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PARADOXES IN BIOLOGICAL STRUCTURES

I. MARÓTI and MÁRIA HORVÁTH

Department of Botany; Laboratory Genetical of the Animal Physiology Department, Attila József University, Szeged

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Great men, answering the intricate questions of our age, showing the way of social development and leading the struggle for a higher development are fulfilling a prominent historical role. This is a known thesis of Marxism, very apt to quote when we are commemorating the centenary of LENIN's birth.

Prominent personalities who have rendered with their activity a considerable service for mankind have inscribed their names in the book of history for centuries and millennia, perhaps ever. LENIN belongs to these latter.

There have lived few people on Earth whose memory was as much enthroned in the hearts of peoples as his. The veneration of peoples for his personality and life-work is growing more and more like a revolutionary force transforming the world.

The French writer, Barbusse, has written about him, in the same way as MAYAKOVSKY, that LENIN is the YESTERDAY, the TODAY, and the TOMORROW.

The new epoch in the development of Marxism that began at the turn of the 20th century is connected with LENIN's name.

He substantiated and developed the dialectical and historical materialism, — making us acquainted with the dialectical materialism in the light of scientific results.

He gave a positive form to the fundamental problems, to those of matter and motion; space and time; causality, liberty, necessity and development, and the theory of reflection, being all of dialectical character.

There are particulalry important the theorems concerning the elaboration of dialectics in the light of logic and modern epistemology.

In accordance with our subject-matter, we are setting forth the law of unity and struggle of antinomies.

LENIN called the theory of antinomy the „nucleus" of Marxian dialectics, giving a clue for understanding every moment and side of development.

There is based upon the law of unity and struggle of antinomies also the reciprocity of content and form, essence and appearance, chance and necessity, etc. This is why this law is so important in dialectics.

The relation with that law is the criterion that decides whether a theory is scientific and vigorous or not, and it is not a mere chance that the anti-Marxist literature is impugning mainly this teaching.

The Marxian dialectics is starting from the principle that it is a property of every thing and phenomenon to have an inner antinomy for all things and phenomena in the nature have negative and positive sides, past and future, declining and developing components, the struggle of these contrasts forming the inner content of the process of development, that of quantitative changes as they are transformed into qualitative ones.

Both members of the contrast pair, the internal and external ones, continuity and intermittence, are preconditions of each other, are existing only in a unity with the other.

If there were no internal contradictions in things and phenomena, if there were no struggle between opposite sides and tendencies, so the things and phenomena would remain unchanged, any development would be impossibles, any qualitative change and everything would remain in a state of stagnation.

If the progressive classes of society did not carry on a struggle against the obsolescent classes then their conflicts would not be solved, the society could not make progress. Marxism is therefore averse to the ideas of a harmony between antagonistic classes.

Class struggle is an objective rule of a society broken up into hostile classes. Therefore has LENIN said, characterizing the essence of development, that development is the struggle of opposites.

This definition gives the driving force of development.

The antinomies are — the complicated processes of contradictions in their state of rising, developing and being solved.

In the course of development, the difference turns into opposite, i. e., into a more developed contradiction in which the two sides of contradiction are already separated from each other.

The phase of solving the antinomies plays an extremely important role in development. The old one decays and the new one gains ground. In the complicated processes, an antinomy cannot be solved immediately after making its appearance.

Inheritance, i. e. the antinomy of accomodation cannot be solved suddenly. The contradictions must grow to a certain degree for inducing the preconditions of solutions.

Any unity of contradictions is but transitory, comparative. The struggle of contradictions is, however, not temporary but a factor having a standing influence, otherwise evolution would cease to be existing.

LENIN's teaching applied at analysing the dialectical development, as a dialectical thesis concerning the unity and struggle of antinomies, may be used also for understanding more generally the theoretical and philosophical questions of the biological structures, for establishing the general theses.

We are dealing now in this way with the peculiar character of unity and struggle of the contradictions contained in the biological structures.

The notion of the structure of living beings is containing several and, at the same time, special contradictions. In biology, structure has the same sense as a relation arranged exceptionally (in space and time) of the elements composing the phenomenon. This new notion of structure is, therefore, not the same as that of mechanism: it is not a kind of some unchanged passive skeletons being but some framework of changes that take place in the living beings.

