Publicado en Ludus Vitalis, Revista de Filosofía de las Ciencias de la Vida, Vol.VIII, Núm.13, 2000.pp.53-70

ON CHANGING VIEWS ABOUT PHYSICAL LAW, EVOLUTION AND PROGRESS IN THE SECOND HALF OF THE NINETEENTH CENTURY

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1. INTRODUCTION

There has been deep disagreements about the significance of Darwin's theory of evolution on changes on the notion of progress that prevailed during the 19th century in Britain and many other countries. As part of a widespread view it is generally argued that Darwin was fully aware of the important implications of his views in overthrowing the traditional Victorian notion of progress and, thus in an important sense, Darwin was more a thinker of our times than of the 19th century. David Hull finds remarkable that "at a time when a belief in progress was pandemic, [Darwin] had so little to say about it, and when he did, expressed himself so equivocally [1]". Hull thinks that in half of the dozen of cases in which he mentions the word, he means only change. In the same tone, Peter Bowler considers that Darwin's theory "challenged the most fundamental values of the Victorian era [2]" to the extent that Darwin's mechanism makes natural development a non-directional and thus non-progressive process. On the other hand, Robert Richards has defended the view that "Darwin crafted natural selection as an instrument to manufacture biological progress and moral perfection [3]". Richards considers that regarding this, Darwin's theory does not substantially differ from Spencer's views.

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Such deep differences of opinion about such an important topic suggest that a more rounded interpretation will require introducing additional elements in the discussion. In this paper I want to examine the relation between progress and evolution in the second half of the 19th century and, in particular, the role of Darwin's theory in changing the terms of this relation by paying attention to the role of contingency in the sort of explanations that matter to the theory of evolution and for a characterization of progress. I want to suggest that, as it is explicit in the contemporary works of Chauncey Wright and Emile Boutroux, who address similar problems from a different perspective, Darwin's theory, as understood by Darwin himself, suggested a way in which what was considered one and the same process by most contemporary adherents of evolutionary theory (the "cosmic evolutionary process" of Spencer) could be understood as different (but related) processes. Thus, even though it is correct to point out, as Richards does, that the close affinity between Spencer and Darwin concerning their common adherence to a teleological and moral notion of progress was a common core in their theories of evolution, there is nonetheless an important heuristic difference between the two theories. This heuristic difference is recognized more clearly by contemporary writers like Chauncey Wright than by Darwin himself, but it is not a difference that could lead us to think of Darwin as having a notion of progress sharply different from that of Spencer and most of his contemporaries.

Roughly, the view that will come forward is the following. The simplistic notion of positivistic progress that is so widely accepted in the first half of the 19th century is a notion of progress that assumes that the theories of science, and the physical sciences in particular, are "continually growing, but never changing" as John Stuart Mill says in 1831 [4]. This notion of progress, already clear to many by the 1830s, does not fit the way science has actually developed historically and in particular clashes with developments in the 19th century that strongly suggest that theories are always subject to revision. William Whewell states already in the late 1820s that the inadequacy of the positivistic idea of progress points to the need of incorporating in our understanding of progress the notion of design and thus a designer (section 2). Several natural philosophers during the second half of the 19th century will attempt to retain a robust notion of progress without committing themselves to a non-natural cause as part of the explanation of progress. Evolution will be a rallying cry for many of those who think that one has to avoid appealing to non-natural causes in scientific explanations and in our notion of progress. Spencer, Haeckel, and many others will thus try to characterize all sorts of progress as instances of an evolutionary process (section 3). All of them, however, will have to assume a rather problematic notion of physical law that would

supposedly ground the explanatory power of their all-embraceable concept of progressive evolution. Darwin will implicitly suggest a different way of understanding the relation between progress and evolution. Evolution and progress are to be understood as law-abiding processes, but different evolutionary processes generate different types of progress. In the *Descent of Man*, Darwin suggests that biological progress is one problem, social progress another. Both of them can be explained as evolutionary processes, but not as instantiations of a general law of progressive evolution [5]. Darwin suggested, and Boutroux said it more explicitly, that progress was not a principle or a law, but rather a possible result contingent on configurations of laws and matters of fact. This sort of attempt converges with developments in the physical sciences. As Chauncey Wright points out in the early 1870s, one should not look at Darwin's theory of evolution in analogy with mechanics, but rather with meteorology. Wright's comparison is the first suggestion that the theory of evolution is a new sort of theory because it uses contingency in explanation. As Boutroux will clearly formulate the idea in 1874, the recognition of the role of contingencies as explanatory factors in scientific explanations leads to a view of reality as consisting in different domains, or levels, each one of them explicable by different sets of laws (section 5). This view of reality weakens the centrality of the notion of progress played in positivistic historiography and opens the way to well known twenty-century reactions against classical positivism. This, however, can only be said with hindsight.

