

## EDITORIAL

# Evolution in Chile: natural drift versus natural selection, or the preservation of favoured theories in the struggle for knowledge

Evolución en Chile: deriva natural versus selección natural, o la preservación de las teorías favorecidas en la lucha por el conocimiento

PATRICIO A. CAMUS

Associate Editor

Facultad de Ciencias, Universidad Católica de la Sma. Concepción,  
Casilla 297, Concepción, Chile, e-mail: pcamus@david.ucsc.cl

Chilean biology covers a wide disciplinary spectrum, where evolutionary biology has been able to gain an outstanding presence, despite its notably small number of practitioners. In this regard, however, numbers may appear deceptive. For instance, a review of the papers published from 1983 to 1995 in the *Revista Chilena de Historia Natural*, which covers all naturalist disciplines, showed that only 4.7 % dealt with evolutionary aspects *sensu lato*, a very low percent in comparison to dominant disciplines such as botany, zoology and ecology (Camus 1995). Of course, Chilean evolutionists publish in other Chilean and foreign journals, and thus the above figure is just a vague reference on the relative importance of evolution. Nevertheless, quantitative estimations could not capture the real importance or the impact of evolutionary knowledge on the formation of Chilean naturalists, regardless any explicit or implicit consideration in their own studies. Very likely, Chilean naturalists do see in evolution the ultimate foundation for their work, as an echo of that legendary statement by T. Dobzhansky, and partly as a result of a long darwinian tradition in Chilean universities. In fact, Manríquez & Rothhammer (1997) documented that Darwin's theory was already incorporated in some school texts as early as 1866, and in 1917 it was approved as part of the official educational program for public schools. This certainly led to intense public debates between lay and catholic sectors, which lasted for about 60 years. However, Manríquez & Rothhammer (1997) also mentioned that such a debate not only was virtually absent in Chilean universities, but darwinian theory, and even the basic tenets of the rising synthetic theory of evolution, were formally included in university curricula during the first decades of the 20<sup>th</sup> century.

### THE ORIGIN OF A CONTROVERSY

Until two decades ago, neodarwinism, the contemporary expression of the "modern synthesis", seemed to be so rooted and widespread in Chilean biology that it was rarely discussed or even mentioned in customary academic excersises, excepting as part of the regular training in biological courses. That homogeneous and peaceful scenario was then disturbed, slightly at the beginning and severely afterwards, by some heterodox notions developed by Humberto Maturana and coworkers. After the publication of the book "De máquinas y seres vivos" ("On machines and living beings") by H. Maturana and F. Varela in 1972, a new and intriguing idea, the autopoiesis, conceited increased attention among biologists, and gained popularity among younger scientist, as a must know. However, the implications of autopoiesis were just becoming apparent, and a new book published in 1984 by Maturana and Varela, "El árbol del conocimiento" ("The tree of knowledge"), was perceived by some biologists as a radical challenge to darwinian ideas generating divided opinions. Subsequent works and a growing diffusion of Maturana's ideas contributed to increase their popularity. At the same time, notwithstanding, many realized that a explicit, complex, and usually non familiar epistemological frame was intimately associated to those ideas, turning less accessible the debate to many biologists.

At that point, it was evident that notions such as natural drift, ontogenetic phenotype, and structurally determined systems were somewhat distant from the daily experience of most biologists. Even more, no mention to them could be found in official text books. Such an originality, however, was

not precisely desirable for the biological community, and the profusion of new terms and concepts resulted a little disturbing. Suspicions took not much time to appear: was that the rise of a new theory or paradigm (something unusual for Chilean science), or just some kind of esoteric, untenable jargon? By then, the contribution of H. Maturana to the study of sensory perception in vertebrates was widely acknowledged, but that was a more familiar field, and certainly a “biological” one. Contrastingly, the new concepts, though attractive, seemed far-away from biological “reality”, and they did not involve quantities, tangible facts, or measurements of some kind. In a time when, in Chile, neodarwinism was “the” framework for understanding evolution, Maturana’s work was incidentally promoting a sort of healthy schizophrenia: to take into serious account his ideas (and many were doing so) lead necessarily to rethink evolution, and even biology itself, a difficult task if someone learnt to read nature through the neodarwinian lens. Eventually, he/she must face the need to conciliate such a different view with his/hers own work or beliefs, an impasse that can be solved only through reflection, no matter the solution. One way or another, Maturana’s work was inducing normal science to meditate about its basic principles or even alternative principles, and in my opinion, this is also one of his most significant contributions to Chilean biology.