The structure has functional and morphological sides; it means the endless struggle and relative equilibrium of these.

We are emphasizing here some particular characteristics of the contrast and unity of structure and function.

First of all the biological attraction and repulsion.

For producing a relation, connection, bond between the elements, we need in any case the contrast and unity of attraction and repulsion. The nature of chemical bond is based first of all on the attraction and repulsion of the electrons with contrary spin: co-valent, ionic, metallic, hydrogen bonds. In the living beings, of course, also the contrast of chemical attraction and repulsion is always present, manifested in the living structures, anyway, in a new quality, as an attraction and repulsion of so far mostly unknown nature.

In the biological structures, also the attraction and repulsion recognized till now manifest themselves in several new shapes. The high degree space-specificity of macro- and supra-molecules (proteins), (nucleic acids), the enzymosis are the basis heredity. In the mitochondria, e. g. the very high speed of respiratory reaction, the immediate transformation of energy (without ATP) are ensured by being arranged spatially and temporally. In the vectorial character of the enzyme effect, too, the particular nature of attraction and repulsion is manifested: the active sites, the anisotropic surfaces having selective chemical affinity are examples of the contrast of co-existence and separation.

All these peculiarities cease to exist or highly decrease if the enzymes (proteins) get in solution. This is an explanation for the new effort of more and more investigators to study the molecular forces on models of solid phase.

The comparatively weak bond between the elements of biological structures — that may be connected with the greater distance of the single elements from each other — manifests itself in an increased sensitivity to light, heat, and pH. It is to be emphasized that the word macro- or supra-molecule — in contradistinction to its etymological meaning — is not only meaning a giant molecule but a category of matter differing qualitatively from molecules.

In biological structures, the development of contrasts: — difference — the well-developed phase of attraction and repulsion — solution of the antinomy, its attainment of relative balance — is regulated; it results but rarely in an antagonistic contrast — the reciprocal change of the place of opposite sides is a frequent solution.

The development of contrasts is carried out by a highly organized regulation of especially separated components of structures in various levels; — these are, almost exclusively, at the service of regulation. The accidental processes in the organization of biological structures become necessary owing to being regulated.

The open and closed organization of structures is connected with that the living beings are forming, from the point of view of metabolism and development, a self-regulating open system. On the other hand, the components, part-structures that build the structure are closed qualities. Their closed state is shown by that, in the whole living world, the single levels of organization are formed by only a few elements of finite number. Chemists have produced about 2—300 kinds of amino-acids while in the living world there are only 20 of them. Nucleic acids are composed of four bases. In the plastid of every plant — however, great differences may be between the plastids of the single taxons in structural and functional respects — the proteins are similarly composed of the same amino-acids. The organization

is open, and the single ortanizational levels appear as a contrast of its being closed. The fact that proteins are composed of only 20 sorts of aminoacid is not a proof of the lack of fantasy in nature but these seem to be the most suitable of all the possible components as regards both their number and quality.

An open organization or development is, therefore, not pre-established first of all by quality and number of the components but by their spatial and temporary relation of an almost inexhaustible variation.

If we investigate the unity of the contrast of asymmetry and symmetry from the antinomies of living structures, then:

Asymmetry is meaning that the molecules of organic matter contain the same atomic groups; the spatial arrangement of these atoms, atomic groups is, however, different on account of which a definite equality of the right and left antipodes may be observed.

The structures composing the living being are not only asymmetric but even the symmetry is characteristic of the structure of several components.

Carbon atoms have a homogeneous energetic symmetry, their electron shell showing a characteristic inclination to polarity.

The organic compounds advancing towards being alive have differed from the others in optical activity as nearly every component of the living matter is leftspinning and not racemic.

In the living being, symmetry and asymmetry, these structural properties of opposite character, do not exclude each other; on the contray, they both are indispensable structural properties from the point of view of life. Therefore, we find their simultaneous, contemporaneous existence in the structural units of life on the various levels.

The carbohydrate molecules that are always present in the living being are generally left-spinning. The carbon atoms, however, that take part in composition of molecules show certain kind of symmetry.

The contradiction observed in the structure of protein, the most important component of living matter, is similarly connected with the phenomenon of asymmetry.

