BIOLOGY: AN OLD PERSPECTIVE

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The currently predominant scientific vision of the world originated in the "scientific revolution" begun in the XVI and XVII centuries by Copernicus, Galileo and Newton's theories. The technical and economic boom that produced the subsequent industrial revolution drove science towards a mechanistic, utilitarian approach to nature, the purpose of which was (and still is) to *predict* and *control* the studied phenomena.

Until then, the close contact with nature inherent to Western and other cultures' lifestyles had engendered an "ecological" vision of "Mother Earth". Scientific perception of the world was aimed at *understanding the meaning* of natural phenomena (in a religious or philosophical context) rather than trying to dominate them.

New knowledge from physics and ecology has highlighted the failure (and peril) of man's attempt to control nature, and suggests a need to return to an "old way of looking" at the world.

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Students of science history will not be surprised to find that "objective" scientific observations can easily be a reflection of the observer's own mental framework. This culturally determined "way of thinking" derives from the combination of more or less accidental historical circumstances that shape the beliefs of a specific society at a given time, along with personal circumstances shaped by the subject's own experience and training. It is what the science philosopher Thomas Kuhn called the "Paradigm", which is not a scientific theory or hypothesis, but a way of looking at the world which is influenced by scientific observation and experience, and also by the observer's cultural prejudice.

Scientific interpretation of nature, especially of the origin and relationships between living beings, is perhaps one the disciplines that has most clearly evidenced this "cultural dependency", most probably due to an unconscious, *a posteriori* attempt by the scientist to find or rather justify man's place in nature in accordance with the most profound, deeply rooted beliefs of his social and cultural context.

Not even the greatest minds of history have freed themselves from this trap. Aristotle's hierarchical concept of the animal world and different peoples can be explained by the fact that he was a member of the aristocracy and hence a slave owner. The theory of cataclysms and successive creations used by Cuvier to explain the obvious sudden changes in the fauna between geological strata had clear religious connotations in addition to the influence of his contemporary revolutionary spirit. There are hundreds of similar examples familiar to us, and thousands more...

So, what about the present concept of the living world?

The theory of evolution, the central idea to the description of the origin and relationships amongst living beings and between them and their environment, is apparently solidly based on Darwin's 1869 work, "The Origin of the Species by Natural

Selection". The influence of the predominant contemporary economic and social theories by Malthus and Spencer is obvious. Thus, if we at least admit the possibility that certain cultural influences or prejudices about the scientific perspective on the world, a brief reference to the current context is also pertinent. From an historical perspective, the present situation is none other than the culmination, and perhaps the start of the crisis, of the economic and social model that began at the time of Darwin's theory. The consolidation and sophistication of the two models have certain similarities. When the free market economy was expanding at the start of this century, the empirical basis provided by the mathematical theory of population genetics for the description and prediction of biological variation facilitated the reorganisation and consolidation of the Darwinian theory in academic circles. Under the name of the Synthetic Theory, it claims that the micro-evolutionary processes of random mutation that generate variability and random genetic drift are harnessed by natural selection or intraspecific competition, thereby acting as the driving force for change and evolution.

Let us try to withdraw from the time context (to do so from the cultural environment is harder) and try to contextualise the present paradigm. Although the synthetic theory has sufficient explanatory capacity and potential for experimental verification to explain the *observable* variability in *present* living beings, it is much less appropriate for explaining how this point has been reached. Even Darwin himself was unconvinced, writing, "Why, if the species have descended from other species through undetectably minute graduations, do we not see everywhere innumerable forms of transition? Why is the whole of Nature not in confusion instead of the species, as we see them, being well defined?"

If his theory was true "The number of intermediate and transitory stages between all living and extinct species must have been inconceivably great." In other words, there should be evidence of the transition between the different animal phyla (fish, amphibians, reptiles, birds, mammals), although this is obviously not the case. Moreover, the larger the amount of data available, the greater the evidence of the lack of a gradual transition between groups (Fig. 1). Darwin himself acknowledged that this was "the most obvious and serious objection that could be raised against my theory."

As in so many other cases, however, the disciples turn out to be more radical defenders of the master's theory than their master himself: the modern defenders of natural selection (the clearly predominant body of thought in the scientific world) claim that by working gradually through intraspecific competition on random mutations, natural selection is not only an acceptable explanation of present biological variation, but is moreover the *only* possible mechanism to explain it.

One extremely belligerent (and apparently successful) exponent of this attitude, the prestigious zoologist R. Dawkins (1), finds no difficulty in explaining the appearance of new complex structures in living creatures as the result of the accumulation of random mutations shaped by natural selection. He does not hesitate to use this mechanism to describe the appearance of the eye, for example, in spite of its complex structure and cerebral connections and its controversial evolution: "O ne per cent vision is better than total blindness, 6% is better than 5%, and so on upwards in a gradual, continuous series." This simplistic way of "explaining" the appearance of complex new organs and structures is quite common in texts on evolution, despite its obvious weakness, since otherwise they could not be explained in terms of natural selection acting gradually on random mutations as a mechanism for change.

