Uroboros, or biology between mythology and philosophy
ed. by W. Ługowski & K. Matsuno
Wrocław 1998 Arboretum

Jorge González-González
Departamento de Biología, Facultad de Ciencias
Universidad Nacional Autónoma de México
Ciudad Universitaria, 04510 México, D.F.

TRANSFORMED AND ALTERED PROCESSES: FOUNDATIONS FOR A PROCESSUAL THEORY OF BIOLOGICAL KNOWLEDGE

1. INTRODUCTION

The present paper outlines the ontological, methodological and epistemological foundations of a general view of biology, which as a whole, I call Theory of Altered Processes (TAP)[1].

TAP is my general view of the world, my theoretical grounds to question ideas and myths on which the dominant view of science as "objective", "neutral" and "universal" is based. I conceive of it as a way of addressing nature and as a theoretical methodological tool for the integral study of living beings. It is possible to say that TAP is the result of the permanent search for the theoretical identity of biology, the search for its own identity, via *a* processual ontological view, derived from the features inherent to the biological object of study which define and delimit it: *self-perpetuation*.

In this presentation ideological, philosophical and scientific considerations are mixed and integrated (consciously), and on occasion (unconsciously) also poetry and science fiction. My professional background (biological) and my professional trajectory (altered consistently) are reflected in it. It is also my intention to prove that mature ideas, methods and results, and above all hope, can be generated if individual and collective efforts are made to cultivate self-conscience, self-respect, self-criticism, self-responsibility and autonomy

[1] I have presented the ideas of this essay before as lectures, graduate courses, personal communications that have been published in dissertations and other works. At present they are compilated into a larger text. Although the elaboration of the general ideas is my responsibility, which I assume entirely, I would like to acknowledge that the final product has been the result of an intense interaction between myself and my students, colleagues and friends, in the process of development and ripening of this theory. I wish to acknowledge and extend my explicit gratitude to all who consciously or unconsciously, formally or informally have participated in my alteration as a person and as a professional of biology.

(values that are out of date and are economically useless).

As a world-view and a methodology TAP is the starting point for almost all academic projects (and sometimes non-academic also) in which I have participated. Phycology, my field of expertise, the study of algae[2] has been my source of inspiration and the field of application for the development and consolidation of the conceptual as well as the methodological aspects of TAP. In my work (floristic) in the Laboratory of Phycology, Science Faculty, UNAM, TAP has been the framework for the studies on flora[3] and the methodological implementation with which the project "Phycological flora of Mexico" has been working for over twenty years, with which many phycologists have been trained and from which multiple other activities and other phycological projects have been derived. In the field of education, TAP has served as a methodological tool in my practice as a professor of biology at different levels, but most of all as an epistemological basis for several proposals of educational practice in biology, which have been applied in the framework, design and elaboration of curricula and programs (from graduate studies in biology in the Science Faculty, UNAM, to biology programs in highschool and editorial programs, such as "El universo de la biología"[4], etc.).

---

[2] "Algae" is the name commonly used for a heterogeneous and complex ensamble of autotrophic organisms, extraordinarily varied and variable, grouped using phenetic criteria due to the great number of analogies, that have resulted from the convergent adaptations to shared environments. Many algae are not what they appear to be, nor do they appear to be what they are. The infinite manifestation of shades and gradations makes it almost impossible to make any clear separation between the different algal groups.

[3] Phycofloristic studies have been the point of departure and the goal for TAP. There have been several procedures for the elaboration of national floras, but they can be grouped into two tendencies: the first intends to accumulate partial lists over many years; the second sets up global projects for intensive surveys to be carried out in a definite and relatively short period. In neither case has it been taken into account that a flora is a transformed process that requires not only to be described, but to be explained. In other words, to think that the flora of a region is known it because it has been studied for a certain period, even a long period, is an erroneous supposition that derives from an erroneous view of what a phycological flora is, and that in turn derives in an also erroneous methodological framework. Floristic studies can never be considered to be finished. The flora is a process altered by an infinite number of biotic and abiotic factors. Although it may appear to the observer as a spatio-temporally situated event from which objective descriptions and analyses can be made, and interpretations of the connections between causes and effects can also be made, the truth is that any event of diversity, any flora, has a history and a becoming in which many elements of alteration incide; the observer, is undoubtedly, one of them.

[4] "The universe of biology" is an editorial program – as well as an integral system for teaching – that emphasizes the unifying principles of biology and due to the way it is organized allows the study of living beings from different approaches.