2. ON THE NOTION OF POSITIVISTIC PROGRESS

Lyon Playfair, in his 1855 presidential address to the British Association for the Advancement of Science, formulates the idea of progress, that predominated in Great Britain and a significant part of Europe during the first part of the 19th century:

> An established truth in science is like a constitution of an atom in matter—something so fixed in the order of things that it has become independent of further dangers in the struggle for existence. The sum of such truths forms the intellectual treasure, which descends to each generation in hereditary succession [6].

Playfair gives a poignant formulation to the positivist idea of progress that has been championed during the first half of the 19th century by John Herschel and many other British intellectuals. The progress of science consisted in an accumulation of generalizations that fitted the already established general plan set up by Newton's laws and the natural sciences developed on this basis. As the quotation of Playfair already suggests, several versions of positivistic progress will be developed in the second

half of the 19th century, often in association with the notion of "struggle for existence [7]."

In positivistic historiography a science experiences a "transition" or a "revolution" once in its history. As soon as this critical stage is past, each science contributes to the positive knowledge that never changes. The collapse of the idea of positivistic progress is related to the collapse of the historiography model that underlies it. As the 19th century advances, it becomes increasingly clear that the idea that a science reaches a stage of positive knowledge, never to change in the future, is increasingly difficult to sustain. Starting with the wide acceptance of the ondulatory theory of light, particularly after the series of experiments of Fresnel in the second decade of the century, continuing with the development of field theories and the theory of electromagnetism in the mid-century, and culminating with the publication of Helmholtz famous paper "On the origins and significance of the axioms of geometry" in 1870, the basic tenets of positivist historiography are increasingly hard to sustain, even within the stronghold of positivistic thinking, the physic-mathematical sciences. The most cherished truths, it appears, are always subject to amendment.

The revision of the wave theory of light at the beginning of the 19th century was a particularly important case, due to the central role that optics played in the Newtonian tradition [8]. Herschel, for example, in the *Discourse*, tries to interpret in a careful language, the implications that the acceptance of the wave theory of light carries to the revision of positivistic historiography [9]. He points out that Fresnel's claim—that his experiments are decisive in favor of the wave theory of light—seems a bit hasty, since even Newton arrived at false opinions concerning the numerical expression for the actual velocity of sound. The message is clear: when trying to infer truths from single experiments, even Newton failed, so Fresnel also could. According to Herschel, the positivistic doctrine requires to draw a distinction between those causes that we can recognize as having a "real existence in nature," from hypotheses such as those defended by Fresnel; distinguishing hypothesis from "those physical laws derived from experiment which no future research shall modify or subvert" requires "stating the laws in a language which involves anything in the slightest degree theoretical" (1830[1987], p. 254). This distinction between experimental laws and theoretical laws allows Herschel to maintain the positivistic idea of progress as the accumulation of generalizations that no "future research shall modify or subvert" and, at the same time, accept the changing opinions about theories. Of course, after Helmholtz challenges the idea that Euclidean geometry is a necessity of intuition, even Herschel's guarded formulation of positivistic progress flounders. The realization of this fact is an important motivation for the development of logical positivism, and altogether another story.

William Whewell was the most consistent and cogent critic of the positivistic view of progress since the 1820s. According to Whewell, it is necessary to make a distinction between different sorts of sciences. For this author, insofar as an historical explanation requires appealing to laws that are not accessible to our immediate experience, such explanations have an epistemological status different from mechanical explanations that are based on laws accessible to our immediate experience. In political economy, in geology, and in any other science that have to incorporate time as an essential variable in its explanations, explanation requires laws that are ultimately dependent on a design and a power that carries out the necessary steps to bring about such design.

