g. P. Thomson (1983) deny the existence of historical laws in biology, others, e. g. R. Bernier (1983) point out that a biologist formulates laws, although frequently only implicitly, by grasping in sentences general correlations and causal and non-causal relationships, but these laws have a statistical charakter. Because of that, historical--genetic explanations are probabilistic explanations.

However, although historical-genetic explanation belongs to the causal type, teleological explanations form a specific group. This is a procedure in which the present state of a biosystem is explicated through inquiring the future state that is the goal to which an organism is tending. The biosystems considered are those demonstrating goal-directed activities specifically determined by the future goal (M. Beckner 1959, pp. 148—150; R. Braithwaite 1960, pp. 327—328).

Some authors discern exactly teleological from functional exlanations (M. Ruse 1973). The latter appeals also to future states but regards them not as goals but as effect of biostructure functioning. It may constitute a subtype of teleological explanation in view of the similarity of the accepted procedure, especially the mode of obtaining explanatory premises (explanans) by means of prediction.

Depending on the accepted research strategy explanations used in biology may assume either a reductionistic character or compositional character. This problem will not be discussed here since there is an extensive literature in this subject.

I would like to stress only that the whole of the logico-methodological procedures shows many features not observed in other natural sciences. This statement should not be regarded as an argument for the autonomy of biology.

3.3. THE THEORY OF BIOLOGICAL KNOWLEDGE

In the classical meaning the theory of knowledge (gnoseology) is a philosophical reflection on the process of cognition, its genesis, range, value etc. The problems are discussed in the evaluation of the role of the senses and reason in the cognition process (apriorism, aposteriorism, empirism, rationalism, irrationalism). With regard to the character of the relations between the subject and object of cognition it is pointed out that the subject recognizes either real objects independent of the subject and process of cognition (epistemological realism), or only subjective impressions and intellectual constructions (epistemological idealism). Another group comprises problems concerned with the validity of knowledge, that is disputes on the definition of truth (classical, coherential, pragmatic), properties of truth (absolutism, relativism) and cognizability of the world (agnosticism, scepticism, dogmatism). These and other problems, as pointed out by A. J. Ayer (1961, chapter 1), have been undergoing a significant historical evaluation and were expressed variously depending on the accepted philosophical attitude.

The theory of biological knowledge as a part of metabiological sciences is still, unfortunately, very poorly developed, although certain above mentioned problems seem to be of great importance in biology. Among them are the disputes between materialism and idealism in biology [4], between necessity, purposefulness and chance [5].

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[4] Such disputes are conducted mainly between the proponents of the dialectic philosophy and thomism, eg. I. T. Frolov: *The struggle between materialism and idealism, Dialectic interpretation of the theoretical basis of biology*, in: *Filozofia i współczesna biologia* (*Philosophy and modern biology*), ed. I. T. Frolov, transl. from russ., Warzsawa 1976, pp. 24—63; G. Schramm: *Idee und Materie in der modernen Biologie*, Bremen 1963; J. Haas: *Biologie und Gottesglaube. Der Gottesgedanke in der wissenschaftlichen Biologie von heute*, Berlin 1961; R. Löther: *Biologie und Weltanschauung*, Berlin 1972.

[5] After the publication of J. Monod's book *Le Hasard et la Nécessité*, Paris 1970, a long discussion has developed, which began with the book of M. Barthélemy-Madaule *L'idéologie du hasard et de la nécessité*, Paris 1972 in which she pointed out a number of philosophical assump-

Detailed gnoselogical problems appear in biology for several reasons. One of them is the fact that this knowledge is different from that in other sciences, since, as stressed by J. Piaget (1967, pp. 893—900), man as a cogitating subject is an organism, belongs to biology, recognizes himself also, and this cognition may be regarded as a peculiar relation between the organism and its environment. This implies a relation between the cognitive mechanisms and the vital mechanisms. By defining concepts and generalizing results of life studying a biologist influences in some way, as a living and thinking individual, the interpretation of vital phenomena even when he strenuously avoids all forms of psychologism or anthropomorphism. The cognitive processes, regarded as the highest form of regulatory functions, are related by Piaget to biological-type regulations. The cognitive process as a specific accomodation and assimilation is an incorporation of empirical data into the structures already possessed by the mind (J. Piaget 1967, pp. 906—915; 1967b; 1971; 1977). It seems that, without sharing the views of Piaget, his suggestion may be used for the extending of reflexions on the specificity of biological knowledge.