2. IN SEARCH OF AN IDENTITY FOR BIOLOGY

It is a commonplace to say that biology is an autonomous science, a feature historically obtained, more due to the independence of its object of study than because of the autonomy of its criteria of scientificity. Nevertheless, as it will be seen shortly, given the diversity of concepts, theories and methodologies which have been generated in the different disciplines that can be called biological, there is no theoretical unit which can define it inwards nor clearly delimit it outwards. So, when I say that there is a need to elaborate a theory of knowledge which tends towards the theoretical unity of biology, to what knowledge, and to what biology am I referring? The unity of biology must not be searched for in the prevalence of one theory or one discipline over the others, but in the search for a unique identity, in a view that reflects the immanent and the emergent features of its object of study, living beings, that allows the definition and delimitation of its own specific sphere of knowledge, that develops its own criteria of scientificity and that integrates biological praxis coherently and consistently in research and teaching.

For me biology as a scientific discipline is a heterogeneous group of intentions, facts reasonings and methodologies that provide different proposals for the ordering of biological knowledge beginning with different views. It could even be said that there is not one biology – there are many. This explains, from my point of view, the broadness and complexity of its goals, objects and methods. Biology studies the qualities and manifestations of life; it studies individuals, organisms, populations, species, communities, ecosystems and the biosphere in general; it analyzes and integrates these different levels of complexity as entities or as units, as elements or as systems, as events or as processes, as parts or as totalities. To do this it adapts and develops methodologies according to the type of entity, intention and problem involved .

Moreover, biology, just as any other science, is a human activity, and therefore has a practical and social function[5], that, through knowledge, tries to widen its limits, transcend to other disciplines and impinge on scientific culture. It is sometimes exaggerated biologizing all human spheres and problems[6], sometimes even with radical ideologies in response to the justification

[5] After the publication of J.D. Bernal, The social function of science, London 1938 – "nobody" doubts that science is a human activity connected directly or indirectly with all other social practices. It was one of the first documented works about the mechanisms and risks of the participation of science in the transformation of the world.

[6] A good example of this is the work of G. Bouthoul, Biología social, Barcelona 1971 Oikos-tau, in which the author makes the analogy between societies and living beings: "Dynamic sociology studies the movements that occur within societies. These movements are, properly speaking, the life of social organisms. Static sociology is like anat-

of abuses based on the myth of the neutrality of science or of the alliance between power and knowledge. The biological justification for aggression, the ideologization and politization of ecology or of bioengineering, and sociobiology are good examples of this[7]. This is not surprising – one's commitment and responsibility within scientific activity and its technological implications, its social function and its ties with the philosophical, ideological and even artistic spheres, depend on one's view of the world, of nature and of man[8].

To understand the current situation in biology, it is necessary to analyze the tendencies of its scientific practice and criteria of scientificity, according to ontological, methodological and epistemological approaches and their ideological determinations. As an example I present a brief characterization of the three most important tendencies in biology: analytical-reductionistic, systemic-holistic and processual-integrative.

ANALYTICAL-REDUCTIONISTIC TENDENCY. This is the tendency of the majority of "modern" biologists who work in the analytical-experimental disciplines such as biophysics, biochemistry, molecular biology, etc. The biologists and the research within this tendency are characterized by the following frameworks:

- ontological: historical and circumstantial alienation of the entity or object of study, that presupposes immanent qualities of the whole in the parts and vice-versa;
- methodological: based principally on the analytical method (hypothetical-deductive) with the intention of descending further and further until the simplest and most basic levels of organization are reached;
- epistemological: explanations and interpretations reduced to a minimum, with transfer of physical laws and theories to biology.

The objects of study are generally reduced to the elements of entities and biological events of a lower dimension; analyses are focused on the detailed study of static moments, of very concrete phenomena and functions; living beings are compared with machines or factories[9].

---

omy that examines organs at rest, whereas dynamic sociology is embryology and physiology in one. In other words, it is a true social biology".

[7] For more on these problems refer to S. Rose, H. Rose, The myth of the neutrality of science, in: W. Fuller, (ed.), The biological revolution. Social good or social evil? New York 1971 Anchor Books, p. 283-294; M. Sahlins, The use and abuse of biology. An anthropological critique of sociobiology, Ann Arbor 1979 University of Michigan Press; R.C. Lewontin, Biology as ideology. The doctrine of DNA, New York 1992 Harper.

[8] L. Leshan, H. Margenau, Einstein's space & Van Gogh's sky. Physical Reality and Beyond, New York 1983 Macmillan.

[9] Cf. P. Calow, Biological machines. A cybernetic approach to life, London 1976 Arnold.