Nevertheless, the lack of any creative role by this process can even be seen in the experiments that purport to confirm it: the famous example of "industrial melanism" in the peppered moth (Fig. 2) shows that natural selection can only explain variations within the limits of a certain species. In 1973, the French biologist Pierre Grassé (L'Evolution du Vivant" wrote that proof of Darwinian evolution "...Is merely the observation of demographic factors, local fluctuations of genotypes and of geographic distributions. The observed species have often remained practically unchanged for hundreds of years!" This phenomenon is familiar to palaeontologists. It has led S.J. Gould and N. Eldredge (2) to formulate the theory of "punctuated equilibrium", according to which most species appear suddenly in the fossil records and remain with few or no changes until their disappearance or sudden transformation into a different species that arrives fully formed (Fig. 3).

Proof of this (previously described by Cuvier in the XVIII century) should lead us to think that the way one species is transformed into another might indicate that there is something other than the gradual change mechanism postulated by the synthetic theory. On the contrary, however, Gould and Eldredge's interpretation does not leave the slightest room for such a possibility. They claim that these new species are formed quickly "in a geological context", but always through the action of natural selection on gradual changes.

Evidence for this phenomenon might have prompted Darwin to propose an alternative mechanism to explain these sudden changes. But it is too late. The Paradigm is too well entrenched.

One perhaps simple but nevertheless pertinent example can be found in modern cities. For the average citizen of industrialised countries, bound to the tough working conditions of a competitive society based on production and consumption, every individual is a potential competitor, customer or employee (this may also be extrapolated to international relations). This is precisely the "scientific" vision set out by Dawkins (3) in his "selfish gene" theory, based of course on the "objective" observation of relations between organisms, which is supported by a considerable number of biologists.

Of course this is an extreme example of neo-Darwinian tendencies, and has obvious ideological connotations. Not all scientists accept such radical socio-biological views. The majority, however, when subjected to the paradigm of natural selection as the driving force of change and competition as its main resource, try to justify the growing body of evidence for genetic variability in organisms, increasingly inexplicable in terms of natural selection, by pointing to a growing proportion of neutral mutations and random microevolutionary phenomena (4).

THE "SAMURAI" BIOLOGISTS

The apparent inability to accept that the fundamental problem, the origin of these divergent and often contradictory explanations, might be the cultural approach used in the to analysis, does not prevent this phenomenon from arising in scientists from other cultures.

One of the best-known Japanese biologists is Mooto Kimura. His "neutralist" theory of evolution is based on "orthodox" criteria and methods, (i.e., acceptable to western science), as he is an expert in population genetics. Nevertheless, his conclusions appear to question the Darwinian model. He claims that the majority of DNA mutations are neutral, i.e., they do not give the organism a real advantage in the "struggle for survival". Naturally, as a specialist in population genetics, he has been able to test the action of natural selection, although he does not believe that it has the "creative" importance attributed to it by Darwinists.

Another highly prestigious Japanese biologist, practically unknown in the West, is less influenced by the "orthodox" methodology. Kinji Imanishi (University of Kyoto), who has been studying evolution since 1941, claims that Darwinism errs in over-emphasising the individual, when in fact the group is the real entity. Nature encourages continuity, mutual relationships and stability. He believes that the basic concept is "coexistence" and not the Darwinian "competition principle". Change is progressive and co-ordinated in cells, organisms and in populations. In evolution, all individuals of a species change at the same time when the moment arrives. It is a "maturing" process, not a random mechanical change in a few genes.

The most interesting feature of this vision, which is the closest match to the fossil record evidence, is that the author acknowledges its cultural component- an attitude hard to imagine in "orthodox" scientists: "Darwin lives in the West and Imanishi in the East", he writes. Western culture exalts individualism; life is competition, while Eastern philosophy/religion is impregnated with a sense of solidarity, the preponderance of the society over the individual.

In "Darwin amongst the Samurai" (Mundo Científico, vol.6, nº 4), the French biologist Pierre Thuillier discusses Imanishi's theory: "Hence, the anti-Darwinist theory can freely develop a "poetic vision" that has the basic advantage of appealing to the Japanese public. Ultimately, the harmonious nature described by Imanishi plays a "compensatory" role. When the Japanese experience harsh competition in their everyday lives, the evolutionary utopia offered to them gives them a reason to believe in a better world."

Apart from this questionable interpretation of Japanese society (a lot could be said about how such competition is organised, its social integration and its results), it is striking that he justifies the origin of a scientific theory on both its cultural context and the "tastes" of its audience. The author does not, however, suggest a similar phenomenon in the "Western" theory, as from his cultural perspective, "It is proven that intraspecific competition is manifested in 90% of the cases studied". He goes on, "Have Kimura and Imanishi been *carried away* , so to speak, by the same cultural wave?"

