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THE PROBLEM OF EVOLUTION

It may be an exaggeration to say that a reappraisal of the concept of evolution is taking place. But it cannot be denied that in the last few years a number of extremely important studies have given new formulations to some of the fundamental questions concerning the rhythm, structure and meaning of biological evolution. It might be of interest, therefore, to discuss the present state of these problems and to indulge in some critical considerations regarding them.

The first group of problems, and perhaps the most difficult one, concerns the time dimension of evolution. The statement that living forms evolve in time is a truism, but underlying that assertion is the assumption that one of the very problems in question has already been solved. What is this time in which biological evolution takes place? Is it historical or physical? In other words, is the chronological pattern of evolution to be related to the concrete rhythms of the temporal experience of man or to an abstract conception of time?

Traditional paleontology has an unambiguous answer: there can be but one time, a time which includes the history of matter, the history of life,

and finally, the history of humanity. Hence eminent specialists even today engage in complicated estimates as to the date of the first appearance of amphibians or sauropsides; and the age of a class of animals or plants is calculated in millions or even thousands of millions of years. If these astronomical figures were merely used as convenient devices or guide posts there could be no objection to such genealogical life trees. But for a great number of people this gigantic chronology seems to have *historical* meaning. Now if one considers that the time of human history is loaded with culture and steeped in sociality one realises instantly that a history of life has only a metaphorical meaning. Nor is it more significant to speak of the universe, connecting histories in which man does not exist to one which is made by and with him. This does not mean that evolution, as it specifically concerns life, is to be thought of as a purely abstract order of succession; such a notion would be absurd and self-contradictory. It simply means that it would be better to conceive of evolutionary time on a level where a tendency to anthropomorphic thinking would be less likely to distort the real rhythms.

A promising attempt in this direction has been made by some contemporary naturalists. And the last few years have witnessed a very original paleontological approach which tends to break up the study of evolutionary rhythms into detailed analyses of phyletic lines.[1] Starting with the hypothesis that *phenotypical* variations (that is, apparent variations) correspond to *genetic* variations (that is, internal modifications of the transmitted heredity), evolutionary rhythms are estimated on the basis of what C. G. Simpson calls the rate of evolution,[2] that is, by coefficients expressing the relative growth of two or more given characteristics. Thus it has been possible to follow the phyletic evolution from *Hyracantherium* to *Equus* by studying the relative growth of the muzzle and of the skeletal frame through all the intermediate species. This study reveals a regular and perfect convergence of both growths. For the more the rate of evolution shows regular integration and convergence in the transformation of numerous characteristics, the more one is able to assume that it has been rapid. The evolutionary rhythm of a line is therefore defined by the congruence, within the line, of the transformations involved. In this new approach what interests the palaeontologist is not so much dating the first

[1] A phylum is a group of organisms of common origin whose progressive divergences are traced in evolution.

[2] Cf. especially *Rythmes et modalités de l'Évolution*, Albin Michel, 1950, pp. 350.

appearance of a phylum in the general history of life—as one dates the invention of printing in the general history of technology, or Newton's discovery of principles of mathematical analysis in the history of science—but establishing the structures that are to define the particular rhythm of transformation in each important line. In this way the fundamental postulate of transformism is preserved, which places the evolution of organisms in a concrete, objective time. But one no longer tries to describe the general *history* of evolution as such. This method, of course, does not exempt us from thinking of evolution in terms of 'before' and 'after'. It is essential to science to be able to determine the successive generations that have led species to their final stage of development, but it is not at all necessary that the unfolding of these generations be expressed in a language that constantly reveals the gaps of a precarious and inadequate chronology. It is sufficient for us to be able to follow this development according to the rhythms that have marked it until now; the time which contains and defines these discontinuous and irregular rhythms is incommensurable with the time in which the evolution of humanity takes place.

But the crux of the problem of evolution clearly does not lie in these chronological impasses. As a matter of fact whether one considers evolutionary time a purely symbolical and logical concept or the concrete frame of the transformation of living things, it can tell us nothing objective about the transformation itself. In order to analyse and try to trace the course of this transformation one must first have defined its nature.

