Laval théologique et philosophique

Finalistic Evolution or “Teleogenesis”

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Volume 8, Number 2, 1952

URI: https://id.erudit.org/iderudit/1020782ar
DOI: https://doi.org/10.7202/1020782ar

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Publisher(s)

Laval théologique et philosophique, Université Laval

ISSN

0023-9054 (print)
1703-8804 (digital)

Explore this journal

Cite this article

Leonardi, P. (1952). Finalistic Evolution or “Teleogenesis”. *Laval théologique et philosophique*, *8*(2), 169–182. https://doi.org/10.7202/1020782ar

Finalistic Evolution or "Teleogenesis"

We have attempted in the following pages to produce a synthesis of what we consider to be the most satisfactory ideas advanced by the various authors who have dealt with the problem of evolution, and have endeavoured to co-ordinate and complete them by new suggestions which our own experience has suggested. It may be felt that we have gone farther than is justified by the facts. However, if we have done so, it has been simply in order to make our own viewpoint clear. As we have asserted in one of our previous works, [1] there are certain ascertained facts which indicate that evolution on a limited scale has occurred. However, there are other facts which although they are not really demonstrative, nevertheless allow us to form a somewhat wider conception. A complete theory of evolution must necessarily take into account all our knowledge on the subject, whether it is certain or only probable, and assemble these various elements, even if they sometimes appear to be contradictory, into a coherent and rational whole. This is the object of this paper. However, we must point out that the ideas presented constitute nothing but a working hypothesis based on our present knowledge of the phenomena of evolution. We shall be satisfied if the data brought together will help our readers to form their own opinions on the matter. — We must point out, to begin with, that evolution is a complex biological process whose manifestations are not determined by a single stimulus acting in a uniform manner, but rather by a system of mutable and sometimes contrasting forces whose combined effect is the equilibrium of the biosphere throughout the geological ages. The failure of many investigators to solve the problem of evolution is quite comprehensible. Desiring to reduce the evolutionary process to the simplest expression, they have taken into account only one factor or only a very few of the factors which have to be considered.

As far as we can judge at present, life probably came into existence in the sea, or at all events, in an aqueous environment, in the form of very simple and perhaps ultramicroscopic micro-organisms produced by the combination of a complex of substances (proteids, glucides, lipoids, phosphatides, cholesterols, etc.) already existing in the colloidal state in the environment. It is quite possible that these primitive organisms did not arise in one point only, but wherever physico-chemical conditions were suitable for their appearance and development. We cannot say at present whether the initial micro-organisms

1. P. Leonardi, *L'Evoluzione dei viventi*, Brescia, 1950.

were of a single type from which all the existing types arose (monogenism) or whether, on the contrary, from the very beginning there were different micro-organisms from which the present types separately developed (polygenism). The theory of monophyletic origin involves some serious difficulties, which have to do in the first place with the marked differences between the principal types of living organisms at the present time and in the absence of actual or fossil transitional forms which connect the various groups. The idea that the first forms of life had their origin in several regions of the earth widely separated one from the other and therefore presenting different environments leads naturally to the polyphyletic hypothesis, since under different local conditions organisms of different constitutions might very naturally arise. Against this hypothesis is the fact that protoplasm, in the organisms which now exist, has a fairly constant chemical composition.

It is probable that the first species of living beings were very similar in appearance, the differences between them, has Rosa has pointed out, being essentially differences in protoplasmic composition such as exist between two eggs of different species or between two bacteria which we can distinguish only by their physiological properties. However, as phylogenetic evolution advanced, the protoplasmic differences began to be revealed in visible bodily characters so that the species, as they succeeded one another, became more and more limited and more strictly specialized for life in certain particular environments.

However, no matter whether we adopt the monophyletic or the polyphyletic hypothesis, we are naturally led to suppose that the primordial organisms were predetermined by their constitutions to development along a certain number of definite lines so that their development did not occur at random, but was co-ordinated from the beginning so as to permit of the existence of animal and plant forms constituting an interdependent and harmonious ensemble.