In the cognition process is a passage from a lower to a higher grade of credibility and gnoseology is a theory of credible knowledge, then, apart from the logico-methodological procedures, the problems include the relations between subject and object and determination of what cognition is reaching to a reality (J. Piaget 1977, p. 21). In the context of varius investigatory activities and their connections with respect to cognitive aims the importance emerges of the relation of the theory to experience and to reality itself. Besides elmentary (observational) terms biological theories comprise many concepts and theoretical statements whose relation to reality is frequently questionable. In the semantic aspect, such theoretical concepts have their designations as ontological equivalents called theoretical object, e. g. "gene"., However, it is not obvious whether a biological theory contains a statement of the existence of an unobservable object such as the gene. The answers vary on account of the multiplicity of views on the nature of a scientific theory (hypothetism, inductionism, instumentalism), and the variety of theories

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tions in the views of Monod, among them cartesianism, existentialism, and the resulting ideological and general consequences.

of meaning, sense and object-reference (M. Bunge 1976, pp. 13—23; 1973). This leads directly to the concepts of truth and to the theory of truth, in general, and this theory is the subject of incessant discussions. Acceptance of a given theory of truth and its recognition as not only a feature of statements but also as an extralogical value, either autotelic or instrumental, depends, on the other hand, on the consensus of ontological and epistemological views. In the case of biology and other natural sciences the concepts of truth or falsity are related to a definite application of a theory, that is to a definite empirical system. Of decisive significance for the truth or falsity of a theory or hypothesis are: 1. the actual state in this system to which a given sentence is related, and 2. the language convention in which a given theory has been formulated. In a less abstract way this manifests itself as the establishing of an agreement or disagreement of the theory with experiment. And in practice, it is difficult to establish this agreement (R. Wójcicki 1977, pp. 94—108).

The theory of biological knowledge, as shown above, should include analyses and discussions of concepts, principles and categories occuring in biological cognition, aspecially the values and truth of this cognition. Despite its importance these problems are not perceived, as yet no systematic studies and attempts to create of an adequate biological theory of knowledge have been undertaken.

3.4. EPISTEMOLOGY OF BIOLOGY

The generally accepted definition of epistomology, called also sometimes the theory of knowledge or gnoseology, is understood here to reduce to the problem of the basic assumptions present in the biological sciences and the most general results of these sciences in the aspects of their validity and scientific usefulness.

Indicating a need for the philosophy of biology R. Sattler (1986, p. 5) stated:

> All biological statements and questions have theoretical and philosophical foundations. We can grasp the full significance of biological statements and questions only to the extent that we are aware of their foundations. Hence, biophilosophy concerned with foundations is of paramount importance to biology.

The presence of such assumptions results from the fact that a scientific theory is an exceptionally complex structure, com-

posed not only of facts, laws and hypotheses, but also of sets of sentences called the intrinsic or extrinsic basis, and a definite class of logical consequences. All statements of a theory should be empirically verifiable sentences which are variably understood. This is in the case of the theory on the verifiable intrinsic basis, but usually these theories are expressed as axioms. Most or perhaps all, empirical theories are formulated by means of unverifiable sentences, although they are verifiable themselves. Attempts to remove unverifibale assumptions from science, undertaken e. g. by R. Carnap (*Testability and meaning* 1937), gave no results.

The presence of non-verifiable foundations in science, including also biology, causes no doubts now. No scientific knowledge is free of them, they are unavoidable, although they are usually accepted implicitly. According to H. Mehlberg (1966, p. 360) "empirically unverifiable sentences play in science only an auxiliary role (although indispensable) of elements of extrinsic bases for the verifiable scientific theories and, as such, they do not derange the adequately understood postulate of verifiability". These assumptions are not studied by physicists or biologists, they are not becoming philosophers since their tasks, resulting from the accepted methods, include empirical testing of the truth and genuiness of their consequences (ibid., p. 360).