It is, then, the fundamental problem of the nature of evolution that we must go back to. We hope that the reader will pardon the necessarily superficial treatment of this question in the brief exposition that follows.

What contemporary biologists are faced with is nothing less than the old conflict between Darwinism and Lamarckism seen in the light of new facts.

It is Darwinism that inspires the monumental posthumous treatise of the distinguished biologist, L. Cuénot, *L'Évolution biologique*,[3] the most recent attempt at a synthesis of the problem of evolution. From the outset Cuénot's position is dogmatic. According to him the only explanation capable of providing a coherent solution to the problem of evolution is the genetic one, a position generally known as Neo-Darwinism. It is not surprising then that the author spends more than 150 pages going over the fundamental data of the science of heredity in a book which proposes to

[3] *L'Évolution biologique*. Paris: Masson Ed., 1951, pp. 392, 197 figs.

deal with nothing but evolution. For him there is no breach of continuity between mutation and variation. And he holds that the same complex processes that, within one species, bring about mutations in the genes through structural modifications, operate within a genus, a family, an order and even a class.

However, as Cuénot himself states, the *gene* (the material factor of inheritance and the fundamental factor in evolution) considered in itself is only a *noumenon*, an abstraction. This gene in fact exists in an *environment*; the study of the conditions of existence of the gene is called *phenogenetics*. This environment, Cuénot adds (and the words he uses here are very important) is 'normal, habitual or average'. We shall come back to this point shortly since it is not at all certain that an environment in which living beings develop can ever be defined as neutral and constant to this extent. After all, life is never indifferent. But let us return to Cuénot. Through phenogenetics (the study of the conditions of existence, provided by the environment, of the transmitted substance) he is obliged to raise immediately the problem of the inheritance of acquired characteristics. We must admit that the way the author states and solves this problem essential to any theory of evolution is rather disconcerting. With admirable erudition and clarity Cuénot passes in review all the facts concerning the inheritance of acquired characteristics. Almost always he denies it: that which is not transmitted directly from germ-cell to germ-cell cannot be inherited.[4] Since all the attempts to find in the transmitted hereditary material those characteristics acquired by the individual have failed, the author believes that heredity of this kind does not and cannot exist. But if this scholar, convinced Neo-Darwinian that he is, refuses to grant any evolutionary significance to 'acquired' variation, why, one wonders, does he attach so much importance to phenogenetics as one of the primary factors in evolution? In fact Cuénot's thinking here is as wavering as the Neo-Darwinian theory is ambiguous and unsatisfying on this very point. The analysis of the influence of the environment on the hereditary material is in fact one of the principles of the theory itself. But what influence can be meant there, if, *a priori*, no violation of the germinal purity by adventitious factors is admitted? One is irresistibly led to think of the Cartesian dualism of extrinsic and innate ideas, the former having no real existence, or at most drawing some semblance of existence from the foundations of the mind itself. But Descartes could justify the thesis that the origin of

[4] Germ cells are autonomous male and female reproductory cells in the organisms (or soma) which produce them, and which contain the heriditary material.

ideas cannot but be in thought itself because of the reflective character of thought, whereas the Neo-Darwinian theory of 'innateness' is self-contradictory when on the one hand it refuses to grant the environment causality, and on the other it pretends to recognise it. In Cuénot's study this ambiguity gives rise to a series of paradoxes or even doctrinal prejudices.