Thuillier claims that, "Imanishi brings us back to an old, still unresolved problem: the integration of Western science [i.e., *Science*] by an *outside* culture." (the present author's italics). *Outside* cultures (outside what?), however, may have "useful" aspects. Thuillier discusses Werner Heisenberg's opinion about the Japanese physicists Tomonaga and Yukawa: "For example, the great contribution by Japan to quantum mechanics since the last war may indicate a certain relationship between traditional Eastern philosophical ideas and the philosophical contents of the quantum theory. It may be easier to adapt to the quantum concept of reality when one has not yet been subjected to the simplistic materialism that still reigns in Europe in the final decades of this century." For Thuillier, this *cultural way* of looking at matter (the Paradigm) seems valid when describing some aspects of reality but not others, as he concludes: "The difference is that Yukawa turned to physics and in 1949 was awarded the Nobel Prize, while Imanishi, who continued to reject the "bellicose philosophy of neo-Darwinian evolution, chose to challenge it with anti-western evolutionism."

It thus seems that matter,*reality*, differs according to one's scientific discipline.... Or perhaps it might be that the differences depend on *who* is doing the studying.

Let us briefly return to quantum physicists who seem to have disengaged themselves from their cultural context to some extent (their obvious advantage is that their study matter is abstract tand thus avoids socio-economic nuances). What is the "philosophical component" of their theory that suggests such kinship with Asian traditions?

Put simply (with apologies to Dr. Heisenberg), there are three outstanding aspects: put in "accessible" terms, the first is that subatomic particles, the ultimate components of matter, are not "individual entities" (particles in a material sense), but only exist in terms of their relationship with the rest. The second is that energy/matter, produced by these "systems of particles" is organised into discontinuous "quanta" from the level of elementary particles up to the Universe. These systems are formed by lower level systems that interact in such a way that "the whole is more than the sum of its parts", called "Holons" by the physicist A. Koestler.

The third and perhaps hardest feature to "visualise" is that the elementary particles, electrons, have the dual quality of being particle and wave at the same time-opposing and at the same time complementary conditions, and thus their essence cannot be described at a given moment other than in terms of probability.

QUANTUM NATURE

These three concepts all differ from the mechanistic, materialist view of reality describe by Heiseberg, but are accepted by the scientific community as if they were scientifically demonstrable facts, (i.e., empirically and experimentally), in spite of being hard to "visualise" materially. If, however, we focus on our "visual field", an intermediate space between subatomic particles and the Universe, we might have a "direct experience". Can these concepts be applied to the living world by applying the freedom of the physicist's mind?

Let us consider the first two points. Although the trend or inevitable necessity in biology for specialisation leads to the study of very restricted aspects of living beings (at times to a surprising extent), it seems clear that the concept of the "independent organism" has little real value. Ecology explains that living beings organise themselves through intense exchanges with their surroundings, which in turn are organised as a dynamic, highly integrated ecosystem. The sum of these ecosystems also makes up system of living and non-living forms at different levels, amongst which there are interrelationships and interdependencies. Finally, the whole biosphere constitutes an enormous dynamic, self-regulating ecosystem.

At lower levels, the organisms themselves are open systems composed of units that are grouped into organs that work in co-ordination with others, and which at the same time are formed by cells- highly complex systems that include mechanisms to transform energy, information and regulation networks, the generation of internal and external structures.... All of these levels have the common quality that the whole is more than the sum of its parts, none of which can survive if not in harmony with the rest. Not even genes can be regarded as individual entities, since their activity (and existence) depends on the co-ordinated interaction of many regulatory proteins, histones, RNA and even other individual or grouped genes that must be synchronised. In other words, biological processes seen in overall terms are in effect systems that integrate different levels and work in harmony, as a whole according to the "eastern-quantum" perspective. Of course the relationships between each component could be described more prosaically (more "objectively" in our perspective) in terms of *struggle* or *competition*: a way of describing biological phenomena such as the selection of males for mating, food gathering, the immune processes and even the mechanisms for genetic regulation, which can be defined in terms of "competition between histones and the transcription factors" (5). This interpretation of struggle or competition may, however, have an element of observer input which, when the specific fact is analysed, might understate its significance or function in the more global context of its relational system and the final results.

BACTERIA: "QUANTAL LIFE"

One spectacular example of such a dual interpretation is a phenomenon that I consider crucial to biological processes- the origin of the eukaryotic cell and hence the first component systems of living beings.

The mystery of the formation of the first cell, a complex and exquisitely interweaving of processes that is so hard to explain from an orthodox perspective (6) as a result of gradual, more or less random chemical processes, has been explained by Margulis and Sagan so soundly that it is considered to be one of the few scientifically proven evolutionary processes. The insertion of a *Prochoron* bacterium, or aerobic bacteria like *Paracoccus* or *Rhodopseudomonas* , into another (Fig. 4) seems clearly (morphologically and functionally) to have been the origin of chloroplasts and mitochondria, essential organelles of eukaryotic cells. It can also be verified by deciphering and comparing the DNA of these organelles with the above-mentioned bacteria, revealing surprising similarities that are indicative of a faithful conservation of these DNA sequences from their origin. The authors also claim to have observed the symbiotic origin of eukaryotic cell organelles in the derivation of cellular microtubules from spirochaetes.