Whewell's argument generalized a series of techniques recently developed for the construction of explanations for physical phenomena that required a genetical analysis of the state of a system, and the identification of forces with developments directed to a certain goal [10]. In this type of model, the variations produced by perturbing causes did not have to generate a better adaptation of the system with respect to a state of equilibrium. This was an important difference with the models developed by the French Newtonians, in which such adaptation to an equilibrium state was assumed to be the consequence of the variations produced by perturbing causes.

Whewell claimed that this different understanding of how models relate to the variations generated by perturbing causes was an implicit lesson in natural theology. Unless God were to intervene in the process, the perpetual conflict among the different tendencies to equilibrium that govern each and every economy would collapse the system in question. The laws of nature by themselves were not able to explain the complex dynamics of the world we live in. As Newton has already suggested in the 17th century, Whewell thought that unless God played a role in keeping the system going, the solar system would have already broken down. Thus, even if it were possible to draw the distinction between experimental and theoretical laws that Herschel suggested, the positivistic characterization of progress would be too poor. Unless the existence of a designer is countenanced, the explanatory value of our models is not accounted for.

In *On Astronomy and General Physics Considered With Reference to Natural Theology*, Whewell makes clear that a dynamical conception of the world can only be understood through divine interventions in crucial moments, calculated to obtain a given effect [11]. Whewell argues that the fact that there is always friction and thus dissipation of energy, even in the movement of the heavenly bodies, forces us to recognize the need for an ubiquitous presence of a "first cause that is not mechanical," as Newton have said. Given that dissipation was such a pervasive phenomenon, it

was not possible to explain in terms of laws of physics the way in which natural processes reach and maintain their state of equilibrium, instead of degenerating into chaos. Thus, Whewell draws the conclusion that natural philosophy cannot explain the origin of the order and structure that those laws describe. Natural philosophy was in need of an explanation to the origin of order and structure that natural theology provided. As we see, the discussion concerning positivism had a lot to do with different views about the explanatory scope of natural laws.

3. PROGRESS AND EVOLUTION

In the first edition of *The Origin of Species*, Darwin uses as epigraph a quotation from Whewells *Bridgewater Treatise*:

> But with regard to the material world, we can at least go so far as this—we can perceive that events are brought about not by insulated interposition of Divine power, exerted in each particular case, but by the establishment of general laws [12].

Darwin seems to have thought that his theory provided the sort of explanation in terms of general laws that Whewell thought was the mark for explanations of the material world. Darwin, however, had misunderstood Whewell in a crucial point. Indeed, Whewell thought that all creation was governed by general laws, but precisely one of the main points he wanted to emphasize, as we have seen, was the need to recognize that a designer lay behind the sort of processes that Darwin was studying and, as he says in the sentence before the one quoted by Darwin, "science shows us, far more clearly than the conceptions of everyday reason, at what an immeasurable distance we are from any faculty of conceiving *how* the universe, material and moral is the work of the Deity."

According to Whewell, a concept was used "inappropriately" if it was employed outside its realm of appropriate application. The use of mechanistic concepts to explain the functioning of vital forces was a typical example of an inappropriate use of concepts. The use of mechanistic concepts by Darwin to explain goal-directed processes was equally inappropriate [13].

For Whewell, the laws of nature were resources ready to be put into action to pursue the divine plan, not blind architects. For him, what was wrong with a static view of the structure of the world, such as that proposed by Herschel, was not the claim that one could explain by means of natural causes describable in terms of general laws, but its lack of recognition that the execution of these laws by God had implications for the historical dimension of the design of the world. From Whewell's perspective, and from the viewpoint of many of his contemporaries, Darwin was defending a philosophical position that was closer to Herbert

Spencer than to Whewell. Let us see what was Spencer's position and why Darwin was in a relevant sense "Spencerian."

4. EVOLUTION AND DEVELOPMENT

In the 17th century the concept of evolution referred to embrionary development. By the 18th century the idea of evolution got extended to a theory that claim to explain the diversity of life under the assumption that God created a plenitude of germs that not only encapsulated a mature individual, but even animals and plants of different species [14]. The power of the microscope had led the anatomists to suspect that Noah's Arch was a microscopic arch.