An example of this is his position on the question of *cavernicoles*. Classified under this name is a heterogeneous group of animals who live in the dark and who have lost their sight; paleontological documents and even ecological studies demonstrate that previously they were able to see. In this connexion Cuénot is faced with the following dilemma: did the *cavernicoles* become blind because they found themselves for unknown reasons in a dark environment to which they gradually adapted themselves; or did they become blind gradually, by regressive orthogenesis[5] because their original lucifugous constitution drove them away from all sources of light? The second horn of the dilemma reflects the Neo-Darwinian viewpoint; it bases the adaptive relation of the species to the environment on a genotypical (hereditary) property of the former. But difficulties begin to arise when, using this simplified scheme, we try to explain the different levels of what is called the regressive orthogenesis of ocular pigmentation in the *cavernicoles*. In fact these animals are of three kinds: the *trogloxenes* whose *modus vivendi* is polyadaptive, i.e., they can live both in the dark and in the light; their visual potentialities are only partially diminished compared to those of animals of their species whose existence is purely epigeal (above the surface of the ground). Then come the *troglophiles* who choose an endogeous (subterranean) habitat but who retain some visual keenness. Finally there are the entirely endogeous *troglobes* who are absolutely blind. Now it is possible to follow the orthogenetic phases which take a species from the trogloxenic to the troglobous state. In order to understand the relation of these phases to the biotopic (environmental) modifications one must admit, as does Cuénot, that in cavernicoles living endogeously, increasingly depigmented mutants appeared. This explanation in no way sacrifices the principles of Mendel-Morgan genetics, but it does suggest a kind of pre-established harmony. In fact it seems to be by two independent series of causes that cavernicoles became blind and that their biotopes passed from semi-darkness to total darkness, the first causal factor being genetic mutation, the second, chance. It is difficult indeed to find a connexion between the two.

[5] Orthogenesis is the process by which a certain number of characteristics are modified in evolution in the same direction and according to a principle of increasing unity.

After considering the genetic and the phenogenetic factors Cuénot examines the struggle for life and natural selection, which he regards as the third and fourth fundamental factors in heredity. There is no point in discussing at length the origin of these basic concepts which were suggested to Darwin by the studies of the economist Malthus. The struggle for life resulting in the survival of the fittest has been given a new formulation in modern genetics. The *virtus* of the fittest is materialised as chromosomic substance, and the fitness of species and individuals is regarded as being in exact relation to their genotypical potentiality. But to speak of the fitness of a gene or group of genes has no meaning if one looks for an objective frame of reference within the genes themselves and not outside them. Now, the criterion of this fitness is the environment defined as all the cosmic, physical, biological and even psychological conditions that envelop the activity of an organism. This environment is to be considered as neutral and indifferent; and on this point Darwin, modern geneticists, and Cuénot all agree. One can only define it as 'the fact of being that which is'. Cuénot clarifies his idea by saying that an environment defined in this way is no more than a synonym for chance. In this environment individuals quickly find themselves in a struggle for survival. Moreover they are exposed to the determinism of cosmic and physical conditions. The inferiority or superiority of an organism of one genotype to another, that is, is measured exactly by the duration of its resistance to this double subjection, and consequently by the progressive reduction of these two hostile factors. The species which is destined to proliferate is, by definition, the one which overcomes both its biological competitors and cosmic adversity.

Cuénot has offered numerous examples of natural selection in the course of demonstrating how this notion has been clarified through the experiments of geneticists. Nowadays it is the inferiority or superiority of the mutant in relation to the specific type which constitutes what can be called the epistemological profile of natural selection.

A concrete rendering of this profile has been attempted by Tessier and Lhéritier in a number of ingenious experiments that Cuénot mentions. Drosophila (fruit flies) of two races, *funebris* and *wild*, were put in a box which represented a miniature universe. At the end of a few months a notable decrease in the number of *D. funebris*[6] in relation to *D. melanogaster*[7] occurred regardless which were more numerous at the beginning. But when the authors changed the temperature of the box-universe from 20° C

[6] Mutant race.
[7] Primitive race.