In 1992, Maturana and J. Mpodozis published an essay entitled “El origen de las especies por medio de la deriva natural” (“The origin of species by means of natural drift”), where they presented an alternative evolutionary theory (better known as structural determinism) which, from a strictly neodarwinian viewpoint, appears as a rejection of the most basic and widely accepted biological principles of evolution. This book definitively moved the debate to a controversial stage, where neodarwinian biologists felt compelled to reply and make public criticism of Maturana’s structural determinism. In a book entitled “Teoría moderna de la evolución” (“Modern theory of evolution”), Manríquez & Rothhammer (1997) argued that the expansion of the “modern synthesis” until present, associated to its ability for explaining most evolutionary phenomena and subsuming alternative views such as punctuated equilibrium into a more comprehensive frame, represent a maturity level that justified the recognition of a new and unified evolutionary theory. For supporting their proposal, the authors developed an extended criticism of the main principles of structural determinism, concluding about their total lack of biological meaning. The proposal made by Manríquez & Rothhammer (1997), along with their analysis and

rejection of structural determinism, was then commented in this journal (Camus 1997) in regard to the logical validity of their conclusions. This last commentary motivated some authors to publish new commentaries which, interestingly, were not directly concerned with Manríquez & Rothhammer’s or Camus’ arguments, but rather they offered theoretical and empirical reasons for supporting or rejecting Maturana’s ideas on different grounds. Against structural determinism, Gallardo (1997) stated that the theory of natural drift was not a scientific theory, lacking empirical tests and corroboration, and being semantically artificial. Gallardo (1997) summarized his criticism to the theory by pointing out that “circular reasoning, abduction, ambiguity, and confusion of logical types plague the definition of concepts central to its tenets and render structural determinism unfalsifiable”. Gallardo’s (1997) conclusions adequately reflect the main objections to structural determinism posed by its Chilean detractors, furthermore suggesting that comments on the subject would no longer be a matter of opinion. In contrast, a second article by R. Rozzi et al. (1998) displaced the discussion into a different scenario, stating that both natural selection and natural drift are indeed evolutionary metaphors, where “the former ... retains links with a modern worldview, while the second, in detaching itself clearly from the notion of progress, is characteristically post-modern”. In this vein, Rozzi et al. (1998) clarify that “metaphors become relevant to science only under the post-modern perspective that explicitly incorporates the cultural circumstances under which scientists work”, even though modern and post-modern perspectives do not “exclude or replace each other, but rather represent different and often complementary approaches”. An interesting remark made by Rozzi et al. (1998) is that the “evolutionary metaphor of natural drift could contribute to de-emphasizing the notion of progress, which in Chile has been, and still is driving a rapid and widespread process of biological and cultural homogenization”. Such a context provides a new perspective where discussions on the legitimacy of structural determinism (or any other theory) could be meaningless. As noted by Rozzi et al. (1998), the paraphrases of Darwin’s original title by Maturana & Mpodozis (1992), although it may appear pretentious, “proposes a fundamental turn by replacing a single word ...”, and “in the substitution of selection by drift, one worldview gives way to another”. Certainly, we are not forced to choose, but we should be aware that in opting for one of these worldviews while rejecting its alternative, we are not contrasting commensurable theories. A particular worldview cannot be disproved

from a different worldview. A separate question is what worldview is to be preferred, but nothing is gained by denying some part of world that will continue to exist whether we accept it or not.

#### WHY THIS EDITORIAL?

At the mature age of 103 years (see Jaksic 1997), the *Revista Chilena de Historia Natural* leaves room not only for regular research articles, and one of its editorial goals is to promote scientific discussion and criticism, reason why a special section, called "Commentary", was created as a forum. It is important that the *Revista* serves a place for expressing and debating contrasting views, as occurred with structural determinism, because such discussions are not frequently observed in Chilean journals, and even less about theories of Chilean scientists. Thus, when H. Maturana and J. Mpodozis submitted a manuscript with the theory of natural drift, and this was later accepted (not lacking criticism), the editors had a chance to fulfill their purpose by presenting in this issue of *Revista Chilena de Historia Natural* a challenging and significant work.

All permissions granted, the present article by Maturana and Mpodozis corresponds to a revised, expanded, and English version of their essay published in 1992. The theory of natural drift has two connotations for Chilean scientists, pointed out by Manríquez & Rothhammer (1997): it is the first work in Chile offering a formal alternative to darwinian evolution from an original viewpoint, and it also contains the suggestive view of living beings as autopoietic machines, based on prior developments by Maturana & Varela (1972, 1980, 1984). Additionally, the editors of *Revista Chilena de Historia Natural* wish to highlight the contribution of Humberto Maturana to Chilean biology, for which he received in 1994 the "Premio Nacional de Ciencias" ("National Prize of Sciences"). We hope that this new article by Maturana and Mpodozis stimulates the debate on evolutionary and ecological phenomena, as well as on the construction of scientific theories in biology, for which readers are invited to submit their ideas to *Revista Chilena de Historia Natural*.