Towards the end of the 18th century, this view of evolution as emboitment looses its credibility. The work of Wolff, Serres and von Baer provide the basis for a new concept of evolution. A concept that, as von Baer emphasizes, can be understood as a law-abiding process characteristic of the whole organic world. It is to this idea of evolution that the 19th century evolutionist's appeal, and the notion that in particular Spencer attempts to develop systematically in a complete "philosophy of progress."

Spencer claims that this "law of organic progress", found by von Baer to characterize the organic world, is the law of all progress. Each and every historical process, says Spencer, can be explained by this principle [15]. Spencer even mentions the evolution of musical instruments and the development of choral music as processes that are to be explained by this law (1857, p.445). I will refer to this view of evolution as the result of laws of universal scope as "cosmic evolutionism [16]."

The basic elements of this cosmic evolutionary view of the world that Spencer would promote during the second half of the 19th century were already familiar in Great Britain intellectual world of 1857. Two best sellers around mid-19th century were versions of cosmic evolutionism: *Vestiges of the Natural History of Creation* (published anonymously by Robert Chambers in London in 1844), and *Views of the Architecture of the Heavens...* (by J. P. Nichol, published in Edinburgh in 1837). Both books defend the idea that the recent developments in astronomy and, in particular, the hypothesis that the solar system has its origin in a nebula of stellar matter, can be seen as evidence for the existence of a process of cosmic evolution that follows von Baer's model of branching differentiation [17]. The "mundane economy", Chambers says, as well as the development of the solar system, the history of life on the planet, and even the procedure in which social progress can take place is nothing but "a portion of some greater phenomenon, the rest of which was yet to evolved [18]" (p. 385). The manner in which Chambers speak of the fossil record is

typical of how these cosmic evolutionists understood the whole of reality as progressive:

> Thus, the production of new forms, as shown in the pages of the geological record, has never been anything more than a new stage of progress in gestation, an event as simply natural, and attended as little by any circumstances of a wonderful or startling kind, as the silent advance of an ordinary mother from one week to another of her pregnancy (Chambers, 1844[1994], p.223).

There are however important differences in the understanding of cosmic evolutionism by Nichol and Chambers on the one side, and Spencer on the other. The most important difference comes out right after the preceding quotation; the following sentence reads:

> Yet, it be remembered, the whole phenomena are, in another point of view, wonders of the highest kind, for in each of them we have to trace the effect of an Almighty Will which had arranged the whole in such harmony with external physical circumstances, that both were developed in parallel steps—and probably this development upon our planet is but a sample of what has taken place, through the same cause, in all the other countless theaters of being which are suspended in space (Chambers 1844[1994], p. 223).

Clearly, for Chambers, evolution takes place through the will of God. It is Him who has programmed and carries out the concerted evolution of parallel lines of development. Implicit in Chambers's view is more than a ring of Whewell's understanding of order, the result of a design in progress attributable to God. Spencer, however, defends a secularized version of cosmic evolutionism. For this author, the harmony of all those parallel developments can be understood by having a common natural cause, the fundamental law of progress; the harmony of the parallel lines of developments with external circumstances is not the result of a Will, but instead, has to be seen as the result of a "struggle for existence" which allows for the effects of the law of progress to become manifest. The idea of a progressive evolution resulting from laws, formulated by Darwin in the famous paragraph before the last one in the *Origin of Species*, is an example of this law-abiding evolution which Spencer conceived as a secular alternative to Chambers and other cosmic evolutionists. Darwin stated that: "To my mind it accords better with what we know of the laws impressed on matter by the Creator, that the production and extinction of the past and present inhabitants of the world should have been due to secondary causes, like those determining the birth and death of the individual [19]." This passage shows clearly Darwin's cultivated ambiguity in dealing with the role of natural selection as a causal factor in evolution. Notice the use of the term "secondary causes" to refer to the laws that govern the production and extinction of species. On the one hand, it puts emphasis on the secularization of the laws of nature, and thus on the

"struggle for existence" by which physical circumstances and the different lines of development come to be in harmony, on the other it leaves open a possible interpretation of those laws as part of a divine design.

In the same paragraph, Darwin makes clear that this process is the result of a tendency to "perfection": "and as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection" (1859[1964], p.489). This view of evolution based on laws (understood as "secondary causes") allows us to accept the identification that Whewell had made between history and progress, without having to accept its conclusion that historical explanations imply the presence of an intelligent final cause [20]. Darwin's formulation only allows us to say that a divine design (a Final cause) is compatible with the theory of evolution by natural selection, not that such theory implies the design.