(a temperature favourable to the evolution of the *melanogaster*) to 15°C they obtained an increased hatching of *funebris* and a marked decrease of *melanogaster*. The conclusions of Tessier and Lhéritier, as well as of Cuénot can be briefly stated as follows: in an experimental environment resembling as far as possible the conditions of the natural environment, the selective value of the environment is measured by the constancy of the relation between the objective conditions of the environment (temperature, food, etc.) and the genotypical constitution of the races or species inhabiting it. The variations in the respective percentages of the two races in the experiment referred to are connected with a reshuffling of this relation. Natural selection which eliminates *funebris* from the *melanogaster* universe at 20° C strengthens them, on the contrary, at 15° because the lower temperature is, if one may say so, the objective correlative of the genetic mutation which engenders the race *D. funebris*. In other words, according to the most modern point of view, natural selection measures the correlation or absence of correlation of the genic mechanism and the environment in which it functions. Here again we find the two independent causalities that we have already encountered in dealing with phenogenetics. On one hand there is genetic causation, on the other, chance. We are again forced to remark that the relation between the two is difficult to see, unless it is a purely random one. But when we speak of selection do we not imply that a hierarchy of values exists among organisms? How is it possible to juxtapose an explanation based on value and one based on chance without a contradiction?

To sum up, we can group Cuénot's theses under three headings. (1) Evolution is an aspect of the phenomenon of heredity and can be demonstrated experimentally. (2) Since it has never been possible to demonstrate the inheritance of acquired characteristics experimentally, such inheritance is dubious. (3) Finally, the phenomenon of selection, one of the principal factors in evolution, is determined by the relation of genotype and environment.

These ideas, as we have seen, constitute the fundamental principles of the Neo-Darwinian theory of evolution, and it appears that Cuénot has accepted them. It is true that he has indicated the limitations of the theory in making certain reservations, but he does not seem to recognise what is paradoxical in his position. In numerous remarks scattered throughout his treatise he recalls the resolutely teleological nature of his biological theories. Moreover, as persons interested in biology and philosophy know, the books and articles he has written or influenced emphasise the inadequacy

of mechanistic explanations of living phenomena. And yet *L'Évolution biologique* seems to be largely based on a mechanistic notion which excludes finality or even the simple concept of the 'direction' of a biological object. Cuénot undoubtedly wished to confine himself to science in this study, and one cannot but respect this attitude. Yet there is the problem of whether a scientific theory based exclusively on experience does not, in biology, falsify the experience itself. In other words, can the type of experience represented by biological evolution be subsumed under the category of what is commonly known as scientific experiment? In the attempt to reduce evolution to a conceptual category to which it cannot be reduced one runs the risk of distorting its meaning. For evolution can only be taken by science as a meaning, that is, a significance given to phenomena which experience cannot account for satisfactorily, and which philosophy with an overly simplified finalistic system can explain no better. We shall see farther on what is signified by the 'meaning' of evolution. At this point we might indicate three areas of confusion in the theory of Neo-Darwinism.

First, there is their identification of evolution with heredity. According to Cuénot, who follows the most orthodox Neo-Darwinians on this point, the continuity of these two phenomena, if not their identity, is absolute. Now one could answer that for Darwin the evolutionary phenomenon had to do only with the transformations of the species, while in the work of contemporary geneticists (nor does Cuénot himself deny this), it has to do uniquely with the mutations which take place within the species itself, bringing about the birth of new races or variants: that is, with 'micro-evolution'. But the experimental production of new species has never been accomplished. In other words what we now call 'macro-evolution' has never been susceptible to experimental demonstration. For Cuénot the problem is simplified owing to his own notion of the species. In an earlier work on this subject[8] he emphasised the rather conventional limits of the species and he denied that there was a specific heredity existing along with a genotypical heredity, as A. Brachet maintained, making a distinction between special or nuclear heredity and general or cytoplasmic.[9] But even admitting that the limits of the species are fluid and that there is only one kind of heredity, which affects both the cytoplasm

[8] *L'Espèce*, Doin Ed.