Symmetry and asymmetry as a fundamentally important structural contradiction can be found not only on the level of the elements and compounds composing the living being but also on that of higher structures. In the whole animal kingdom there came about an almost unparalleled asymmetry. And in plants we also find asymmetry. Notwithstanding symmetry is also found both in plants and animals. The unity of symmetry and asymmetry changes in the course of ontogeny; in an early phase there is a perfect symmetry, later on, however, a series of asymmetries develops.

Emphasizing the unity of structure and function, we may not leave the development out of consideration. There is not really any absolute conformity between structure and function. The present degree of conformity is a result of a long historical development where the reciprocity of structure and function conduced to the present degree, in addition to the inner and outer conditions being determined.

The unity of structure and function, like any dialectical unity, is contradictory. The contradictions can be approached from different sides.

We may lay stress on the contradiction between structure and function. We have so far said that they are forming a unity presupposing each other reciprocally. They turn into each other reciprocally in the sense that the structure is functioning and function brings about a structure or modifies it. Structure and function contain, besides unity, also the relation of mutual exclusion.

As a result of the uneven development of structure and function, a contradiction takes place between them. As a consequence of the reciprocal influence of the structure as a whole and its part structures, as well as of the structure and external world on each other, there may change primarily either the function or the structure at one of them while the other factor retards. And that can be a source of contradiction, too.

It occurs that the structure of a function that already ceased to exist survives in the form of atrophied organs. But it is more frequent that the structure falls somewhat behind the functions. A function, however, does not creat in itself any structure. The new structure and function come about on the basis of the contradiction of the structure and function opposed, the old ones being rendered unnecessary in that way.

The unity of structure and function modifies as function may detach from structure, and the structure itself can be contradictory to its own function in the sense that upon a comparatively simple structure there can be based a rich multiplicity of functions. The structural elements of proteins and nucleic acids are not as diversified as the macro-molecules composed by them concerning their functions and the amount of information stored in them.

The realization of function as that of some phenomena of life takes place to the account of the structure.

Every phenomenon of life needs some energy produced by the living being to the account of the structure — that is the production of energy, decomposition, reconstruction.

The consistence of protoplasm is contradictory in itself. It is representing a transitory state. On the surface of protoplasm physical and chemical processes take place functioning as a result of contradictions. There are contradictions in the structure of protoplasm like attraction and repulsion.

Among the contradictions of the components of structure as well as among those maintaining the structure there are to be found the pH-relation and the ion-antagonism, as well.

Inside the living being, there is the contradiction of DNS and RNS, two concerte structures of fundamental significance.

If we take into consideration that the replicative ability of a DNS molecule is based fundamentally on the sequence of bases and this sequence on the contradiction in structure, then it is evident that this is the most important example.

In the process of protein synthesis, there steps in again some contradiction: a state comes about that is suitable for the biosynthesis of protein, and this state is based on the unity of the acidic-basic contradiction of compounds.

The existence and character of function is determined by the structure if we are now not taking notice of the reaction. There is, consequently, not only the structure but the function, as well, of contradictory character.

We are meaning by the contradiction observed in the functions of a living organism not a pathological decompositions of the conarted action of the organism — although this may be a type of contradictions, as well, as that forming the inner content of decay or decomposition — but the contradictions stepping in the normal functioning that is the inner concent of ontogeny and of the development of genotype.

In the living being there are a lot of structures on different levels performing a very great number of functions, the totality of these functions in their high-degree co-ordination meaning life itself.

We cannot demonstrate the antinomy of every function but are investigating only a few of them.

Structure and function as a pair of contradictions are not similar to the pair white-black but to those right and left, old and new in a sense that the notion of white or black can be defined objectively even independently from each other while structure and function cannot be separated from each other. Function is the „own counterpart", i. e. contradiction of structure and it is also vice versa, they do not exist without each other and turn into each other mutually.

In biology and medicine, function is often interpreted mechanically. In classical physiology, function means the activity, work of a cell, tissue or organ that is perceptible externally. The various interpretations of function can be summed up with a simplification:

Function is considered as a purpose of a structural formation, as a passive result of its existence: we speak about a protective function in plants in connection with thorns and spines, in insects in connection with the chitin cover, in snails in connection with shell, horn.