5. DARWIN AND SPENCER

It is very common among historians of biology to make a sharp distinction between the concept of evolution in Darwin and the one his contemporaries like Spencer and Haeckel sustained, it is claim that the Darwinian concept does not imply progress, whereas the concept of Spencer and Haeckel holds so. As we have seen, and Robert Richards has argued in detail, things are more complex 21. There are obvious and consistent references to a progressive notion of evolution in Darwin. Furthermore, as Spencer argued more explicitly, what Darwin wanted to emphasize was the secular nature of his notion of evolution (and progress) as a consequence of a "struggle for existence". However, the scope and the origin of the progressiveness of the laws that grounded this evolution were not systematically addressed by Darwin. As we shall see, there are reasons to think that he was worried about the issue; nevertheless, before elaborating on this, it is worth pointing out an important difference in the manner in which Darwin understood evolution (and progress), and those of Spencer and most contemporaries, including convinced "Darwinians" like Hooker and Huxley.

This difference has to do with an implicit but clear rejection by Darwin of evolution as a "cosmic process" which, in turn, has to do with the important role that Darwin attributes to natural selection in his theory of evolution. For Darwin, evolution by natural selection does not derive its explanatory force from the assumption of a general law of progress, but from the models of phenomena that it allows us to construct. This explanatory force, in the tradition of the *vera causa* methodology, was closely related to the unifying power that the theory had to offer when dealing with living phenomena.

Very few contemporary natural philosophers saw this difference between the theories of Darwin and Spencer (and other "evolutionists"). Chauncey Wright did.

Wright was well aware of the importance of the, by then very recent, successful construction by Maxwell of statistical models of phenomena that incorporated statistical concepts in the very description of a physical process. This author glimpsed the implications that the development of the concept of statistical law had in understanding the theory of evolution.

Wright recognized the importance of Whewell's point, that explanations of an historical process cannot ignore the problem about the origin of order, and replied by appealing to the notion of a statistical law, instead of turning, as Spencer did, to a nebulous "law of progress". According to Wright, this was the implicit answer of Darwin. This is the main idea behind the comparison he makes of Darwin's theory of evolution with his notion of "cosmic weather" (as opposed to Spencer's "cosmic evolution") [22]:

> The comparison of the continuous order in time of the organic world and its total aspect at any period, to the progressive changes and the particular aspect at any time of the weather, will, doubtless, strike many minds as inapt, since the latter phenomena are the type of indetermination and chance, while the former present to us the most conspicuous evidences of orderly determination and design. This contrast, though conspicuous, is nevertheless, not essential to the contrasted orders themselves. The movements in one are almost infinitely slower than in the other. We see a single phase and certain orderly details in one. We see only confused and rapid combinations and successions in the other. One is seen in fine, the other in gross form. But looked at from the same point of view, regarding each as an ensemble of details in time and space, they are equally without definite order or intelligible plan (1872, p.178).

Wright is trying to exploit further the metaphor of "deep time" that was so successfully exploited by Lyell and Darwin in the formulation of their theories. The explanatory power of "deep time" has to do with the complexity of the phenomena involved, and this is the key fact that allows a comparison between weather and evolution:

> There are in the successions of changes in the weather sufficient traces of order to indicate a continuity in space and time corresponding to the geographical distributions and geological successions of the organic world. The elementary orders, which exhibit ultimate physical laws in simple isolation, are, in their aggregate and complex combination, the causes of the successions of changes in the weather and the source of whatever traces of order appear in them, and are thus analogous to what the theory of natural selection supposes in the organic world, namely that the adaptations, or the exhibitions of simple principles of utility in structures, are in their aggregate and complex combinations the causes of successive and continuous changes in forms of life (Wright, 1872, p.179).

Since Wright had not fully emancipated himself from the sway of a deterministic world picture, he thought that the analogy between weather and evolution had to take into consideration that in both cases contingency was only apparent, that ultimately deterministic universal laws prevailed. Thus, he thought that Darwin was to some extent responsible for a series of misunderstandings to his theory, since he has not emphasized enough his faith in the universality of the law of causation in the whole of physical nature [23]:

> He has not said often enough, it would appear, that in referring any effect to "accident", he only means that its causes are like particular phases of the weather, or like innumerable phenomena in the concrete course of nature generally, which are quite beyond the power of finite minds to anticipate or to account for in detail, though none the less really determinate or due to regular causes (Wright, 1871).