The gradual execution of this creative " design " is entrusted to a complex of natural forces capable of transforming organisms progressively in certain definite directions depending on the functions allotted to each organic group and to the elements of the group in the general plan of the organic world.

The finality of natural phenomena is evidenced by a vast mass of facts. Evolution also in our opinion is an eminently teleological process. The evolutionary transformations occur, at least to a great extent, according to a preordained plan by means of natural laws.

The attempt recently made by Professor Simpson on the occasion of a " symposium " dedicated to this subject to overthrow the

finalistic view of evolution appears to me to lack objectivity and I find it unconvincing. [1]

We can, it is true, agree that we do not often find evidence for monophyletic orthogenesis. However, I do not think we can regard orthogenetic evolution as a simple straightforward process of progressive development along a single line. We must admit that it includes evolutionary developments which have had the same origin but which have occurred independently, moving indeed toward a common objective which, nevertheless, some lines fail to reach, either because they have been prematurely extinguished or have undergone developments which are either hypertelic or degenerative.

In our opinion, the evolutionary tendency must be regarded as one of the essential properties of living things. This tendency exhibits itself in organisms in an inherent tendency of species to change, that is to say, to bring into existence individuals more or less different from themselves which are in turn capable of transmitting their new characteristics to their offspring. These variations may appear suddenly and may be of considerable amplitude (mutations) or they appear slowly and gradually. In the production of these variations, external factors probably play a considerable part though our understanding of their action is still incomplete.

It has been shown experimentally that mutations arising through spontaneous genetic changes can give rise to new forms and may come into existence under the effect of external agencies such as radiation. But the fact that the radiations which normally occur in nature are incapable of determining such mutations leads us to believe that they are not caused by external agents alone.

Furthermore, the fact that distinct phyla, however closely related they may be, evolve along parallel lines indicates clearly that evolution is a process determined by an internal directive factor common to the phyletic group and not to environmental causes alone.

The frequent cases of orthogenetic development, which obviously correspond to a directed evolutionary process, help to show — whether they rise from mutational processes or not — that the phenomenon of mutation itself is not determined merely by external factors. In our opinion, orthogenetic evolution and adaptation are not explicable by a simple mutational process even if we admit that non-adaptive mutations may have been retained and developed by natural selection.

The existence of adaptation and of adaptive orthogenetic evolution under the influence of the environment and therefore of external factors can be reconciled with the non-adaptability of mutations, demonstrated by experiment, only when we assume that the process of mutation is, at least in some cases, under the control of self-regulatory mechanism existing in organisms and comparable with the mechanism

1. G. G. SIMPSON, in *Paléontologie et transformisme*, Paris, 1950, pp.123-163.

that exists in individual organs. Considering the matter from this standpoint, it appears that there is no incompatibility between the old concept of adaptation and the mutationist concept of preadaptation.

In our view, preadaptation can only be the result of a predisposition in organisms so that they react to environmental variations in certain directions so as to ensure the survival of the race.

The innate self-regulatory power which we believe to exist in organisms produces, under certain conditions, mutations among which only the advantageous types continue to exist owing to the effect of natural selection. In this way, there arise forms different from the original ancestor but progressively better fitted to the new environment. If changes in environmental conditions are abrupt, the mutational changes may be discontinuous but we may also regard them as continuous, having in some sense a relation to future necessities.

One of the most clear and interesting results of modern palaeontological work is that when new morphological types arise, there immediately occurs an adaptive irradiation with the production of a great number of forms belonging to the same type. The bush-like form of geological trees, as modern geologists have worked them out, is a result of this phenomenon.

In fact very few of the divergent branches survive very long. Most of them become extinct in a short time. Only those survive which are potentially capable of producing descendants able to adapt themselves to the environmental changes. [1]

The transmissibility of acquired characters produced either by environmental factors or through use and disuse has not been experimentally proved. Hence the evolutionary process, which cannot be satisfactorily explained on mutational theories, is still without an experimental basis. Some authors think, of course, that the environmental factors, acting on the somatic part of the organisms, can nevertheless influence the germ plasm (for example the cytoplasm of the female germ cells) by means of internal secretions (Fraipont).