[9] The first kind concerns only the details of organisation of individuals within the species; the second fixes within each individual the general characteristics of organisation which determine the structure of the species.

and the nucleus, Cuénot has merely shifted the problem and not solved it. For the transformations of what we are forced to call the species (if only for convenience) have never been perceived, either by observation or experiment, except within the species itself. Thus the genetic experiments invoked by Neo-Darwinians to justify their theory of evolution is hardly capable of providing a demonstration of it. No one has ever succeeded in creating a species experimentally, and, *a fortiori*, a new genus, family, or order. Hence, heredity cannot be identified with evolution. It does offer a picture of transformations that can be produced in the domain of life, but between evolutionary transformation and genetic mutation there is probably a difference of kind and not simply of degree.

The second confusion concerns the notion of 'acquired'. Generally 'acquired' is taken as synonymous with 'experimental'. Declaring that it is impossible to demonstrate the inheritance of acquired characteristics by experiment, the Neo-Darwinians conclude that this heredity does not exist. But they confuse life considered in its own vital process with the narrowed life of the scientific experiment. For it is clear that in this domain even more than in those usually studied by biology and physiology, the experimental conditions represent very inexactly indeed the normal conditions of biological phenomena. The laboratory is not a normal environment for a living being, if by normal one means 'that which conforms to the norm', i.e., to the biological dynamism of this being. Life is dynamism, or even better, 'dynamic polarity', as G. Canguilhem put it.[10] For the organism the norm is the sum total of biological behaviours which realise its optimum adaptation in the environment where it develops; the normal then, G. Canguilhem maintains, cannot be defined in terms of statistical frequency. It implies an evaluation on the basis of which the organism selects that environment which is most favourable to its physiological potentialities. Therefore the natural environment is irreducible to the experimental environment; the former is chosen by the living organism, the latter is imposed on it. It follows then that evolutionary phenomena, which manifest the dynamism of life itself, have a better chance of developing in the environment that life has chosen in order to realise itself than they have in artificial conditions where the normal defined as normative tends to become the normal of mathematical average.

We have pointed out over and over again Cuénot's tendency to define the biological environment as the sum of the conditions of existence which

[10] 'Essai sur quelques problèmes concernants le normal et le pathologique', *Les Belles Lettres*, 1943, pp. 157.

are presented to the living organism from the outside, just as they are, indifferent, neutral, without any essential relation to the needs peculiar to this organism. But this conception is probably too narrow. And we shall again quote Canguilhem, who notes that environments, like organisms, can only be called normal with reference to a norm, that is, to the sum of conditions of existence which are 'normal' because they permit organisms to manifest their productivity by and through them. Thus the environment, which the Lamarckians considered to be one of the chief factors in evolution is able to play a role in the transformation of living beings only in so far as a concrete and inner relationship is established, with the organism constituting itself the best environment for living and the environment taking on biological significance only to the degree that it has been given value by the organisms. It is in this sense that the notion of 'acquired' takes on meaning. But obviously this meaning cannot be demonstrated experimentally, for the biological environment would have to be reduced to the environment of the laboratory, thereby giving rise to the same confusion and error we have just pointed out.

The third ambiguity is the confusion of the notion of selection with the idea of chance. It has been shown over and over again that the concept of chance played an almost magical role in Neo-Darwinism. We have called attention to the fact that life is never indifferent and this should be enough to refute the explanations of evolution by chance. But the weakness of such an explanation becomes real confusion when even the phenomenon of selection is attributed to chance. As a matter of fact the notion of selection is borrowed from the social and technological activities of man. Selection signifies a definite choice aimed at the elimination of values that are considered unfruitful in favour of values considered to be superior or more efficacious. In other words, finality is an element in all selection if one uses finality in its etymological sense to mean the pursuit of an end. Natural selection, then, is simply one aspect of a specifically human teleology on the biological plane. So we see that natural selection cannot be determined by chance, which could function only in a universe completely devoid of values; natural selection makes sense only in reference to superior or inferior values of life, whether it is a matter of fertility, strength, or power of resistance to the external stimulations of the environment. So that selection can be called 'natural', strictly speaking, only in so far as life manifests, in the form of implicit meanings and judgments, the same striving for values that characterises human choice explicitly.