Indeed, Darwin did not emphasize this belief in the law of universal causation, and his suggestion in the *Descent of Man* concerning the origin of human culture (and human values and morals in particular) as the result of a mechanism of selection different from the type of mechanism that Darwin had proposed as predominant in organic evolution, would go against the reading of what Wright considered necessary to avoid the misunderstandings (see Darwin's quotation below). To put emphasis on the law of universal causation would leave completely on the air Darwin's suggestion that it is rather a process of selection among communities what allows us to explain the evolution of culture (see below the discussion of Boutroux's views).

To take seriously Darwin's suggestion requires that the notion of accident involved in an explanation by natural selection cannot merely be ignorance of deterministic causes playing a role at an underlying micro-level. In the same way in which the role of geographical accidents in explanations for the distribution of species cannot be reduced to the mere ignorance of underlying microscopic deterministic causes, the sort of contingencies Darwin is talking about cannot be reduced to ignorance of deterministic laws. How can this tension pointed out by Wright be resolved was not clear to Darwin, nor to Wright. Leaving this tension aside, Darwin's proposal not only suggests how his theory could be used to explain social life and the origin of values; it also allows us to out-turn an alternative explanation to different concepts of progress that are not mere instantiations of one single basic notion, and that do not involve such a highly speculative principle as that of "cosmic evolution". For one thing, Darwin's explanation of progress does not require to be grounded on a principle of universal applicability. In *The Descent of Man* [24], Darwin says that

> the bravest men, who are always willing to come to the front in war, and who freely risked their lives for others, would on average perish in larger numbers than other men. Therefore it hardly seems probable that the number of men gifted with such virtues, or that the standard of their excellence, could be increased through natural selection, that is, by the survival of the fittest; for we are not here speaking of one tribe being victorious over another (1871, p. 130).

Whether some selection (not strictly natural selection) explains the origin of human values is contingent on the structure of the world and requires a distinction between different sorts of causal processes; it is not a consequence of a necessary principle of universal applicability. Similarly, whether an analogous explanation can be given of social progress, it depends on contingent matters of fact, including biologically determined ones.

The idea of Darwin that some sort of selection (not strictly natural selection) can have a causal role at the level of community (an idea also suggested by Bagehot in *Physics and Politics*) shows a profound difference between Darwin's approach to the concept of evolution and the one of contemporary evolutionists like Spencer and Haeckel. For Spencer, as for Nichol, Chambers and other 19th century evolutionists, evolution is the sufficient cause of all progressive change. From this perspective, it was inconceivable a mechanism of selection which could play an explanatory role *in different sorts of causal processes* depending on contingent matters of fact. Thus implicitly, Darwin questions a presupposition of the positivistic tradition which was not doubted neither by Spencer, Haeckel or Whewell: the assumption that a mechanistic explanation has to be understood in terms of laws of universal scope. Wright formulates in 1870 the idea as follows: "strictly speaking natural selection is not a cause at all, but is the mode of operation of a certain quite limited class of causes" (1870, p. 108).

6. BOUTROUX AND DARWIN

Darwin's suggestion that "selection" can play an explanatory role in the characterization of different sorts of mechanisms without requiring that those mechanisms were understood as instantiations of a universal force or principle leads to a view in which our causal explanations have a genuine limited scope. The explicit formulation of this thesis, as an answer to the collapse of positivism as a model for the historiography of science, was given by Emile Boutroux in his famous doctoral dissertation from 1874 [25].