Another notion of function is the activity, work of an organ that can be appreciated externally: e. g. the flying function of a wing, holding function of a hand, digestive function of the stomach.

According to a notion of function generally accepted by philosophy and special sciences, function is one of the manifestations of metabolism. This definition is emphasizing one of the most characteristic properties of the living being but in the course of recognizing it often the „manifestation" becomes first known having the appearance that the cycles, processes, functions come about „without background", „pure" and structure-free.

According to the view of molecular biology, in the relation of structure and function at emphasizing the structure there are dominant, first of all, the extensity, the morphological sings, and at emphasizing the function the temporal character, process, cycle and rhythm. In this conception, based on the unity and struggle of contradictions, it becomes more and more obvious that structure and function as two sides of a contrast-pair are not only inseparable but also indefinable without each other.

Metabolism as a fundamental function of life is of contradictory nature, anabolism and katabolism are two sides of a circulation presupposing each other reciprocally. Composition and decomposition are processes with contradictory results; releasing and consuming energy, they cannot exist without each other and form the two sides of the same function.

A further contradictory character of the part-processes of metabolism is shown by the enzyme activity without which there in no metabolism. For transforming a matter, first of all proteins, that are extraneous to the species into species-specific matter during the intermediary metabolism, the organism has to decompose them into their components. This part is acted by the enzymes and we can observe also in their activity a contradictory motion, of promoting and inhibiting character.

A peculiar form of the enzyme and the inhibiting matter is shown by the contradiction, the competitive inhibition.

The contradictory nature applies to the enzymes themselves, as well, e. g. as the same enzyme can catalyze processes of contradictory direction.

There belong to the contradiction of metabolism also the problems of regulation. In plants, there are the contradictions of auxin, gibberellin, cytochinin, in animals those of the functioning of the neuroendocrine system. Without regulating mechanisms the normal course of metabolism is not ensured. The regulatory substances are capable of contradiction, of contradictory effect. In a low concentration stimulation, in high concentration inhibition has been observed.

The contradiction of the production and transformation of energy that is unit of metabolism is a peculiar contradiction both in the content and in the form of the living world.

This problem had been investigated as we had analysed the function. Here we are going on. The most important function of the living being is the metabolism that contains a number of detailed functions. Now we have to clear the problem whether metabolism and its contradictory sides are a peculiarity of the living world.

The literature dealing with the philosophical question of biology is using this notion in a wider sense than the special branches of sciences.

Metabolism is identical with intermediary metabolism. The latter is a molecular process forming the basis of the phenomenon of life. Intermediary metabolism means a chemical and physical molecular process that takes place in submicroscopical structures.

In a broader sense, metabolism means the whole circulation of materials in the living organism, with two main parts: the external and internal traffic of materials.

A characterization of metabolism like this is justified but the broader philosophical interpretation affects the connection of organism with its surroundings, as well. This philosophical interpretation is important for regarding the living being as an open system.

In connection with this wider interpretation there arise also the problems of „*Weltanschauung*". The intermediary metabolism does not give too great a possibility for a philosophical interpretation.

There arises on philosophical level only in this broader interpretation the metabolism as a peculiar connection of organism and surroundings, as well as the living being as an open self-regulating system. And at present it is only after making a distinction between metabolism and circulation of materials that the question may be posed if there exists a metabolism in society, and

whether assimilation and dissimilation are really a contradiction in the living world.

On the other hand, in the living being the exploration of the metabolic process means to recognize the most important peculiarity of the living matter. The contradiction of anabolism and katabolism can be placed therefore among the most particular antinomies that are characteristic only of living beings.

The living being, for preserving itself, has to carry out certain activity, namely: procuring and intake of food, transport in the organism, transformation, release of the energy stored to possess again the energy that is necessary for starting the whole process anew.

At the contradiction of structure and function we have already exposed from another side that the living organism releases and utilizes the energy stored in its own structure. A part of the external activity of living beings procures and takes up from the environment the matter they need.

Parallel with the organism being more developed a greater external activity takes place with a due differentiation for performing it. The external activity has also an internal side for mastering the environment that endeavours to have balance.