The mentioned basic assumptions may be of various type: ontological and metaphysical, concerning the existence of objects and phenomena, and relations between objects; axiological — in the sense of estimation of a choice of a field of studies and questions; epistemological — connected with the question concerning the cognizability of world, the unity and limits of knowledge.

The starting foundations discussed, among others, by S. Nowak (1984, pp. 26—28), and serving also as a source for formulation of new research problems and for ex post analysis of the basis of an already developed science, is that they cannot be an argument for the truth of the theory based on them, while the successes of research in this science may confirm indirectly the validity of starting assumptions.

In biology assumptions of this type were analysed, among others, by M. Beckner (1964, pp. 15—29). He stresses that they are rather certain beliefs of the researcher assumed unconsciously or formulated very generally, and influencing the form of results or interpretation of the procedure. They are

called metaphysical presuppositions and are thought to be an indispensable working background of modern biology.

Apart from indicating the philosophical presuppositions present in the basis of the biological sciences, the epistemology of biology is concerned with the most general results of these sciences, that is the most far reaching generalizations and extrapolations, which are connected with the actual data covered by the theory but this connection is rather loose, and as unverifiable these results exceed the framework of the biological sciences. By extrapolation we mean generalizations and biological theories of such a type that neither they alone nor the conclusions drawn from them are verifiable in direct or indirect experiments. It is not necessary to suggest test implications and extrapolations since this is the work of the biologists, but their scientific usefulness should be evatuated, and the question should be answered, whether and in what degree they are authorized, and whether they contribute to the initiation of new directions and fields of studies. The presence of extrapolative elements are found in many biological theories, and particularly in ones in which the process of reconstruction plays an important role, e.g. in the study of the genesis and evolution of life.

If from a set of statements and hypotheses of biological theories, besides test implications, also extrapolations result as too far-reaching conclusions which cannot be verified directly or indirectly, or be falsified eventually, it should be established, whether such hypotheses are unverifiable for the moment, e.g. in view of imperfections of this method or too small range of studies, or may be unverifiable in principle. In the latter statements sentences may have been included which contain insufficiently precise concept which have no unequivocal designations, and thus the sentence resulting from the hypothesis is unsolvable, that is facts of which it speaks are non-existent. Hypotheses or statements which are essentially unverifiable should be eliminated from biology as evidence of pseudoproblems.

4. DISCUSSION AND FINAL CONCLUSIONS

It seems that when a science is in the stage of formation and has not yet been sufficiently developed theoretically, the tasks to be undertaken first should be: 1. indication of a set of problems which is to be studied by it, 2. detailed studies should be undertaken or, if that had been done already,

their results should be collected, and then 3. a comprehensive theory of this science is to be formulated. It seems that this is the case with the philosophy of biology which has not yet completed the second of the above stages, and at any rate, has not yet been expressed as a more or less unified system with it shares in large measure its fate and character. philosophy of biology accepted by myself may be regarded as summation of the first and, in part, the second stages, seem to cover the whole of this problem which has a meta-biological character. Its main body are the problems of a logico-methodological analysis of the science of life. This usually raises no doubts.

On the other hand, the gnoseological-epistemological problems are variously and in various degree considered, and this leads to fervent discussions. The cause of dissent may come from two interconnected sources:

1. the specificity of living systems, the variety of vital structures and functions, their goal-orientation and wholeness;

2. the multiplicity of biological disciplines, their diversity — from molecular biology to evolutionary biology — and, consequently, the necessity of using various research strategies.

Since biology is so diversified due to the complexity of the living world, and the methods of studies as well as the degree of theoretical progression, the philosophy of biology connected with it shares in large measure its fate and character. Because of that there is as yet no coherent and global concept of the philosophy of biology. This justifies, e. g. Hull's or Ruse's selection of only one field of interest, e. g. molecular biology or evolutionism as a subject of their metaobjective analyses.