In any case external factors cannot in our view really be the cause of a variation but rather determine its appearance by a kind of catalytic action. In other words, they unleash the evolutionary energies which are latent in the genetic patrimony of each organism when a change in environmental conditions demands an adaptive change or the re-establishment of a different biological equilibrium.

The importance of external factors in determining the extinction of organisms appears particularly obvious. I agree with Arambourg that the most common cause of extinction (though not the only one) is that a certain environmental change necessitates in the organism

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1. G. ARAMBOURG, in *Paléontologie et transformisme*, Paris, 1950, p.95.

a mutation produced more rapidly than is possible, or in an impossible direction.[1] It is not, I think, a simple coincidence that the great mutations of the fauna occurred in connection with the great geodymamic phenomena such as the elevation of mountains or the transgressions and regressions.[2] Nevertheless, these environmental factors or changes in environmental factors produced the extinction of organisms only when their genetic constitution had altered so that they had lost the evolutionary potential necessary to produce the adaptive mutations required.

We must note that evolution can be either progressive or regressive according to whether it brings about either the development or the reduction of an organ or of a complex of organs. Nevertheless, it must be pointed out that the terms just used have only a relative value because the reduction of an organ may be useful to the organism as a whole (as for example in the case of the reduction of the lateral digits in horses [*genus Equus*]) and thus may contribute to the progressive evolution of a biological entity.

On the other hand, we can recognize regressive evolution in the absolute sense when it results in the degeneration of a species or of larger systematic group as a result of a temporary crisis or, more frequently, as a prelude to extinction (for example in the degenerative forms of the cretaceous ammonites and the small elephants of the Pleistocene in the Mediterranean islands).

Every specific entity may be considered as a combination of gene complexes. Each of these determines a certain morphological feature and is in a condition of discontinuous evolutionary change either progressive or regressive. Every gene complex and consequently every character dependent on the complex appears to possess an individuality of its own and to be to a certain extent independent, in the sense that every complex and every morphological or physiological character deriving from it may follow its own evolutionary course, while other complexes and characters appertaining to the same specific entity may remain unchanged or evolve along lines of their own. This is a modification of Osborn's law of the variation of single characters.

If we consider any phyletic group, particularly among those where orthogenesis occurs (for example the case of the horses or of the titanotheres) we find that in every one of them some morphological feature undergoes a progressive transformation (size, skull protuberances, teeth, etc.) while others regress (lateral digits) or remain unchanged. However, we do not think it is possible to speak of a complete independence of a character with respect to the evolutionary process because single characters are not biological entities existing

1. In *Paléontologie et transformisme*, Paris, 1950, p.118.
2. *Ibid.*, p.108.

by themselves but coexist so as to constitute an organic whole. We think that in every species the evolutionary processes corresponding to the single characters proceed harmoniously at least in the progressive stage of development, that it is only in the terminal and regressive stage that we find independent and inharmonius developments which contribute to degeneration and extinction which we may regard as a symptom of the ageing of the species.

In the present stage of genetics, the mechanism of evolution is not yet well understood. However, the geneticists incline to the view that the data on variation provided by experimental genetics indicate that there is no real contradiction between genetics and evolutionary theory and it is possible to reconcile the idea of evolution by means of successive mutations and the almost absolute stability that the species exhibits in the intervals between mutations.

The present view is that the variations are primarily [1] due to mutation and to chromosomic reconstructions and that the derivative forms coexist *ab initio* — in a condition of unstable equilibrium — with the normal individuals (resembling the progenitors). In this way there are produced polymorphic populations on which, during the period of adaptive irradiation, natural selection exerts its effect (A. C. Blanc).

Certain conditions are necessary if a variation is to produce a new race (and eventually a new species) without being eliminated by a natural selection in the crossing over with the more numerous individuals of the typical primitive form (Romanes). The variation must appear about the same time and with a certain constancy in several individuals or some particular environmental or physiological condition must favour these individuals. Studies of the changes in the structure and number of chromosomes have revealed several possible mechanisms which may produce partial or even total separation of stocks (Buzzati-Traverso, Jucci, Timofeeff-Ressowsky).