For example, it has been observed that two varieties of butterflies of

the species *Biston betularia* in the industrial districts of England find themselves in a struggle for existence, and that the number of black butterflies (mutants) is greater than that of grey (normal). In captivity, however, it has been shown that the grey eliminate the black. If one accepted the usual explanation that natural selection is purely random, one could not understand why the relative predominance of the same varieties changes in two different environments if the environment is considered neutral. The explanation is simple. Although the grey butterflies are more vigorous than the black the latter in their natural environment can conceal themselves better than the former on trees that have been blackened by the smoke of the surrounding industrial districts. The natural selection which operates in favour of the black variety in nature, translated in our language, expresses the choice by this variety of a *protective universe* which the grey variety cannot enter. And since in captivity the norms of this universe are upset, it is the sheer biological strength of the grey variety that imposes itself as the new norm of selection. But there again it cannot be chance that decides; at most one might suppose that it is as a result of chance, driven by a blind determinism, that the grey variety is stronger than the black. But since the norm of this strength can only be evaluated in the course of the struggle for life in an environment which is only what the organisms make of it, the strength of the grey variety is completely relative to the normative structure of the environment: lack of the particular trees that provide a means of protection for the black variety. In captivity this structure is imposed by man and consequently cannot be considered natural; but were such a structure to constitute itself in nature it would correspond to a series of biological undertakings or behaviours by both varieties which would exclude the operation of chance, because there is nothing random in even the most elementary processes of life. But, as we noted already on a previous occasion, it is not always easy to separate the level of pure biology from that of philosophy, when we are dealing with the problem of evolution. In obtaining nourishment the organism already imposes its life norms on the environment in some way by the mere fact of preferring one food to another. Life is always selective. And one can speak of natural selection on two conditions: (1) that it be recognised as a directed selection operating in a nature where values exist, a nature characterised by choice and preference which the living being imposes on the environment by imposing itself on other living beings; and (2) that we eliminate the vague and abstract notion of chance which may, indeed, appease our ignorance but which hardly defines a reality.

Ought we conclude from this brief analysis that Cuénot is to be criticised for having adopted the only theory that has attempted to give an explanation embracing the whole of biological evolution? In other words, is it by going back to the notion of 'acquired', by accepting the possibility of a direction and an 'orientation' in evolution that we should reformulate the problem? Such a hypothesis would obviously be too ambitious, if not indeed fantastic, unless it were supported by a philosophy. On the other hand, without encroaching on a field where Cuénot's competence and authority are uncontested one may raise questions and suggest problems which biology itself may be able to substantiate in the future.

Until now we have not mentioned the principles of Michourinian biology, which attempts to justify the inheritance of acquired characteristics experimentally and to explain evolution in general by it. There is no question here of entering into the technical debates which started after the publications of Michourin's school. But we cannot ignore them if we want to restore meaning to the concept of 'acquired'. It is true that from the point of view of previously held ideas about the inheritance of acquired characteristics there is a danger of inconsistency in the present tendency to regard such heredity as experimentally proved. This is a difficult problem to solve. But even if the facts are disturbing and controversial, the theoretical principle underlying them is so suggestive that biologists will undoubtedly try to clarify and develop its implications. Through the studies of the school of Michourin the notion of adaptation has been given a significance that it had lost after Lamarck. The idea that the species are tied to their life environments by a concrete bond; that the relation between them is not fortuitous but organic and effective—all of this has been brought to light by the Russian biologists. It would be paradoxical indeed if at the very time when vital processes, be they somatic or psychological, tend to be defined by this relationship we refused to take it into account on a level where it would probably have incalculable importance at once.