The contradiction of external and internal activities is similar to a whole series of contradictions discussed so far, e. g. to the contradiction of structure and function discussed above — where the contradiction has meant among others that the function takes place at the expense of structure annihilating it partly or entirely. And the problem is in connection also with the contradiction of organism and surroundings as the organism carries out the function against the activity of surroundings for an equalization. Life ceases to exist in the minute as the thermodynamic equilibrium whith the surrounding ensues.

For surviving, the organism has to perform a standing activity, work against the endeavour of the surroundings for obtaining balance.

The problem of an external and internal activity and work reminds us very much of the contradiction of assimilation and dissimilation. These two processes can be included in the notion of an external and internal circulation of material, as well as in that of metabolism. By characterizing the external and internal contradictions we have not repeated the above mentioned ones because the contradiction of its external and internal activities is a contradiction of the organism primarily in energetic relation, showing simultaneously from a new side the connection of organism and surroundings, illuminating the dynamical equilibrium and the unity of the balance and balanceless state.

From the functions that are characteristic of living beings, we may investigate the contradictions of multiplication, as well. We do not endeavour here to discuss every problem connected with the notion of multiplication. We are taking for basis zoogamy, observing the contradictions in the course of the union of spermatozoa, growing and development of the fertilized ovum.

At the starting-point of zoogamy, a contradiction is contained by the aggregation and division of cells. The two joining sperms contain several contradictions before uniting, e. g. in respect of the function, as well. It is very important that they are of contradictory character from genetic point of view, too. There is, at least, a difference on the level of being different, meaning

that inside some limits there joins a gene substance carrying the information of a genetic heredity differing from one another. If we consider that according to the genetic theory of evolution the source of variability is mutation, as well as the structural and numerical change in the chromosome number and the recombination together: a recombination cannot take place without uniting the sperms of the individuals with different heredity. It is obvious, therefore, that an important contradiction is in question not only from the point of view of fertilization but also from that of ontogeny and mainly from that of the development of the species, too.

The development of the new individual is not confined to growth similarly to other courses of evolution. There follows a differentiation, too. With that comes concerning the character of cells, the turning into their own contradiction, the process of differentiation.

Anyway, the result of the differentiation process of ovum becomes only suitable for a newer differentiation after being fertilized if previously it had dedifferentiated.

The thesis is therefore meaning differentiation that carries in itself also its antithesis: dedifferentiation.

The contradictions of structure and function, investigated together and separated, give some basis for theoretical conclusions.

Our first conclusion is: The structure is a base of function and as it is contradictory, accordingly, also the function is of contradictory character. This does not mean, however, that behind each of the functional contradictions there should be a structural one. Both function and structure have some relative independence and, consequently, similar functions can be carried out by different structures, too. The functional contradictions are, therefore, not immediately attached to a structure.

In the second place: It is equally characteristic of the contradictions of structure and function that every structure and function can conflict with another structure, respectively function — because a living being as a unitary whole consists of several intertwined structures and functions or of those penetrating one another, being in contradiction even with itself. That is in some extent identical with the problem of the external and internal contradictions, being in connection with the philosophical question whether the antinomy is a contradictory relation connected with identical or with different aspects. According to the functional investigation of structure, it is both of them.

In the third place: It is shown by the investigation of contradictions both in structural and in functional relations that the contradictions constitute the internal content of the existence, motion and development both of things and processes and there is no sharp boundary between the contradictions ensuring the existence and development of things. Polarity ensures the definite existence of a structure and it may be a starting-point for the course of vital processes with a polarized character.

In the fourth place: Investigating the different structural and functional areas, we are driven to the conclusion concerning the antinomies that the contradictions form a unitary chain in the living being. What we are talking about are not contradictions existing side by side but contradictions that are

interlocked chain-like and their connection has a diverging character. This means that whatever contradiction we may examine, one of the sides of the things or processes in contradictory relation is only the unit of contradictions known in themselves. If we take one of them, we shall discover a disintegration into newer and newer contradictions.

(Lecture delivered in the Biological Committee of the Attila József University, Szeged, and in the Department in Szeged of the Hungarian Biological Society.)

Address of the authors:
Dr. I. MARÓTI
Department of Botany,
Dr. MÁRIA HORVÁTH
Laboratory Genetical of the Animal
Physiology Department, A. J. University,
Szeged, Hungary