#### WHAT IS NEW WITH NATURAL DRIFT

Structural determinism is one of the varied alternative views on evolution that can be found in contemporary biology. Darwin has been reinvented in different ways (e.g., see Eldredge 1995), and dynamical structures have been ex-

plored by a growing number of biologists with different perspectives (e.g., see Goodwin et al. 1989). However, the structural determinism of Maturana and Mpodozis has several distinctive features. For instance: it is a theory on its own, it develops its own language introducing a number of new (or redefined) concepts and terms, and its starting points are the phenomena of cognition, perception, and language. Clearly, the theory does not look like an ordinary construction, and it is not hard to understand why its detractors consider it a non scientific (falsifiable), untestable, tautological, and metaphysical formulation, lacking empirical support. While the critics of structural determinism claim that they have legitimate arguments, Maturana and Mpodozis have not entered the battle field, and they have been refining their theory during the last years. Instead of making judgements on the biological value of the theory, I prefer to introduce the article of Maturana and Mpodozis by presenting some personal comments of their authors on the origin, fundamentals, and significance of natural drift.

#### MATURANA AND MPODOZIS ON NATURAL DRIFT

Mpodozis considered that, in order to highlight some content of the article, he would say that "natural drift shows how is that living beings are actors, and not merely patients, of their own history". Regarding the article itself, Mpodozis points out that, "in posing a serious challenge to some more or less culturally sacralized truths, it calls to the legitimate human activity, mix of passion and reasoning, that is the critical interest", and that the article "contributes to raise new questions that seemed answered and to open avenues of thinking rather dogmatically closed". I believe that such comments reflect some of the reasons why the theory results so appealing to many people, specially to young biologists.

But the essence of the theory certainly relies more on its fundamental propositions than on its alternative novelty. Maturana clarifies that natural drift is not an invention but a realization, pointing out that "in order to explain any biological phenomena, I had to seriously recognize and act and think accordingly, that living systems exist operating as structure determined systems", and interacting "with a structure determined medium". He also says it, "means accepting that living systems are systems such that nothing external to them can specify what happens in them, and that any external agent impinging on them can only trigger in them structural changes determined in their structure". This view arised when

Maturana was devoted to the study of vision, when he was exploring questions such as “how do we see the objects that exist in the world in which we are immersed?”, “... how does the world external to us tell us how it is?”, or “how do we generate our behavior such that it arises adequate for the conservation of our living?” According to Maturana, “the usual answer since the early fifties has been that the sensors receive information from the external objects and that nervous system processes such information to compute the adequate behavior. But I soon discovered (1965) that the notion of information was both inadequate and misleading ...”. “... I also realized that the operational congruence between the organism and its medium could only be the result of a dynamical structural congruence that existed between organism and medium as a necessary condition for its existence. *Indeed, this is the epistemological fundament of the evolutionary proposition of Darwin* (italics mine). But what I also realized then was that such structural congruence could not be the result of a continuous adaptation to a preexisting medium, and that it had to be the result of the continuous spontaneous congruent structural changes that necessarily occur when two structure determined systems with plastic structures interact recurrently while they conserve their respective organizations as well as their dynamical structural congruence in the flow of their recurrent interactions”.

It is clear that Maturana could not agree with natural selection, and thus he adopted a different view: evolutionary change is “a result of a phylogenetic process of differential survival in a domain of conservation of both organization (autopoiesis) and adaptation”, where reproduction is “a process that generates both continuity as well as change”, and the mechanism is the congruent and spontaneous change of organisms and the circumstances in which they exist. As a student of Ernst Mayr in 1956 and 1957, Maturana was somewhat shocked by this conclusion, and he did not become fully aware of its implications until completing his research on perception, cognition and language between 1966 and 1978. Today, Maturana feels that “cannot but be happy when I see how my research ... has found its fundament in the understanding of the process of biological evolution in a way that although it may not easily look so, follows the orientation I received from Darwin, Mayr, and other great biologists that were directly and indirectly my teachers”. To appreciate the relationship of natural drift with Darwin, Mayr, and others is not an obvious matter to some biologists but, following Maturana, we should conclude that natural drift is

a darwinian theory, though certainly not a selectionist theory.

On the other hand, Mpodozis arrived to natural drift due to his collaboration during several years with Maturana in the undergraduate course of evolution at the Universidad de Chile. As Mpodozis tells, in 1990 he gave to Maturana a small document (less than five pages) summarizing the main ideas and notions that they have been discussing and maturing in previous years. After some months, Maturana counter-attacked with a manuscript of 150 pages, which finally lead (in Mpodozis' words) “to a honorable and mutually satisfactory peace of about ninety pages”, which resulted in the original article of natural drift published in 1992. Mpodozis points out that this article provoked “less indifference than interest, and sometimes a frank and picturesque fury”, although in the short term there were several both unofficial and authorized (even some apocryphal) versions of the article in different languages, and also a number of essays and critical comments published in formal and electronic media around the world. Indeed, the present English version in *Revista Chilena de Historia Natural* responds to that interest, giving their authors an opportunity for revising an expanding the 1992 version.

Can natural drift replace natural selection? Unlike darwinian organisms, however, in the struggle for knowledge the favored theories are not necessarily the better or stronger ones, but those most compelling or insightful. The decision, then, is left to the readers or, more accurately, to their own ways of seeing.

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