If natural selection is favourable to the new forms, an equilibrium between these and the original progenitors will be established. However, this equilibrium will be rather unstable and as result there will be fluctuations involving the competitive forms (Timofeeff-Ressowsky's vital waves). The selection of the elements which constitute these polymorphous populations will have as a result the segregation of

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1. But not exclusively. According to some authors, these are not even the predominant causes of evolution. See for example the remarks of A. VANDEL (*L'homme et l'évolution*) about cytoplasmatic heredity. In the opinion of Vandel, the Mendelian laws of inheritance and the mutations of chromosomes have to do with only the most evolved organisms which have therefore already attained a certain stability. "It is likely," says Vandel, "that originally the distribution of the heredity factors occurred through a cytoplasmatic process which was connected with the distribution of organo-formative substances in the blastomeres resulting from the division of the egg."

more distinct and more specialized populations of elements which coexisted in the starting populations (A. C. Blanc).

At the beginning and for a certain number of generations, the typical form and the derivative forms will be fertile *inter se* and therefore these derivative forms will be only races of the mother species. At this stage the evolutionary processes are reversible; crossing which will produce a secondary polymorphism is possible either artificially or naturally (when the environmental conditions which operate it to produce segregation have ceased to act) (A. C. Blanc).

However, eventually it may happen that the mother species in some of the derivative forms which differ more and more from it attain a point where mating is no longer possible (at least with positive results) under natural conditions, either because the difference in morphology is too great or because there is a physiological incompatibility (the cause of which is still uncertain). When this stage is reached, the evolutionary process becomes irreversible and the new features are definitely established.

A study of the evolutionary processes during the geological period seems to indicate clearly enough that every organism or group of organisms normally exhibits a plasticity in its initial stages and subsequently a polymorphism which is more marked than it is in later periods of its history.

Specialization and adaptation seem to be in inverse ratio to the evolutionary potentiality in the species or in the group. The more specialized an organism or a phylum is, the more strictly limited will be the transformations that it can undergo. For this reason, only the organisms which retained generalized characters were able to advance toward higher degrees of organization, while the others which branched off from the principal generalized stock and specialized in various directions retained only the relatively slight evolutionary capacity which allowed them to adapt themselves to a certain definite environment or to a certain definite function in the equilibrium of the biosphere.

It should not however be imagined that when certain characters have attained a stable condition corresponding to the origin of a new species, the species has for that reason become completely and definitely stable. In our view, it has become stable only because the characters which differentiate it from the other species and other similar species have become part of the genetic constitution but in other respects it retains its capacity to evolve. If an opportunity occurs, it can under the influence of internal or external stimuli change either gradually and imperceptibly or suddenly and resume evolution after a static period, remaining either in the field of the species (as for example when the external agents are the predominant factors and

variations are limited and gradual) or producing by mutation new polymorphic populations on which the selective process will act so that additional new species will be created.

Recent studies in the field of experimental genetics permit us to say that the evolutionary process can extend beyond the limits of natural species from a physiological standpoint but it does not appear that they can go beyond the frontiers of the genus. For this reason, some authors accept micro-evolution but not macro-evolution though good support for this phenomenon can be found in the palaeontological data. In our view, the results obtained by genetic experiments do not demonstrate conclusively that only mutations of the kind we obtain in the laboratory and nature have been responsible for evolution. We think that the time factor has been too little appreciated and often neglected by biologists. It appears to us that in the geological past, evolution occurred with more important transformations, transcending the limits of the genus. Since we must admit that certain new and particularly complex organs can hardly be conceived as having come into being by an accumulation of slight variations (since in some cases the rudiments of organs such as wings would have been more harmful than useful), investigators assume that in past epochs mutations have been very much more important than those which have been produced experimentally. Among the biologists, there are some who believe that at the present time the intense evolution which occurred in the geological past has been replaced by a relative stability. We cannot see the necessity or even the probability of this view, especially if we consider the undoubted evolution of mankind from its oldest to its most modern representative. However, the attainment of a stable condition might be regarded as reasonable if we assume that the final aim of the evolutionary process was the creation of the human body and of an environment in which this creation could occur.