Considering the metascientific character of the philosophy of biology it could be said that the problems of gnoseology and epistemology do not belong to biology as such in view of empirical research methods used in it. They are included into the philosophy of biology, but also with certain restrictions. For example, let us consider the initial assumptions. The task of the philosophy of biology here would be detection of the (in extrinsic base) presuppotions on which the theory in biology is based, and determination of their philosophical character. When they could not be eliminated from the theory without decreasing singificantly its value, then they are relegated respectively into ontology, metaphysics or axiology of science depending on their type. A philosopher of biology

as a meta-scientist is not necessarily an ontologist or metaphysicist, nad probably could not be. It is sufficient that he demonstrated the necessity of accepting a given assumption, even a unverifiable one, and its role in the theory of biology, which is as a rule verifiable.

The problem of the peculiar character of the philosophy of biology and its delimitation against other sciences, although interesting in itself, assume further importance as far as the relation of natural sciences to philosophy is concerned. The analysis of this relation would be without the scope of this discussion, but deserves attention because of the place of the philosophy of biology among other sciences.

The philosophy of biology as a part of the philosophy of natural sciences, shows already natural connections with the biological sciences as the subject of its studies. The state of biological studies determines, in some way, the range of logical-methodological-epistemological analyses. The merging of the philosophy of biology with biology and the dependence of the level of the former on the progression and development of the latter is not necessarily evidence of their identity (Sz. W. Ślaga 1969, p. 1473). Biology is an empirical science studying processes and objects in nature by means of observation, formulation of laws, hypotheses and theories. This level of objective study is frequently confounded with the metaobjective level. All problems exceeding the range of biology are uncritically qualified as belonging to some philosophy of biology, often not defined sufficiently. I have been trying to demonstrate that the philosophy o biology is not an empirical science, but a discipline analysing biology in its logical-methodological and gnoseological-epistemological aspects.

The philosophy of biology as a metascience is also neither ontology nor metaphysics nor so called philosophy of nature, since these disciplines have an objective character studying the really existing world ("the real reality" according to N. Witehead) in the aspects of its nature and existence. The ontological problems concerning the nature and real existence of living organisms may be analysed philosophically within the framework of the philosophy of animate nature (as is the case e. g. in the traditional Thomism) or in another type of ontology [6].

[6] The ontological aspect of the exploration of biocosmos is well ex-

Despite a sympathy for the tradition of thomism. I admit that the term "philosophy of animate nature" is rather awkward and inconvenient in use. I would like to propose here a more operative term, that is "biophilosophy". In analogy to biology as an empirical science of life, this would be a philosophy of life — biophilosophy, different from the philosophy of biology as a metascience. Biophilosophy would include such e. g. ontological problems as determinism, causality, teleology, nature of life etc [7]. The method of practice of biophilosophy would depend, naturally, on the accepted type of ontology.

These considerations suggest the answer to the question posed in the title. The philosophy of biology is not and cannot be either theoretical biology or biophilosophy as an ontology of life, but is a metascience covering the logical-methodological-epistemological analyses of biological sciences. In view of this, tertium datur: the philosophy of biology is the philosophy of biology.

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pressed by the term introduced by J. Ferrater Mora (1965, pp. 74—95): "the ontology of organic reality", similarly as the terms: "philosophy of organism", see D. Emmet: *Whitehead's philosophy of organism*, London 1966; J. Maritain: *Philosophie de l'organisme. Note sur la fonction de nutrition*, Revue Thomiste 43(1937), pp. 267—275; F. Grégoire, *Note sur la philosophie de l'organisme*, Revue Phil. Louv. 46 (1948) no 11, pp. 273—334.

[7] It is worth to mention the fact, that the work of R. Sattler: *Biophilosophy* (1986) is a philosophy of biology in the first part pp. 125—256, while its second part is an outline of biophilosophy analysing these problems from the aspect of ontology. This was the case of the work of R. Bernier and P. Pirlot: *Organe et fonction. Essai de biophilosophie* (*Coll. "Recherches interdisciplinaires"*), Paris 1977, Maloine. The above mentioned Jeuken (1968, p. 284) sets apart philosophical biology and biophilosophy including the latter rightly into philosophy.

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