SYSTEMIC-HOLISTIC TENDENCY. This is the natural tendency of biologists who study biodiversity (taxonomy, ecology, evolution, etc.), as a result of their training, reasoning, or their "intuition" based on common sense and on their years of experience. As opposed to the previous tendency, here the objects of study are entities or groups of them. They work with the individual, the organism, the population, the species, the community, the ecosystem and the biosphere as systems of elements that interrelate dynamically, as irreducible wholes with distinctive or emergent qualities that are something more than the sum of the qualities of their parts, and therefore cannot be understood by the simple addition of the structure or function of the parts. The attitude of biologists representing this tendency is characterized by the following frameworks:

- ontological: they view entities as a whole, as a hierarchical system of levels of complexity and organization, with emergent qualities for each level, that are not found in the inferior levels;
- methodological: they make expansionist analyses and globalizing or holistic syntheses, they develop an antireductionist methodology based on systems analysis to evaluate the interactions and the behavior of wholes at the different levels;
- epistemological: they correlate the explanations and interpretations of the different phenomena "discovering" the systemic laws and principles of organization and order that unify the different levels.

PROCESSUAL-INTEGRATIVE TENDENCY. Scientists and research done within this tendency integrate and evaluate the elements and relationships in systems, they make integral analyses and confrontative syntheses to understand, explain and reconstruct events and processes; they understand nature as historical, irreversible and unpredictable[10]; they consider science as one more human activity, with all of its implications, such as the need to integrate it to the other activities and interests of a specific society or nation and of humanity in general[11]. This last tendency considers the interaction between theoretical models and integration of knowledge between the two previous views. The notion of the potential is a possibility of the total expression of nature, as an interaction and integration of the immanent and the emergent, the immanent

[10] Cf. I. Prigogine, Tan solo una ilusión? Una exploración del caos al orden, Barcelona 1983 Tusquets; I. Prigogine, I. Stengers, La nouvelle aliance. Métamorphose de la science, Paris 1980 Seuil.

[11] Cf. the works of R. García and his philosophical position on theory of complex systems applied to teaching, research and regional planning: R. García, Conceptos básicos para el estudio de sistemas complejos, in: E. Leff (ed.), Los problemas del conocimiento y la perspectiva ambiental del desarrollo, México 1986 Siglo XXI; R. García (ed.), Deterioro ambiental y pobreza en la abundancia productiva, México 1988 CINVESTAV.

being the capacity to respond to a crisis and the emergent being the result of said response. In other words, the capacity to respond is immanent but it can be modified by the emergence of new qualities. The emergent qualities accumulate and increase the potential immanent capacities in the different levels of organization of matter. This is for me, from the ontological point of view, if not the only, the authentic dialectical and *processual* approach, to if not the only, the basic epistemological problem of the sciences, that try to explain the unity and totality of the diverse and the diversity of the unique and total.

I place TAP in this tendency of which I will explain the philosophical grounds in more detail to try to contribute to an integral understanding of the processes of nature and knowledge, of which man and science are a part. The philosophical grounds of TAP are of three kinds: ontological, epistemological and methodological ones.

3. ONTOLOGICAL FRAMEWORK OF TAP. TOWARDS CONSISTENCY IN THE *PROCESSUAL* VIEW OF THE WORLD

To speak of the universe, of nature, of the world or of man, and of their infinite expressions, is to refer to reality, that has been defined in many ways by different authors. In this essay the one that interests us is that which conceives of reality as a series of continuous processes[12], entities and phenomena with true and therefore material existence, objective and concrete, whose manifestations are knowable, but that exist with or without our knowledge, with or without our consent. This declaration, apparently obvious and trivial, is not so, when the consistency of the view and praxis of professionals of science are evaluated. This view can be extended by the following postulates.

The universe is the potential, the totality of being, of matter and of energy, without beginning nor end. Every expression of nature is connected to the totality and potentiality of the universe. All expressions of the totality, all entities are becoming. In nature only processes of spatio-temporal manifestations exist, and not static or eternal entities or objects. Alteration and movement are the immanent and objective capacities of matter that give it the potential to modify and to be modified by its self-development and interaction, expressing emergent qualities. Nature is an interacting group of processes that is constantly being modified in its becoming; it is the group of connections among

[12] The notion of process has been used with several meanings by different authors and in different contexts; in the biological context, the most interesting for us is that of M. Cereijido, Orden, equilibrio y desequilibrio, México 1978 Nueva Imagen, p. 30. For this author a process is "any change of matter, energy or information in a system (...) A process is the temporal sequence of the structures of a system (...) in reality systems do not suffer processes, they are the forms adopted by processes", p. 32.

phenomena, entities and their manifestations that are and are becoming spatio-temporally, forming a continuum. Said processes and their differential manifestations of matter and energy in space and time are expressed regardless of consciousness.