The orthodox interpretation of this extraordinary process is that it is a case of phagocytosis (i.e., one "bacteria industry" or "bacteria bank" devouring or assimilating another) conferring a selective advantage , or a case of parasitism (by which one benefits at the other's expense).

From a different perspective, i.e., from outside the paradigm of competition as the driving force of evolution, it can be described as the integration or co-operation of two or more systems, the result of which something more than the sum of its constituent parts: Bacteria are systems, totalities, what physicists call Holons and, although seemingly strange, this integrity ensures their sudden appearance, given that totalities, like quanta in physics, cannot appear gradually. This different perspective might encourage a search for the *meaning* within the phenomenon- its *teleological* content (which is not in itself negative or ascientific, but merely a possibility), and allow the deduction or induction of the results or consequences of such co-operation.

This concept (or something similar) has been used in a rigorous study of the phenomenon by Margulis, who defends bacteria against their "excessively maligned" traditional role ("What is Life? Simon and Schuster, 1995) as merely the source of illness, overlooking their vital role in the origin of eukaryotic cells and a wide variety of important functions within the dynamic relationship between the "living" and "non-living" worlds. It is generally accepted that in the origins, the extraction of carbon dioxide from the primitive atmosphere and the generation of an atmosphere with a high oxygen content was largely due to the activity of photosynthetic bacteria and subsequently of unicellular algae, their first descendants.

Moreover, present-day bacterial functions may differ greatly from the pathological character usually ascribed to them. Some fix nitrogen in poor soils and facilitate plant life which would otherwise be impossible, others produce fermentation and make substances assimilable and useful to complex organisms which could not be exploited without such prior activity. Some do their work in herbivore intestines, some in humans, while others transform elements that are toxic to other organisms such as nitrogen, sulphur and carbon compounds into organic matter that can be absorbed by plants.

The neo-Darwinian explanation of these *necessary* processes for life might "simply" be that the bacteria have adapted to a lifestyle that coincidentally is useful for life itself. However, there is further process (guided mutation) which disturbs the defenders of the orthodox theory, as it may well "waken the ghosts of Lamarckian evolution", although it might also shed light on the matter. It has been found (8) that when certain bacteria are presented with a food source they cannot use, they mutate (in this case two independent mutations which alone would be of no use) that facilitate the assimilation. The probability of this simultaneous event happening spontaneously is virtually nil. It is thus a response to the environmental conditions, and hence a post-adaptive mutation.

In other words, as Margulis indicates, they are not merely pathogenic agents but a basic component of life. They obviously have a pathogenic character, but one might consider that this is so when an external phenomenon disrupts the harmony (or, if that sounds too "eastern" or unscientific, the *balance*) by which biological phenomena occur in nature. In an ecological sense, is there a "bad guy" in the food chain?

THE VIRUS: MESSENGER OF DEATH - MESSENGER OF LIFE?

Speaking of "bad guys", there are other "critters" that do not seem to fit into this "harmonious" vision of the terrestrial ecosystem. Judging by the social repercussions echoed in the scientific and general media, the virus has apparently become the worst enemy of the human race.

In scientific terms, the way they invade cells, their self-organisational ability, their origin and place in nature, etc., are still a mystery despite their detailed study and our knowledge of many of their genetic sequences (Fig. 5).

These beings on the boundary between the living and non-living worlds have no real existence except within other organisms. Outside, they cannot be regarded as "live" organisms. They are simply a DNA or RNA molecule wrapped in a protein capsule of a sometimes surprisingly geometric shape. The way that these "inert" bodies inject their genetic material into the host cell is also surprising, but more astonishing still is that with their genetic material they feed in the enzymatic machinery that makes it possible to cut and merge the host cell's DNA with their own, entering the host cell where they can stay inactive or begin to translate their own genetic information. In some cases this information allows new viruses to be constructed using the cellular machinery until the cell is destroyed and others are infected. This is their pathological quality. Others, however, merely feed their genetic information into the rest of the cellular DNA (Fig. 6).

The biological significance of this integration process may be familiar to the reader: it is a means by which two genetic units (two systems) can combine into a single larger unit. How does this fit into the evolutionary context? This feature makes the virus worthy of consideration as a potential mechanism for the input of complex DNA sequences into animal and plant genomes. By taking the unconventional path, i.e., instead of trying to fit the data to a preconceived body of ideas that explain evolution, we shall look at the data afresh and then see what plan they suggest.

Variable amounts of DNA known as "endogenous viruses" have been found in animal and plant genomes. Most of the different types are thought to be derived from exogenous viruses that infected the species in the past and have become endogenous by insertion into germ cells. Thousands of sequences of viral origin are being discovered that actively participate in the function of distinct tissues. Some of these sequences can be regarded as true genetic fossils; "ancient" proviruses that have undergone multiple mutation although they can still be linked to some present retroviruses. Others occur in the form of mobile or *transposable elements* (TE)- DNA sequences capable of moving and inserting themselves or their copies into new locations in the genome.