In our opinion, organisms would advance owing to an inner stimulus to a higher and higher level, culminating in the appearance of man and through such stimuli they would be led to co-operate in maintaining the equilibrium of the biosphere necessary for the perpetuation of life.

Indeed, if we admit that all animals and plants descend from a single original, neutral organism (monogenism), all the great groups of living beings (or most of them) would have played a part directly or through their ancestors in the phylogenetic process which culminates in man and in maintaining the equilibrium necessary to life. If on the contrary, as seems more probable, or at least more in conformity with our present knowledge, the principal types of organisms descend from forms distinguished *ab initio* (polygenism), only the vertebrates and the organisms from which they descended would have had a part in producing the human body while all the others, animals and

plants, would have co-operated in maintaining the equilibrium of the biosphere throughout the geological ages.

The inherent tendency in any organism to move toward a higher level of organization may be in our view either facilitated or blocked (or at least delayed) by environmental conditions (favourable or unfavourable climatic conditions, predominance of more powerful organisms, etc.) which — as above stated — do not actually cause variations but act rather as catalysers in the evolutionary process and contribute up to a certain point to the direction of evolution. When we realize this, we can understand that a process of this kind is not necessarily continuous but that on the contrary periods of intense variability may alternate with long periods of relative or total stability (Eimer's Epistasis). [1]

Among the factors which contribute to revive the evolutionary drive, we must mention the building up of new energies owing to the effect of a new environment after the migration of a phylum which is not yet excessively specialized.

A similar result may be produced by environmental factors in those evolutionary processes which are directed to the maintenance of biological balance.

When any environmental factors seriously interfere with the biological balance, the evolutionary drive of the organism is awakened and rapid and important evolutionary processes result. These processes can produce (in a longer or shorter time) a new equilibrium between the various evolving organisms and between these organisms and the environment.

To us it appears that just as every organism and every organ has a self-regulatory power by means of which its normal condition is re-established after it has been disturbed, so in the biosphere (by which we mean the complex of interdependent organisms) we have to a great extent the same self-regulatory mechanism which maintains throughout the ages an equilibrium favourable to life.

The biological cycle of every group of living beings can be represented, in our view, by a parabolic curve : this curve rises at first rapidly in a manner which corresponds primarily to the strength of its inherent evolutionary drive and, secondarily, to the environmental circumstances, until it reaches its highest point, which corresponds to the optimum for that particular group. After reaching this point, the animal or plant group reaches a stage of decline and proceeds towards a more or less rapid extinction, sometimes preceded by a stable period. The disappearance of many more or less important

1. In agreement with this is the fact that some groups of organisms (and sometimes several groups at the same time) have failed to change and then have passed into a phase of rapid evolution. A case of this kind is the simultaneous evolution (outbreak) of mammals and birds which followed a long period of very slow and unimportant evolution.

groups of organisms that has occurred during the geological past can be better explained if we attribute it to internal causes than as a result of environmental conditions which have probably merely assisted a predetermined process. Indeed in many cases it has been determined that the extinction of a group of organisms was preceded by clear signs of degeneration. An example of this is found in the exaggerated gigantism and the degenerative features in the most recent dinosaurs and the irregularity in the coiling of the shell in the cretaceous ammonites. On the other hand, the fact that these and other groups of organisms became extinct at the same time toward the end of the mesozoic era seems to show that environmental facts also contributed to their decline.

The conflict between the internal evolutionary drive of the organism or group of organisms and the effect of environmental factors has of course the effect that the curve representing its biological cycle is discontinuous and shows irregularities which may be regarded as the resultants of the two interacting elements.