Consciousness is part of the manifestations of matter; consciousness is internal, it is a quality of the cognitive being, with which he or she can recognize him or herself, through his or her feelings, thoughts and actions. Therefore the consciousness of existence implies distinguishing between two spheres: the internal, subjective sphere (genetic-psychological) of one's own existence, and the external sphere (ecological-social) of the environment, of the objective conditions, of the existence of others, of what is beyond the conscious being. To distinguish between the internal and the external, between the subjective and the objective, is to establish an ontological-epistemological relationship between being and knowledge, which is mediated by the process of knowledge. Knowledge is the quality of the conscious and transforming being that allows him or her to apprehend, understand, construct and reconstruct reality and to establish a relation with it via his or her praxis[13], which not only transforms the present reality but makes possible the future of reality. To sum up, ontological properties are objective, their interpretation is subjective, but their combined becoming of existence as well as of knowledge, is the result of a reciprocal alteration of an unalienable ontological-epistemological relationship.

An ontological-epistemological relationship is a relationship with multiple causes and effects between a subject capable of knowledge and a knowable object. This relationship is determined by the world-view or conception ("episteme") with which the subject decides how the action will be carried out and by the process of knowledge itself. Under my conception of the connections and integrations between being and knowing, if consciousness does not intervene between becoming and reality, the continuity of existence flows "objectively"; consciousness interrupts, recognizes and reconstructs said continuity, "subjectively", altering reality.

Now I am going to refer to the alterity of processes: continuity and becoming of the world. The infinite possibilities of ontological expression are given by the same properties of change of matter (entity, phenomenon, etc.); these processes of alteration in nature occur at three levels or dimensions.

FIRST LEVEL: INTRINSIC PROCESSES OF CHANGE OR PROCESSES OF SELF-DEVELOPMENT (ALTERATION FROM THE INSIDE). The intrinsic capacity of change is a quality inherent to every entity, process, phenomenon or manifes-

[13] The concept of praxis has been elaborated and discussed extensively by A. Sánchez Vázquez, Filosofía de la praxis, México 1980 Grijalbo, p. 121-128.

tation, and it is the capacity of expressing itself in different ways in its spatio-temporal becoming. Thus a being has unity and continuity in itself (identity), but it also has a process of differential manifestation (alterity) throughout its existence.

This first element causing alteration contributes a certain deterministic component, because every phenomenon, entity or manifestation has a history that is translated into an inertial tendency of development; its orginal expression changes during its becoming. Nevertheless, this intrinsic capacity for change is not a destiny, but its capacity for alterity and at the same time its capacity to respond.

SECOND LEVEL: EXTRINSIC PROCESS OF TRANSFORMATION; OF CIRCUMSTANTIAL ALTERATION, OF COINCIDENCE AND TRANSFORMING INTERACTION; TRANSFORMED PROCESSES. A transformed process is the entity in movement, it is the becoming of the being and its circumstance; it is the process resulting from the intrinsic change of the entity, the changes produced by the interaction with other entities and the changes of the surroundings. The interaction of these processes, entities, phenomena or manifestations, simple or complex, produces transformations in the processes involved; a reciprocal alteration is produced that constitutes the second level of alteration of real processes, determined by the capacity and possibility of interaction and circumstantial alteration of every process, entity, phenomenon or manifestation and its circumstance (capacity to alter and be altered).

This second cause of alteration of processes contributes a certain aleatory component, because the becoming of an entity is altered directly or indirectly by the co-occurence of its existence and the existence of other entities which it alters and by which it is altered; in a word, a transformed process is a becoming of becomings. From this point of view, reality is not a stochastic process, it is a complex transformed process, which in turn, is constituted by an incommensurable group of groups, of transformed processes.

THIRD LEVEL: ALTERED PROCESSES. It is the transformation of the real entity into a unit of knowledge, i.e., the subjective alteration of processes due to the intention implied by knowledge (conscious or not). This means that reality can only have limits in space, in time and in space-time when it is translated to the dimension of consciousness.

This third cause of alteration of processes contributes one other component, that of creativity, because in the process of knowledge, the subject resorts to his or her previous information, experience and practice, using different procedures and devices (criteria, methodologies, techniques, etc.) that produce a new alteration of the transformed processes: the subjective alteration by the

subject. This last alteration or alteration by knowing, converts a transformed process into what I have called an *altered process*. An altered process (AP) is the moment when the subject confronts concrete and abstract; in other words, it is the process of obtaining information from reality and interpreting it. This implies recognizing the dimensional incompatibility between human knowledge and the manifestation of infinitely large or infinitely small events and processes, and infinitely complex, that make it impossible to perceive, explain, manipulate and transform the totality of reality because we are too small or too big. AP mediates between the reality of mega and micro transformed processes and knowledge, searching for the elaboration of epistemological and methodological tools that allow the translation of the different dimensions to enable to apprehend, explain, manipulate and transform said processes.

In general terms, the moment of confrontation is constituted by all of the instruments, intrinsic and extrinsic and their interaction, which the subject (scientist) uses in the process of knowing, in the elaboration of the abstract from the concrete, in the construction of knowledge.