The meaning of the presence and activity of all these viral elements in animal and plant genomes can be deduced from their effects. Through their reinsertion, the mobile elements can provoke chromosomal reorganisation and, above all, changes in gene expression and regulation, with important evolutionary consequences. A retrotransponson has been described that is responsible for the modification-amplification of the expression of the genes involved in amylase secretion. In mammals it is only secreted in the pancreas, but in humans it is also secreted by the salivary lands, thus extending the range of food that can be ingested- a clear adaptive advantage. Other retrotransposons are involved in the regulation of genes linked to hystocompatibility (9), and to the expression in tissues of human, mammal, invertebrate and plant alphaglobines (10, 11, 12, 13).

This explains the lack of correspondence in attempts to link the morphological evolution of closely related species to the rates of amino acid change in proteins: it may have taken place primarily by means of changes in the regulation of genetic activity rather than through changes in amino acid sequences.

Recent discoveries are even more spectacular (and informative) about the activity of endogenous viruses: in some cases, endogenous retroviruses can carry genes from the somatic to the germ line. In a recent study, Rothenfluh demonstrates the existence of a genetic transmission mechanism of the acquired immunological memory of lymphocytes to the germ line, thus constituting a strictly Lamarckian mechanism. In other cases, the retroviral sequences are expressed directly: nearly 1% of the 10,5000 completely known genetic sequences expressed in 37 animal tissues correspond to endogenous retroviruses and are expressed as a constituent part of the brain, placenta, embryo, lung, etc. (Genome Directory, Sept. 1995).

Finally, another important form of activity from an evolutionary-mythological perspective has been discovered in HIV-1 retroviral antigens, expressed in human placenta trophoblast cells. This important task contributes to the *morphological differentiation* of these cells.

Data from a well-studied organism in developmental genetics can provide clues to the obvious evolutionary significance of this phenomenon, as well as in terms of the control of cell proliferation: 15 retroviral sequences have been identified in Drosphila embryos, whose purpose is the spatial and *temporal* control of the development of different tissues (12).

An expanding body of this type of information can be found in recent (and doubtlessly future) scientific publications on molecular biology, virology, genetics, etc.

A VERY OLD NEW MODEL

Returning to the previous theme, what might this type of information mean from an evolutionary perspective? In the above context, it provides a reasonable answer to several unresolved problems for the Synthetic Theory:

Firstly, it demonstrates the existence of a mechanism by which the *new* genetic information may be fed into genomes by the integration of a complete system- a mechanism that is much more plausible than the mutation-disorganisation of a closely interconnected cellular system. Secondly, it may explain the appearance of these new sequences (Goldsmith's "macromutations, se Box 2), in a sufficient number of individuals to facilitate their survival as a species. And thirdly, the sudden changes associated with this phenomenon would prove the existence of the saltationist phenomena observed in the fossil record.

Defenders of the conventional evolution theory would not hesitate to reject these three general aspects, but if we avoid the theoretical or philosophical implications and focus on the rationalist, Cartesian methodology -the only one in our cultural context of any use for a scientific analysis of reality, we can seek possible proof for these three suppositions.

Abundant molecular information solidly backs the first aspect: one significant example is the extremely conservative nature of ancestral sequences that can be traced from bacteria up to higher organisms. They can be followed from the regulatory sequences of genetic activity such as the TBP (the "universal protein"), through cellular proteins, up to cellular structures such as microtubules. This astonishing pattern is often mentioned but rarely given any importance. However, it would obviously not happen if evolution were to happen by small random mutations that had diversified the DNA from the bacterial origin up to the present organisms.

This is not a mere hypothesis or interpretation. The changes and chronology of genetic sequences by integration have recently been documented: sequence analysis of genes related to the expression of amylase in human salivary glands suggests that the retrotransposon responsible for amplifying its expression may have been inserted 45 million years ago (the palaeontologically established point of separation between prosimians and anthropods (9). Furthermore, the retrotransponsible element L-1.2, the first to be identified in the human DNA in chromosome 22, has been located in the same place in chimpanzees and gorillas (15), suggesting that it has been at the same genome location for at least 6 million years.

Spectacular results have been obtained recently in the study of large tax, although they do not lead to any evolutionary interpretation as they are inexplicable from the official paradigm. A considerable difference between the retroviral "populations" of reptiles and those of birds and mammals has been demonstrated (16). Does this have an explanation from our perspective?