In this dissertation, Boutroux defends a metaphysical view of the world that will have a major impact in the development of the philosophy of science in the 20th century, and in the philosophy of Poincaré in particular. According to Boutroux, reality consists in a hierarchy of structures,

each of them characterized by laws that have a relative autonomy from laws in other structures. The laws of physics do not determine the laws of biology, nor the laws of biology determine those of psychology. Boutroux calls these different relatively autonomous structures "worlds". What is important to our discussion is the reason that Boutroux gives to explain why reduction among the worlds is not possible. Each "world", he says, incorporates contingent aspects in its formation that makes impossible to capture by means of laws the structure of other worlds. This idea of Boutroux would have rallied Darwin's enthusiasm, had he known of his work. It is worth quoting Boutroux:

> To discover whether there are causes really distinct from laws, we must inquire how far the laws that govern phenomena are necessary laws. If contingency, after all, is only an illusion due to a more or less total ignorance of the determinative conditions, cause is but the antecedent set forth in the law, or rather, it is the law itself in its general aspect; and the autonomy of the understanding is a legitimate one. But if the given world were to manifest a certain degree of genuinely irreducible contingency, there would be grounds for thinking that the laws of nature are not self sufficient but have their reason in causes that govern them: the standpoint of the understanding, therefore, is manifestly not the ultimate knowledge of things (Boutroux, 1920, p.6).

As Boutroux points out in the preface to the 1920 translation, there are two leading ideas in his dissertation. One is that philosophy should put itself in direct touch with the realities of nature and life. The other, says Boutroux, is that "the contingent nature of the laws of nature dignify life and constitute points of support or basis which enable us constantly to rise towards a higher life." Progress and laws are not first principles with universal scope, but rather a result of contingent matters of fact that in the case of social progress involve choices. Darwin would have certainly agreed. It is important, however, to point out that Boutroux, as Whewell earlier, saw this criticism to the classical positivistic view of progress as a law, leading to the recognition that "God is not only the creator of the world: He is also its providence, and watches over the details as well as over the whole [26]". They want to arrive to the conclusion that "the standpoint of the understanding is manifestly not the ultimate knowledge of things," as Boutroux says in the last quotation. One can read Darwin as pursuing a different explanatory strategy. Natural selection could be seen as a causal factor in evolution (keeping in mind Wright's comment that strictly speaking natural selection is not a cause but a mode of operation of a limited class of causes) that could be interpreted ambiguously as part of nature or as part of a divine design.

7. CONCLUSION

Contingency, as it enters in Darwinian explanations, could be used to describe natural selection as a sufficiently "neutral" explanatory factor that could be accepted either by a believer in a divine design or by a non-believer. Darwin seems to have had this idea in his mind when he used Whewell's epigraph in the first edition of *The Origin of Species*. The idea takes different forms in different writings, but it can be clearly recognized as a sustained attempt to show the pertinence of what we call today "seleccionist explanations" in scientific accounts of Man (i.e., human values). As we have seen in *The Descent of Man*, this idea plays an important role in Darwin's strategy to show the pertinence of natural selection (in a sense that it is not to be contrasted with artificial selection) in a causal account of the origin of human values, language and customs that can leave aside natural theology. As Wright formulates the idea in a note:

> The objection that the origin of languages does not belong to the inquiries of Natural Selection, because language is an invention, and the work of Free-Will, thus appears to be parallel to the objection to natural Selection, that it attempts to explain the work of Creation, and both objections obviously beg the questions at issue. But both objections have force with reference to the real and proper limitations of Natural Selection, and to the antecedent conditions of its action (footnote p. 108, 1870).

As Boutroux points out, this requires to accept as basis for explanation laws that have explanatory force but which are not laws of universal scope. The explicit recognition of this implication, ironically, is what Boutroux uses as a ground to infer "that the laws of nature are not self sufficient but have their reason in causes that govern them". Whewell would certainly agree, Wright not so, while Darwin would have remained silent.

The discussion whether scientific explanations can be grounded on laws of restricted scope, without appealing to some sort of value whose origin cannot be understood naturalistically is still with us. To think of natural theology as some distinctive old fashioned feature of 19th century traditions of thought that just vanished in the 20th century, obscures the fact that the relation between natural theology and natural philosophy was intended to answer genuine epistemological problems, and that those problems, in different form, are thus far among us. The slow process through which non-deterministic models of the world are generating explanations that require laws of restricted scope is certainly an advance, but this advance cannot be seen as an achievement of the 20th century. Within a historical perspective, everything is a slow process.

The research leading to this paper has been supported by grants from CONACYT (4337-H) and UNAM (IN600192).