In consequence, knowledge is an abstraction, a representation that intends to reflect as closely as possible, the concrete, reality. Knowledge is a permanent construction of a reality in constant change. Being a construction, it is a proposal of order and at the same time, a proposal of truth that tries to understand and reconstruct reality.

4. EPISTEMOLOGICAL FRAMEWORK OF TAP. THE INEVITABILITY OF INTERRUPTING REALITY AND THE DISCONTINUITY OF KNOWLEDGE

In TAP the moments of confrontation are indispensable for any critical analysis and evaluation. It is necessary to elaborate a group of epistemological instruments compatible with the conception of transformed and altered processes. The use of these processual instruments of knowledge, of analysis and synthesis are what enable an approximation to reality, since they enable the translation from the dimension and the continuum of transformed processes, to the dimension and discontinuity of knowledge.

FIRST EPISTEMOLOGICAL APPROXIMATION: THE RELATIONSHIP BETWEEN EVENT AND PROCESS. The first of the epistemological approximations that enable the translation of transformed processes to the dimension of knowledge is the spatio-temporal situation, the delimitation of one moment of the transformed process, its conversion into an event of reality. If a transformed process is the becoming of an entity and its circumstance, any point of said becoming is one moment of the entity and one moment of its circumstance, therefore it is a part of reality, located and/or restricted spatio-temporally. Said

moment, with limits and a certain level of connectedness is an event.

An event is one moment of reality, a conjunction of what is known to that moment, of what can be known at that moment and of the altering influence of the consciousness of the subject. To apprehend the object is to define and delimit its existence, to alienate it from its becoming. To know the events of a process then, means to fragment the process, rupture its continuity, to produce discrete components. An event thus allows approximation and contact with the subject who wants to comprehend it, because it is defined and delimited. That sample of reality, that moment of contact is – for epistemological purposes – a unit of knowledge that I have called a *tigmic unit*. To know a moment of reality, a *tigmic unit*, does not guarantee knowing all of the connections of the elements in coexistence at that moment, because the becoming is collective and the specific becomings have a certain degree of interaction and a certain degree of independence: they are in motion. Many events can be delimited from the same process, but each event is different, unique, because it is the result of the becoming of an entity or the co-occurrence of several becomings, in a present of entities that were not necessarily together before, nor would be afterwards. The longer the time and/or distance between two events, the greater the uncertainty about their connection.

The group of events constructed from one process, makes the reconstruction of continuity of the process possible. A reconstruction of the connections among events is a proposal of order in the procession; said procession of events is an altered process.

SECOND EPISTEMOLOGICAL APPROXIMATION: THE COMMITMENT OF THE DESCRIPTION. To know an entity, once it has been situated spatio-temporally, and at least a first event has been delimited, a second epistemological approximation becomes necessary: the translation of the manifest and potential, objective and concrete qualities of the entity into perceived or inferred features, subjective and abstract, to conform a unit of knowledge, a description. Units of knowledge, the concepts constructed from the commitment of the description become, thus, an important epistemological instrument, being the abstraction and initial representation of reality. The larger the number of units confronted with their entities, the more objective they will be. From the permanent confrontation between entity and unit, generalizations can be made that explain the entity. In other words, the unit represents the entity and enables its confrontation and explanation.

Units of knowledge are constructions related to the moment for which they are used. Each unit of knowledge has a certain function or plays a specific role. Units can be analytical or synthetic, they can refer to one moment or try to reflect

a process, i.e. they can be eventual or processual units. Some processual units some have methodological applications and others have theoretical implications.

5. METHODOLOGICAL FRAMEWORK OF TAP. TOWARDS THE UNITY OF BIOLOGY

In TAP, from the dialectical point of view[14], the praxis of biology implies: 1) recognizing the qualities of the object of study; 2) defining and delimiting its scope of action; 3) the permanent search for the theoretical unity of biology within a *processual* ontological conception; 4) establishing a reciprocal relationship of alteration between the object of study and the cognitive subjects.

It would not be possible to approach the object of study (living beings as a whole) to know them, constructing the appropriate units of knowledge and the pertinent theoretical formulation without sectorizing, without a precise focus and without the elaboration of the corresponding procedures, taking into account the eventuality of the manifestations and of the connections of the biological processes. On this basis, emergent qualities, that increase and accumulate the potential immanent capacities, can be recognized in the different levels of complexity and organization of matter, as well as their definition and the scopes to which they belong. These qualities are:

- *self-development*: a quality of matter; scopes of physics and ontology
- *self-organization*: a quality of organic matter; chemical and systems theory scopes
- *self-perpetuation*: a quality of living organic matter; biological and biosophical scopes
- *self-conscience*: a quality of living organic cognitive matter; psychological and epistemological scopes
- *self-responsibility and self-respect*: a quality of living organic cognitive matter aware of the implications of existence, of freedom and of happiness; philosophical, sociological and political scopes.