Other, less demonstrable but no less indicative proof can be added to this list. Several aspects of embryonic development have been interpreted lucidly by Charline and Devilliers (17) in an evolutionary context. They claim that the biological variation of the Synthetic Theory, which states that genes are treated in calculations of evolutionary genetics as being independent from each other, "is an unsustainable reductionist position. Not all genetic combinations are actually feasible. There is a small number of genotype combinations for each organisational plan." The genome now appears to be "a system organised into hierarchical and interconnected functional levels." The gene ceases to be *a free agent* , and becomes "a member of a society whose correction mechanisms restrict its potential for variation within a range of the possible and the impossible". The stability of these paths, however, would not imply that they were unalterable. natural selection has clearly worked in living beings, but only on specific characters in the final stages of embryonic development, whose inflexibility diminishes as the initial "almost immutable" stages such as those that determine the overall organisation are superseded by phases that are more "open" to minor changes.

The action of retroviral sequences involved in *cellular differentiation* is perfectly plausible in this embryonic mechanics of "hierarchised and interconnected functional levels", as this is a means of feeding into a closely knit system the sequences (the system) necessary for the expression of a new tissue (or even an organ) with a large number of equally interconnected processes that this requires.

Strange as it may seem, the experts in ontolonogenetic development are not surprised. They conclude their article by asking, "Have these intermediate forms, so often lost and missed, always existed? Are they not in many cases simply the fruit of imagination impregnated by the necessity of continuous series?" The conclusion from the rigorous analysis of embryonic processes and their role in evolutionary change is clear: "The discontinuity (of the fossil record) may not be contingent- linked to gaps in the record-, but rather fundamental, which can be attributed the evolutionary mechanics."

What is really disturbing about this more than plausible evolutionary mechanism, however, is that it inevitably implies that the viral sequences which most probably have been involved in the evolution process must have contained *a priori* complex sequences with a biologically consistent expression. Naturally one may think that their current expression may have been acquired "randomly" after their insertion, but certain anatomic facts help to choose one of the two alternatives.

"Mosaic evolution", normally used as an example of gradual change (Fig. 7), is usually explained very vaguely in palaeontology texts. Often used examples are the "mammal-like reptiles" from the Permian and Archaeopterix (268 and 150 M.y.a., respectively). However, these examples not only give the impression of a gradual change, but also of large-scale reorganisations that involve simultaneously interrelated sets of tissues and organs (for a deeper analysis, see "Lamarck y los Mensajeros" by the present author).

Perhaps the most important information in this sense stems from a much more surprising and controversial evolutionary process. "Adaptive convergence" has been defined from the neo-Darwinian perspective as proof "of the incredible ability of natural selection to collect *good designs*" (1), i.e., incredible similarities produced by random (and individual) mutations that survive and dominate as a result of similar selection pressure. This claim, however, is based more on a firm belief than on scientifically proven facts. How can these random, independent mutations explain the surprisingly close resemblance in the general morphology of species from different sub-classes of mammals that branched in the Early Jurassic (200 M. y.a.) and have evolved separately since then, e.g., marsupials and placentals? Morphologically similar versions of wolves, cats, moles, flying squirrels, anteaters have arisen in Australia (Fig. 8). Is the same morphology necessary to move across the ground and feed? Is it imposed directly by habitat, which on the other hand is not absolutely identical on every continent? Why could the randomly produced organisational plan not have led to the existence of a chickephant, for example?

The present or past existence of complex genetic sequences that led to these "general designs" may seem mysterious, but on clear reflection, it would be even more fantastic if they had been reached via processes that are accepted as logical by the conventional evolution theory. Whatever the case, for orientation purposes we may recall a mammalian order in the early Palaeocene (66 M.y.a.), the Creodonts, which left no "direct" descendants, i.e., they bear no relation to their present counterparts although their remains prove that their anatomies "resembled" ferrets, cats, wolverines or dogs. Similar phenomena have also been observed in insects and plants.

Taken together, these arguments probably cannot even establish the plausibility of this process, so we shall make a final effort using the arisal of the eye, an incredibly complex and efficient structure with simultaneous essential neuronal complements, which has been the subject of fierce debate. Some sequences even belong to retroelements involved in the formation and function of the crystalline lens (18). The existence and structural similarity of the eye in many phylogenetically distinct lines has obliged acceptance of the surprising idea that because it is an efficient model, it may have arisen several times in the (fantastic) random process of evolution. Pausing for thought along the rationalist method, this multiple development would be statistically equivalent to the probability of a gorilla (or in its absence an action movie star) bashing away at random at a typewriter and producing Don Quixote several times over. In spite of the range of "environment pressures" , however, it is surprising to see the close resemblance of, for example, vertebrate and octopus eyes.

All of these data lead us to propose an alternative concept or model which Darwin himself would probably have accepted as a clarification of his doubts. It is an old model that shares the concepts of Cuvier and Lamarck who, incidentally, can be found at the deepest roots of Darwin's work.

In effect, "intermediate stages" cannot be seen in the fossil record, nor even in living species, because they probably never existed. We have also seen that the inheritance of acquired genetic characteristics is possible, and even the horizontal transmission of these genetic sequences amongst species in different phyla is possible (19).