To us it appears probable that many groups of animals and plants attained the summit of their developmental cycle, having fulfilled their function either with regard to the development of the human phylum or with regard to the preservation of the biological balance. After this point they entered a degenerative stage (regressive evolution) which is a symptom of their eventual extinction. In other cases on the contrary, it appears that certain species or indeed certain more or less extensive groups of organisms, which have either not fulfilled their functions or have never become specialized to very precise environmental conditions, have persisted indefinitely without alteration from remote periods until the present time. [1] This prolonged stability which is so disconcerting at first sight can be well understood in the case of many organisms whose existence is necessary to the balance of the biosphere. Looking at the matter from this standpoint, we can understand how neither external nor internal agents have been able to induce the protozoa which still exist at the present time to advance toward a higher degree of organization in spite of the passage of an immense period of geological time from the Algonkian era until the present day.

The progress of biological studies shows more and more conclusively that the different organisms which belong to the same morphological type are not independent and that the extinction of one group and sometimes even of a single species can determine the disappearance of other species or groups of species even among the higher organisms and thus produce very remarkable disturbances in the equilibrium of the biosphere. This interdependence of organisms

1. This is typical of *Lingula*, *Nautilus* and many other organisms which are called *panchronic* because of their persistence throughout the geological time.

is exhibited also in the order of the appearance of the great groups in the geological ages. For example in the uppermiddle Jurassic period the angiosperm-phanerogamic plants appeared at the same time as the Hymenoptera and the Lepidoptera whose existence is intimately connected with that of the flowering plants.

It is thus logical to assume that the evolution of individual organisms, even though it is directed toward the attainment of the highest degree of organization is, on the other hand, subordinate to the preservation of the balance of the biosphere. Neither the higher plants nor the animals and much less the mammals could survive at the present time without the existence of myriads of lower organisms whose activity is necessary to their existence.

This explains why the evolutionary processes attained great amplitude only in certain organisms predestined to attain the higher levels of organization while in others involved in the evolution of the environment, only limited transformation occurs. Others became stable when their role was the maintenance of conditions necessary for the existence and development of the highest organisms, which can survive only in the presence of others in an inferior stage of organization. We can understand these phenomena only if we realize that the various primordial organisms (in the polygenetic hypothesis) or each of the branches derived from the original single ancestral organism (in the monogenetic hypothesis) had already *ab initio* a well determined biological destiny prefigured, so to speak, in its constitution and that evolution has occurred in each of the various types within the limits allotted to it as regard to nature as a whole. To us it seems probable that in the maintenance of each group of organisms and in the determination of its biological destiny environmental factors also have played a part which though it appears to us as a complex of chemico-physical phenomena acting at random according to the laws of probability, constitute, nevertheless, a causative agency which contributes, together with the internal evolutionary stimulus, to the progressive actuation — according to natural laws — of a creative design.

It seems now advisable to examine the problem of the origin of the human body which, owing to its connection with extra-scientific problems, is particularly delicate. The solution of this problem involves very serious difficulties but to complete my survey of evolutionary phenomena I think I should attempt to offer a personal interpretation in which the ideas we have now acquired are completed and placed in a setting of wider concepts.

We must of course stress the fact, which we have already mentioned, with regard to biological evolution in general, that what we are offering is nothing more than an absolutely provisional working hypothesis by which we are simply attempting to co-ordinate and

explain the facts which, as we know, sometimes appear to be contradictory.

The first fact we have to remember is that man presents many primitive features, not only with regard to numerous living Anthropoids more specialized than he is, but also with respect to many other mammals. Among these features, we have to remember the five fingered hands and feet, the complete set of teeth, the quadritubérculate grinding teeth and the unspecialized digestive apparatus. Man's skull is much more similar, morphologically speaking, to the skull of the young anthropoid than to that of the adult anthropoid. In fact both in the human skull and in the young of the anthropoid, there is a remarkable development of the cerebral region, a deficiency in the bony arches over the yes and of the median crest. The face and the mandibles are reduced, the masticating muscles and the eye-teeth are feebly developed. These features become gradually modified in the anthropoids as they grow older. In other respects also, the human body is more similar to the young of the anthropoid than to the adult. For example among the white races pigmentation is very slight (the anthropoids and the coloured human races are lighter at birth than later in life), the disappearance or reduction of the hairy covering (the hairy covering of the Gorilla and the chimpanzee is at birth only on the head). On the basis of these facts and many others which it would be too long even to summarize, we may think with many great palaeontologists and anatomists of the possibility that a sudden genetic mutation of an anthropoid — living at the end of the Pliocene or at the beginning of the Pleistocene — produced a first human neotenic form which retained in the grown-up the immature features of a poorly specialized mother form. From this human form having generalized and synthetic characters and thus able to generate all the extinct and living human races, a polymorphic and heterogeneous population took its origin. In this population the native synthetic form and some new ones arising from later mutations coexisted. Some of these persisted or regressed having distinctly pithecoid characters and others neotenic and progressive characters more and more similar to present man.