TAP IN THE SPHERE OF BIOLOGY. THE ESSENTIAL QUALITIES AND THE GENERAL PROCESSES OF LIVING BEINGS. To give a definition of life is beyond the

[14] "Noam Chomsky once remarked to one of us, who accused him in a conversation of being insufficiently dialectical, that he despised the term and that in its best sense dialectics was only another way of saying 'thinking correctly'. Now dialectics has once again become acceptable, even trendy, among intellectuals, as ancient political battles have receded into distant memory. In psychology, anthropology, and sociology, dialectical schools have emerged that trace their origins to Hegel", R. Levins, R. Lewontin, The dialectical biologist, Cambrige MA 1985 Harvard University Press, p. VII; for further information on the the dialectic method and its use in biology cf. the excellent work of C. Nowiński, Biologie, theories du developpement et dialectique, in: J. Piaget (ed.), Logique et connaisssance scientifique, Paris 1969 Gallimard, p. 862-892.

intentions of this essay. I will say only that the conjunction, interaction and interdependence of the most important functions and phenomena of living beings – metabolism, adaptation, reproduction and variation – constitute the most complex process and the most essential quality of life: *self-perpetuation.* In this process (identity-alterity), biological entities modify their adaptive and evolutionary potential through the possibilities of their genetic information; they improve their capacity of adaptive response and optimize their metabolic capacities through natural selection; and lastly, they multiply and propagate, increasing the number of individuals and their range of distribution. The bases for *self-perpetuation* are in continuity and change, a double process that occurs in time, from generation to generation, through reproduction.

LIVING BEINGS AS TRANSFORMED PROCESSES. Living beings are manifestations of a complex form of organization of matter and energy, and as such, they possess the capacity to alter themselves, alter others and to be altered by others. The intrinsic capacity to change, the capacity to alter themselves, alterity in the course of their own becoming, inherent to all transformed processes, constitutes the first level of alteration. The relationship between identity-alterity manifests itself during the process of ontogenetic development, thanks to which the individual maintains unity and cohesion of its elements and regularity and constancy in the connection, interaction and integration of its parts due to the genetic identity between the different stages that occur during development, and which have differential phenetic manifestations between stages.

The second level of alteration is produced by the interaction among the different processes in nature. An individual manifests itself phenotypically in different ways according to the conditions of its environs, constituted by other individuals, similar or different to itself, and the environmental conditions. In other words, the second alteration or extrinsic alteration, is the result of the interaction between the capacities of the individual and the characteristics of the surroundings, in which other individuals and the environment are included. This second alteration is a reciprocal process, because just as an individual is modified by the presence of others and by the environmental conditions, with its presence it also modifies the environs. These two alterations are present in all living beings internally and externally, simultaneously and continually, constituting a very complex procession of events.

THE BIOLOGICAL SPECIES AS AN ALTERED PROCESS. Biologists, regardless of their focus or approach (taxonomic, ecological, evolutionary, etc.) have a working unit: the species. Working with the species has posed, however, certain problems. On one hand, approaches to species vary from one branch

of biology to another. For example taxonomy defines and delimits species' features, i.e. it works with the discontinuities of the individual's entities; ecology defines and delimits the interactions between entities and the characteristics of the environment; evolutionary biology defines and delimits history of both entities and environment. On the other hand, problems arise from the variety of entities from which the species concept derives, (individuals, life cycles and populations). One example of this is that, as a rule, species are defined exclusively on the genetic flux of populations during sexual reproduction, ignoring the fact that many living beings lack sexual reproduction. A better criterion for the definition and differentiation of a species, at least for algae, would be to consider the generational continuity during reproduction of the individuals; then to characterize the different phases of the life cycle of the organism, and lastly, to define the continuity and reproductive potential (sexual and/or asexual) of the populations.

We can differentiate three basic types of criteria to construct different species concepts: logical, ontological and ideological; therefore we speak of a logical, an ontological and an ideological species concept.

The logical species concept (concept-category) has to do with man's attitude and capacity to systematize all events of diversity that he encounters; it is a form of appropriation and relationship with nature. It is always based on hierarchical criteria, methods and systems of organizing working units, i.e. taxonomic categories. It is the typical working unit in taxonomy. The taxonomic species is, by definition, a discrete unit.

The ontological (bio-logical) species concept (concept-concept) intends to describe, characterize and understand objectively the existence and qualities of biological entities. The ontological species concept cannot be a discrete unit since it intends to represent the manifestation of the biological processes of entities or of different discrete units in connection with the present and historical conditions. The impossibility of the identity between ontological processes and the process of knowing is implicit in the ontological species concept. It has been an excellent motivation for technological and methodological developments in different areas of biology.