Furthermore, we would also accept the evidence of data that shed light on an old debate: whether selection equals (or implies) *adaptation* but not *evolution*. The truth is in fact completely the opposite. Moreover, even if one accepts the "non-creative" but conservationist role of natural selection, it is still impossible to adduce a fundamental role to all-powerful chance, in the light of two striking facts that have been disputed since the onset of the Darwinian theory: the response of organisms to natural selection and the perfect adaptations to the environmental conditions (in many cases so sophisticated that Darwinian biologists tend to use Lamarckian expressions, "The branchii grow longer or increase their area *in order to* extract oxygen more efficiently in deep water", etc.). The complexity of processes involving many adaptations makes their appearance extremely difficult to justify as a random action of small *individual* mutations and their subsequent slow expansion through the population by means of mechanisms proposed in population genetics.

There are, however, mechanisms that seem to justify "mutations" as a response to the environment, making these two phenomena more reasonable.

Recently (20) non-pathogenic viruses have been found to undergo multiple mutations that render them virulent as a consequence of dietary deficiency in the host. The Coxsackievirus is a family of two types- A and B. Their infection of humans induces pathologies in only 10% of cases, some of which have been well documented experimentally. In mice, for example, the CVB3 and CBV4 viruses produce inflammations of the myocardia and pancreas respectively.

When mice were inoculated with a non-viral strain of Coxsackievirus 3 (CV3/O), a selenium-deficient diet was found to produce a single, extremely virulent type of CVA3 in different mice 10 days after inoculation. Their genomes revealed that they had undergone 6 nucleotide changes at the same 6 positions. Studies of different nucleotide changes in the CVB3 genome confirm that there is a small number of changes linked to this virulent trait, i.e., not just any change will do.

The paper interprets this obvious response to environmental stress through several independent mutations (reminiscent of what we have seen in bacteria) in a way that is driven by the *obligation* (perhaps unwitting) to not transgress the orthodox interpretation, i.e., the paradigm. It claims that there were multiple random mutations and what was found in the different mice was the result of selection that had led the different viruses to precisely the same mutations.

This interpretation is hard to defend. It is a further example of the way that scientists "tend to see what they have been trained to see, and cease to see what they *know* should not be there" (Kuhn). Subjecting the data to the paradigm of competition as the driving force of change impedes one's view of the obvious, and leads to interpretations that are at times so complicated that they verge on the miraculous in explaining much simpler phenomena (albeit no less mysterious to our mental schemes- Fig. 9).

The aggressive vision of nature criticised by Imanishi sometimes turns scientific language into something reminiscent of military terminology. We are at war against the virus, at war against bacteria, against insects... But perhaps, as has often been the case in human history, we have provoked them beforehand. The difference is that in this case, there might be no winners.

However, by distancing ourselves from this viewpoint, well-reasoned explanations can be found to the evolutionary predicaments arising from such strained and often contradictory interpretations.

Viral integration provides a mechanism to explain the saltationist phenomena (obvious in the fossil record), speciation and even rapid response to the environment. Evidence of post-adaptive mutations in virus (also seen in bacteria and yeast) and the ability of the virus to integrate and then leave the genomes of living beings, explains horizontal transmission between different species, and even between different phyla.

The latest discoveries of these surprising phenomena suggest that the whole concept of nature may have to be reworked. It is not a matter of starting over again (the methodology and specialisation have amply proven their efficiency), but rather changing the way of interpreting the information which, as we have seen, lead to different answers. And these answers in turn make us ask new questions:

Might this response by the virus to environment stress explain the existence of sources of "emerging viruses" in populations subjected by the economic system to harsh misery and famine? When humanity lived in harmony with nature, we must have lived in a reasonable balance with micro-organisms (which does not mean that we were free of illness), and the permanent famine we see now at different points of the planet were then only sporadic events.

Are "scientific" manipulation such as the production of vaccines using ape blood, or xerotransplants (using the tissue of other animals) perhaps feeding specific viral sequences into humans from animals that might have terrible repercussions?

Are treatments using broad spectrum antiretroviruses on AIDS (or simply seropositive) patients damaging retroviral sequences that normally work in different organs, accelerating their death?

And finally, might "oncogenes" not simply be sequences of a viral origin, whose purpose is to work during embryonic growth to produce the cellular differentiation and proliferation of a specific tissue (an interesting clue is the extreme cellular specificity of the virus)? Might tumour proliferation be "simply" an activity of these sequences at an unfortunate moment, either due to environmental factors, of renowned influence in viral activation such as radiation, foreign chemical substances or dietary habits or deficiencies?(21).

The answer to these questions (and their practical consequences) does not imply that the "Paradigm" needs to be questioned, but it does highlight the need for a change of attitude in scientific and philosophical vision of natural phenomena. There may well be a great deal of truth in the harmonious concept proposed by Imanishi: the ideas of concerted change and maturing (Lamarck's trend towards complexity). This also indicates that a process may be underway that is still beyond the scope of our scientific and technical ability which are, in fact, a result of our way of thinking. Because what is definitely beyond doubt is the enormous danger (especially for humanity) of senseless attempts to manipulate biological processes which we really do not understand.