The work of the Russian school deserves attention from still another point of view. The school has been considered to belong to the Lamarckian tradition as a matter of course; some people have gone so far as to speak of the 'Neo-Lamarckism' of the followers of Michourin and Lysenko. This genealogy is evident enough when they try to explain evolutionary phenomena in terms of adaptation. But it is hardly necessary to emphasise the weakness of such a comparison if one considers the doctrines in their most rigorous sense. The true significance of Lamarckism must be sought in its

finalism; for Lamarck the concept of use had meaning only in relation to that spontaneity of the life force which so to speak projects organisms into their environments. In the evolutionism of Michourin, on the other hand, it is the strict determinism of the environment that imposes itself on the organism. And the contrast between Lamarck and Michourin becomes flagrant if we consider the materialistic ideology which inspires the work of the Russian school. But the difference as well as the similarity is instructive in relation to the general implications of theories of evolution. The current debate between biologists is most paradoxical. On one side is Neo-Darwinism, a mechanistic notion of evolution supported by the great majority of biologists and defended by Cuénot whose philosophy seems ill-adapted to an easy assimilation and acceptance of its principles. On the other side there is a conception of evolution which declares itself to be inspired by dialectical materialism but which even on very superficial analysis reveals its finalist nature. These paradoxes suggest that great caution and scepticism are necessary in any consideration of these questions. Through what seems to be only a quarrel between schools they disclose a much deeper contradiction which is that of evolutionism itself.

Now Cuénot has reminded us, with great eloquence, that no serious person today would think of questioning the fact of evolution. But whatever Cuénot may say, evolution is not a fact in the strict sense in which science understands the term. It remains an idea. And since this idea is not exactly a philosophical concept nor a theory in the scientific sense, it operates between the poles of pure speculation and objective experiment, getting closer and closer to its subject matter without ever covering the distance that separates them. From this follows the necessarily ideological aspect of the problem of evolution. And from this, too, follows the fundamental importance of the history of this idea, which, while not being a scientific fact to be added to other scientific facts, could well be the only notion that gives a valid order to the known facts.

In this connexion Paul Ostoya's *Les Théories de l'Évolution*[11] is particularly interesting. In studying the 'evolution' of the ideas about evolution one begins to wonder if it is possible to think of these two 'evolutions' separately, and if the law of one does not impose itself on the other. Ostoya's virtue is first of all to have shown the remote origin of the concept of evolution. Long before the notion of transformism was recognised in the field of science, the idea of a progressive modification of living forms

[11] Payot Ed., 1951, pp. 319.

has been expressed as a necessary principle of explanation, if only in the form of superstition. It seems, then, that the notion of evolution was from the very beginning a requirement of thought itself. It should be the philosopher's task to seek the psychological foundations of this need. Perhaps the concrete meaning of the conflicts which manifest themselves so violently within present-day transformism would then become clearer. But the historian who notes and follows the complex changes in the evolution of the ideas themselves is already able to tell us something about them. One has only to read Ostoya's analysis attentively to be convinced that there is no progress, strictly speaking, in the ideas concerning evolution. At most one can say that there is progress in the methods of investigation and in the techniques of comparison and experiment. But we have already seen that these methods and techniques, which have to do with existing structures and which are applied to a realm of 'facts', do not really substantiate the theory. Without the theory, however, the facts in themselves might have no value. Now the successive theories that have tried and are still trying to put these objective results into a system are so interrelated in their agreements and oppositions that they do not succeed in arriving at increasingly clear and objective explanations. For instance, there is Lamarckism in Darwin; and we have already seen that contemporary Neo-Darwinism seems to be a coherent system of explanation only in so far as it does not explain evolution properly so called. But an exclusively Lamarckian system would be no more satisfactory, and as interesting as are the current ideas of Russian genetics, they have not demonstrated that a decisive influence of the environment on the evolution of a species can occur without the mediation of the genotype, which would remain the indispensable, internal generator of pheno-typical modifications.

At the conclusion of this rapid and superficial analysis we are led to remark that, given the fact noted by Ostoya that it is impossible for contemporary evolutionism to explain the mechanism of large-scale evolution, the most cautious and satisfying attitude to adopt is one which recognises the historicity of the human mind. Evolutionism, a necessary category of thought, is subject to the vicissitudes of its history. The limits of its objectivity are the limits of the objectivity of this history.