Lastly, we have the ideological species concept (concept-notion), that has to do with the different ways of viewing and perceiving the world, and with man's capacity to know and transform it. In other words, its criteria for classifying the living are not necessarily related to the qualities of life or its concept. Thus, this concept is used anthropocentrically, with utilitarian, pragmatic and subjective criteria, sometimes questionable, but not, therefore, false or unimportant. For the ideological species concept all subjectivity is justifiable, because whereas for traditional science objective data are prevailing, for the concept-

notion it is more important to recognize science as a human activity in which every interpretation is a subjective appraisal of reality. Based on this concept the search for the connection between data and facts allows the reconstruction of natural events, processes and phenomena and enables the interpretation and generation of ideas and innovative ways of relating to nature, taking into account traditions. This concept is at the base of our culture and at the base of our current and future knowledge. Nevertheless, in all cases, the species concept is an epistemological discontinuity which intends to represent an ontological continuity.

A COMPLEX SPECIES CONCEPT (IOPS). In terms of the sectorization of the ontological totality of global biological diversity into discrete entities, capable of being known and transformed into units of knowledge, the concrete manifestation of a living being in nature is the individual, conceived of as a transformed process. Each individual is consequently an entity in movement that begins with birth and ends with death, passing through different stages in its ontogenetic development and/or different phases in its life cycle. All these manifestations – different among each other – maintain a certain unity derived from the quality of identity-alterity, which is defined by the content of the individual's own genetic information. Each of the stages of ontogenetic development and phases of the cycle is determined by this information.

During ontogenetic development the individual expresses its information differentially, therefore each stage is morfo-physiologically different from the others; in addition, starting from its own potential, the stages vary according to the conditions in which they are present. In brief, the individual is a concrete unit of continuity, and permanent action and interaction in the process of ontogenetic development of an entity.

In many living beings the life cycle is constituted by only one type of individual, as described above. But in many others the life cycle has two or more types of individual, that are distinguishable at least by their chromosomic number i.e. gametophyte and sporophyte of many plants. Each individual (phase) has its own stages of development, and in these unity and change also exist. The presence of different individuals may be unsynchronized in space and time, and can therefore play different ecological roles. In spite of these differences, they constitute one life cycle (alternating generations) and are one whole conformed by a procession of events that condition each other reciprocally. This whole is an organism. In short, an organism is an abstract unit of continuity and action and of relation between different chromosomic phases of a life cycle. When there is only one phase, individual and organism overlap because there are no differential expressions between phases.

The group of individuals possessing similar characteristics and isolated from other individuals by its internal exchange of genetic information i.e. sharing a set of genetic, morfophysiological and ecological characteristics – basic structural and functional pattern – conform a population. A population is the concrete unit of change and evolution.

The group of stages/phases of different individuals, of similar populations (sharing a basic structural and functional pattern) and that live in different spaces/times constitute a species. A species is the abstract unit of change and evolution, because it contains all the potentialities and manifestations expressed in space and time.

In consequence, the impossibility of separating these entities-units (individual, organism, population and species) in their ontological becoming (ontogenetic and phylogenetic processes) makes it necessary to establish a complex concept, IOPS, that epistemologically integrates the discontinuities of their manifestations and represents their phenomenological differences. Individual, organism, population and species thus form a new unit of knowledge that explicates the concept of species as a *complex transformed process*. This complex concept, IOPS, is also an approximation to the theoretical unity in biology that intends to understand and explain the manifestations of living beings by means of the process of self-perpetuation of life.

In sum, said process involves the *individual* as an ontogenetic process, where all vital functions take place (metabolism); with its qualities of identity in maintaining the features of a basic structural and functional pattern (unity) and alterity (change); that expresses itself as differential generational manifestations of the genetic potential (variation) in the *organism;* and with the capacity to respond to the environment (adaptation) with its differential, historical genotypic expression in the *population*; that maintains itself throughout time in the *species* by reproduction (continuity) and enables the establishment of phylogenetic relationships between the different existing basic structural and functional patterns (diversity).

AN EXAMPLE OF THE ELABORATION OF THEORETICAL-METHODOLOGICAL UNITS FROM THE CONCEPT OF IOPS IN THE PHYCOFLORISTIC SPHERE. The concept of IOPS is a major tool in the study of a flora. This complex species concept that integrates ecological and evolutionary units with a taxonomic criterion is based on the *meristic* and *holistic units*. In both the notions of the potential as a possibility of expression in nature and the manifest as a real expression spatio-temporally situated are included. The potential and the manifest are conceived of as an interaction and integration between the immanent and the emergent; the immanent is the organism's capacity to respond to a critical moment or phenomenon in its *self-perpetuation* (*biapocrisis*), involv-

ing metabolic, reproductive, adaptive and variational capacities (plasticity); and the emergent is the result of said response, adaptation. *Biapocrisis* is immanent but is modified with the emergence of new qualities (mutation and recombination), that increase and accumulate said potential capacities of manifestation in different IOPSs. Both represent the unity and totality of the diverse and the diversity of the unique and total.