We do *not* dominate or control nature, although we are convinced that we do. We can only attack it, and we cannot predict its response, the way it will regain its balance. Unfortunately, this is not a metaphor but a fact that "ignorant natives" the world over have discovered and suffered: our science, our culture with its reductionist and mercantile attitude has focused too much on studying trees and the profit that can be made from them, which is precisely what has prevented us from discovering the beauty and harmony of the forest.

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Box 1:

The selfish gene hypothesis or theory can be regarded as the philosophical culmination of liberal economic Darwinism taken to a mechanistic, reductionist extreme.

At present it is widely accepted by many biologists, especially geneticists and biochemists, who regard it as a good model to explain the variability of genetic sequences in different animal and plant genomes.

The theory claims that the real unit of evolution is neither the species nor the individual, but the individual gene or DNA segment which is virtually eternal once it has gained "supremacy" amongst populations. Organisms are only a vehicle, a survival machine for the genes.

According to Dawkins, all animal behaviour is guided by the following principle: "For every survival machine, every other survival machine is *an obstacle to overcome or a resource to be exploited*".

Criticism of this warped vision of nature includes the fact that this theory has become part of the British neo-Nazi party ideology. But it is not necessary to seek out radical ideological connotations. The theory is actually the basic idea underlying the business and social relations of our "free market economy".

Box 2

In the 1940's, the German geneticist R. Goldshmidt was the first scientist to propose a genetic explanation for the saltationist phenomena found in the fossil record. He found that ordinary and isolated mutations in Drosophila were too small to be extrapolated to macroevolution. There had to be "macromutations", i.e., mutations with an instantaneous effect that had a great influence on the viability of the individuals. The reaction by "orthodox" scientists was cruel. They claimed that the results of these "macromutations", which they sarcastically called "monsters with a future" or "hopeless monsters" would have no partners to mate with, and would thus have no place in evolution.

Nevertheless, viral integration not only makes "macromutations" feasible, but also the simultaneous appearance of a considerable number of "monsters with a future".

Figure legends

Figure 1

The comparison of basic components in today's major taxa (DNA, RNA, cellular proteins and even hormones") provides increasing support for the existence of these gaps in the fossil record. The phylogenetic relationships deduced from them are "lateral kinship", not descent.

Figure 2

"Industrial melanism" of the peppered moth is a classic example of direct observation of natural selection, and is commonly used in texts on evolution. When light-barked birch trees and building facades in England were darkened by industrial pollution at the start of the century, the dark moths became more abundant than the pale forms because predatory birds found them harder to see. When the pollution was reduced, the pale varieties became predominant again, i.e., only the proportions of each colour changed.

Figure 3

The presence of "living fossils" is usually attributed to the stability of the marine habitat, but this stability cannot explain the sudden disappearances and transformations that are seen in both the marine and terrestrial environment.

Figure 4

Research is bringing to light a growing number of bacteria which enter another and actively participate in their life cycle. The truly astonishing aspect is that this cannot be described as a case of phagocytosis or parasitism. It is real symbiosis which is transmitted by inheritance in many cases, i.e., the symbiotic association is maintained during reproduction.

Figure 5

The usual explanation for the origin of the virus is a fragmentation of genetic material, which "somehow" escaped from the original cell. This explanation might be comforting to a mechanistic mind, but neither its strange properties nor its appearance are so. the illustration shows a T-type phage. The electron microscope photograph shows a l -type phage "landing" on a bacteria. While those who have studied biology are familiar with the image and know (?) its origin, the traditionalists try to convince their "profane" audience that it is "merely" a piece of DNA that "escaped" from a cell.

Figure 6

The biological cycle of the virus, first seen in bacteria and then in eukaryotic cells, has two alternatives: in the lytic phase (A), the virus injects a DNA or RNA molecule which takes on a circular form and replicates by a rotation that generates a long DNA chain with several copies of viral genes. Each copy controls the synthesis and assembly of the proteins in the virus capsule using cellular material. In an hour, the host cell lyses (self-destructs), freeing some 100 viruses which can infect others. In other cases, depending on currently poorly known conditions, the lysogenic phase (B) arises. The viral DNA enters a point of the cellular DNA (specific to each virus) where it codifies its own genetic information and replicated in each cell division. Under these conditions, the latent virus ("protovirus") can be maintained indefinitely, although it sustains its ability to produce a lytic cycle, multiplying itself anew. This process can be induced experimentally by exposing the cell to UV or X rays, or chemical compounds.

Once the cell is infected, the RNA or retro-viruses are transcribed to DNA by means of an enzyme: reverse transcription.

While the DNA has an extremely stable behaviour (it can reproduce more than 100 million times without a single nucleotide error in its chains), RNA viruses change (mutate) some 100,000 times faster than DNA viruses. The basic cause is that reverse transcription "does not know how to correct" the errors in the copy, and hence often feed "imprecise" nucleotides into the transcribed DNA. Considering the extreme stability of the DNA (heightened in the cell by the extraordinary mechanism of enzima.