NOTES

1 *Evolutionary Progress*, edited by Matthew Nitecki, Chicago 1988, p. 30
2 Bowler P. J. *Theories of Human Evolution*, Baltimore 1986, p.41.
3 "The moral foundations of the idea of evolutionary progress: Darwin, Spencer, and the Neo-Darwinians", in Nitecki 1988, p. 131.
4 From "The spirit of the age", in J. M. Robson et. al., eds., *The Collected Works of John Stuart Mill*, CH vols. Toronto, 1981-1991 CH, vol. 32, p. 228) Quoted by L. Daston in "The vertigo of scientific progress", Preprint 21, MPIWG.
5 A similar idea is expressed by Bagehot in *Physics and Politics*, London 1872.
6 "Science and technology as sources of natural power", by Lyon Playfair. Presidential Address to the British Association for the Advancement of Science, Aberdeen, 1885, in *Victorian Science*, edited by George Basalla, W. Coleman and R. Kargon, Doubleday Anchor Books ed. 1970.
7 The origin of this association is often thought to be a by-product of the influence of Darwin's theory on the intellectual landscape. But at most we can say that Darwin's use of the term "struggle for existence" reinforced a deeply rooted view.
8 For a detailed argument along these lines see L. Daston "The vertigo of scientific progress", Preprint 21, MPIWG.
9 John Herschel, *A Preliminary Discourse on the Study of Natural Philosophy* (a facsimile edition of the 1830 edition London). Foreword by Arthur Fine, Chicago 1987, p. 207.
10 See by Norton Wise and Crosbie Smith "Work and waste...," *Hist. Sci.* xxvii, 1989.
11 This is the third volume of the *Bridgewater Treatises*, the first edition was published in London in 1833. The general title for the Treatises is "On the power wisdom and goodness of God as manifested in the creation".
12 The quotation is from p.356 chapter VIII, titled "On the Physical Agency of the Deity", fifth edition, London 1836.
13 There is at least another issue that separated Darwin and Whewell. Biology for Whewell could not pretend to have reach a stage of development in which it could be possible to formulate its hypothesis mathematically, something that Whewell thought it was required for the "clear" formulation of a science. Darwin, implicitly at least, was saying that a clear formulation of a science did not required that its general laws be formulated mathematically.
14 Robert Richards, *The Meaning of Evolution*, Chicago 1992.
15 "Progress, its law and cause", *Westminster Review*, April 1857, pp. 445-485.
16 Cosmic evolutionism is a widespread view among the most ardent advocates of Darwin. Ernst Haeckel thought of the unfolding of nature as "merely the inevitable outcome of the struggle for existence" and had views more similar to Spencer than to Darwin on the nature of evolution. Clemence-August Royer, who translated *The Origin of Species* into French in 1862 thought of progress as a universal law and even criticizes Darwin for failing to draw

conclusions for morality and political evolution from the law of progress, that, according to her, he has discovered.

17 On this issue see "The nebular hypotheses and the science of progress", by Simon Schaffer, in *History, Humanity and Evolution*, Essays for John Green, edited by J. Moore, Cambridge U.P, 1989.

18 *Vestiges of the Natural History of Creation*, by Robert Chambers, edited with a new introduction by J. Secord, facsimile reproduction of the first edition, the University of Chicago Press, 1994.

19 References to Darwin's *Origin of Species* are to the first edition (facsimile, with an introduction by Ernst Mayr, Harvard University Press, Cambridge 1964).

20 In many other passages of the *Origin*, and in letters of the time of publication of the *Origin*, Darwin states his view of progressive evolution, emphasizing its secular character. (See for example, letter of Darwin to Lyell, 25 Oct. 1859, in *The Life and Letters of Charles Darwin*, by. F. Darwin, 2: 177.) In the *Descent of Man* this secular understanding of evolution is even more insistent, as we shall see.

21 See *The Meaning of Evolution*, by R. Richards, chapter 4.

22 "Evolution by natural selection", *North Am. Review*, July 1872. Included in *Philosophical Discussions* by Chauncey Wright, edited by Charles Eliot Norton, New York 1877.

23 "The meaning of accident", *North Am. Review*, 1871.

24 *The Descent of Man in Relation to Sex*, London 1871.

25 The references to Boutroux's work are from the translation by Fred Rothwell of 1920: *The Contingency of the Laws of Nature*, E. Boutroux, Chicago 1920.

26 Boutroux, 1920, p.172.