Meristic units. They are the minimum spatio-temporal expression of an IOPS, i.e. an eventual manifestation of an individual at a certain stage of its development. A spore, a zygote, a gametophyte or a sporophyte at a certain stage of its development is a meristic unit and is different from all others. The meristic unit is the most concrete unit and the closest to the entity.

Holistic units. They represent the diversity of the unique and total of the meristic units and the unity and the totality of the diverse within an IOPS. It is the sum total of the manifestations of the meristic units of a natural group; it is a pattern for confrontation between the meristic units that constitute it and other holistic units. The holistic unit is a type that is gradually transformed as new confrontations are made; it is a structural and functional pattern that is constructed from the features of all the meristic units it intends to represent.

The difference between the holistic unit and the species category is that in the holistic unit the rigid and arbitrary limits of a unique and invariable type specimen that supposedly represents a structural and functional pattern are eliminated. This allows the incorporation of new data and the correction of delimitation errors (overlapping or closeness of qualities, features, measurements, etc.) by means of confrontations. The holistic unit is wider and has more content because the intention behind it is to define and connect rather than to delimit. It includes and evaluates intrinsic and extrinsic individual and populational variation, i.e. genetic and ecological.

6. FINAL CONSIDERATIONS AND PERSPECTIVES

This has only been an example of the application of TAP – a theory that express the becoming of the world and of knowledge – in the biological sphere and some implications in a few others. Many already elaborated aspects have not been mentioned and many others are in need of re-elaboration. Nevertheless, we can conclude that biology as a branch of knowledge, IOPS as a major entity-unit of living beings, and self-perpetuation as the essential quality of life, are altered processes.

TAP, as well as most biological theories – or at least those with an integrative focus such as taxonomy, ecology, evolution, etc. – as Peters[15] says, after Popper – have nothing to do with the requirements of falsifiability and prediction, to validate scientific theories; with said criterion (refutation method and objective knowledge), biological theories and disciplines with a holistic and organismic focus would be disqualified by the characteristics of their object of study and by their theoretical and empirical methods.

It is as detrimental to censor a theory without understanding it, as it is to accept censorship without questioning it. The danger of this discussion is falling into the trap of trying to prove or justify that falsifiable truths and important predictions are generated in biology[16]. It is accepting that the criteria of a specific (positivist) view of the world prevail, granting itself the privilege of judging other views; in other words, it is accepting that all theories must be sanctioned by the dominant scientific ideology. The hegemony of positivism in the scientific policy – national and international – in the evaluation and promotion of scientists or the financing of research projects has had as a consequence that many biologists search for the "identity"[17] in the use of methods borrowed from other sciences (mainly classical physics) promoting the impoverishment of their own field.

The existence of the concrete and its objective manifestations cannot be denied, nor can the possibility of knowing, learning and abstracting said manifestations according to the possibility of the concrete of being known and of man's cognitive capability. But one can or must doubt, and even suspect of any unique proposal of identity between reality and what is known; between the concrete and the abstract; between objective truth and subjective truth; or even worse, of a proposal of identity between the world and a view of the world[18], that is transformed into status quo and provokes the loss of hope, faith, of the sense and value of the individual's creativity, making him or her appear as only one more gear in the scientific machinery.

Scientificity and the scientific value of biological theories must not be measured by the absoluteness of its truths, or the completeness of its methodolo-

---

[15] R.H. Peters, Tautology in evolution and ecology, "The American Naturalist" 1976, v. 110, no. 971, p. 1-12.

[16] G.L. Stebbins, In defense of evolution. Tautology or theory?, "The American Naturalist" 1977, v. 111, no. 977, p. 386-390.

[17] Mexican scientists, and specifically professionals of biology, "must awaken and acquire their own identity, retrieve their identity, be aware of the importance of having their own identity, to have something to offer the world", B. de la Fuente, Peldaños en la conciencia, México 1985 UNAM, p. 101.

[18] Cf. J. Piaget, R. García, Psicogénesis e historia de la ciencia, México 1982 Siglo XXI, ch. 11, Ciencia, psicogénesis e ideología, p. 227-245.

gies, but by its capacity to respond, to adjust and change in its historical, contextual, methodological and conceptual development, to a reality that is not absolute or complete; and above all, by its capacity "to put scientific culture into permanent motion" (Bachelard).