A certain number of lines developing by parallel evolution arise from this polymorphic population by process of segregation. These we can group in three phyletic complexes.

a) A complex having synthetic characters analogous to those of the native form under which the last known representatives are, in my opinion, some races having mixed characters in the middle Pleistocene (e.g. Palestine man).

b) Another complex (it might be derived directly from the native polymorphic population detached from the first group at a certain moment of its evolution) having more or less well marked pithecoid characters in which we can observe progressive evolution toward the

human form and also in certain races a more or less stable condition persisting until relatively recent times (man of Solo) or a true degenerative regression which, starting from moderately theroid forms like the Protoneanderthalians (Steinheim), the man of Gibraltar and of Saccopastore, reaches at the end of the middle Paleolithic in Europe (La Chapelle, Circeo) perhaps in more recent times in Africa (Rhodesia) a degenerate condition.

c) A complex with characters which approach more and more nearly to those of present man. This took its origin in the lower Paleolithic in forms such as the Swanscombe and the Fontéchevade man includes all the ancient and modern races of *Homo sapiens*.

Among the three complexes, the limits and affinities of which are very difficult to define, single hybrids probably existed ; only the last one (*Homo sapiens*) is still living, while the races corresponding to the other two complexes disappeared more or less rapidly through the geological ages or perhaps united with *Homo sapiens*, thus losing their individuality. By this interpretation — which has been very inadequately sketched and which would require a much more profound study than we can make with the insufficient data we possess at present — it seems possible to me to conciliate both the monogenetic origin of mankind and the known coexistence of already differentiated human types in the ancient Paleolithic.

Following what we have remarked at the beginning, it may be that in the view of some of our readers our conception which — we repeat — is simply a working hypothesis — and nothing more — presents in its more speculative aspects some extra-scientific elements since many scientists now claim that scientific statements can contain only what emerges directly from experimental research. Indeed the reality of some of the fundamental concepts of our theory, such as the one of the finality in nature and the co-ordination of all the evolutionary processes in order to attain in the end the formation of the human body and the equilibrium of the biological environment — cannot be proved by entirely experimental principles. We take the liberty of referring to the statement of Charles Darwin about his hypothesis of natural selection — that the strongest argument in its favour was not so much the many facts brought in support of his assertion but the discovery that several problems until then unsolved found in it the most logical explanation. And if it is true that the Darwinian hypothesis is not sufficient to explain the complicated phenomenon of evolution, there are not many today who refuse to admit natural selection as one of the factors of evolution.

Certainly we do not intend to compare our very unassuming paper with a work of genius such as *The Origin of Species* which opened a new era in the history of the knowledge of nature. We refer to Darwin's words only because in our case also it appears to us that our hypothesis gives a reasonable explanation of some problems

which have not even been faced or which have been solved only partly by preceding theories. In its general aspect, it presents a fairly complete and harmonious picture of the complex phenomenon of evolution discovered up to the present time so that anyone who studies nature free from materialistic preconceptions can find satisfaction in it. We think this fact is in favour of our concept. However, we do not intend by any means to give it the value of a final theory which is free from lacunae and errors.

The way to the truth is still long and hard and we will be satisfied if our attempt may constitute another step toward the ultimate objective, or at least if it gives a starting point for new investigations and broader perspectives to readers, whether their attitude is favourable or unfavourable.

PIERO LEONARDI.