THE HYPOTHETICAL-DEDUCTIVE METHOD OR THE INFERENCE TO THE BEST EXPLANATION: THE CASE OF THE THEORY OF EVOLUTION BY NATURAL SELECTION

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ABSTRACT. Critical rationalism sustains that the best way of evaluating scientific theories is through the hypothetical-deductive method. Scientific hypotheses are tested deducting observational conducts from them. The task of science is to refute hypotheses, which mandates to postulate other hypotheses which can surpass the previous ones in terms of their precision and explanatory content. However, according to the Duhem-Quine thesis, the problem is that a hypothesis can never be totally refuted. In view of this, the hypothetical-deductive method appears as extremely permissive, but minimally probative. The aims of this paper are to show that: (1) the so-called 'inference to the best explanation' gives a more adequate answer than the hypothetical-deductive method about how to evaluate scientific theories; (2) The theory of evolution by natural selection is a clear example of what is pointed out in (1).

KEY WORDS. Inference to the best explanation, hypothetical-deductive method, Duhem-Quine theory, theory of evolution by natural selection.

1. INTRODUCTION

Critical rationalism sustains that the best way of evaluating scientific theories is through the hypothetical-deductive method (H-D). According to the H-D, the scientific theories are hypotheses which are tested deducing observational consequences from them. These hypotheses cannot be confirmed, but refuted through the H-D. When a hypothesis is falsified, it obliges to postulate other better hypothesis in terms of their precision and their explanatory content. A hypothesis is thus scientific if it can be falsified. However, the problem is that a hypothesis can never be absolutely refuted. According to the Duhem-Quine thesis, any theory can be

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made compatible with any evidence through an adequate adjustment of an auxiliary hypotheses. This implies that the H-D does not have the epistemological strength necessary to refute the hypotheses, which indicates that the H-D is extremely permissive yet minimally probative. A clear example of the drawbacks of the H-D is shown in the case of the theory of evolution by natural selection (TENS), which is for Karl Popper a 'program of metaphysical research' due to its irrefutable character. The problem of this characterization of the TESN is that it doubts its belonging to the field of science. Moreover, TESN as a metaphysical program is used by Intelligent Design, among other creationist variants, to affirm the necessity of resorting to the presence of a Designer. Here the key question is: this characterization is a problem of the TESN or the H-D?

The objectives of the present contribution are: (1) the so-called 'inference to the best explanation' (IBE) gives a more adequate answer than the hypothetical-deductive method about how to evaluate scientific theories; (2) the TESN is a clear example of what is pointed out in (1). In order to do this, the problems generated when dealing with the TESN using the H-D are going to be developed—specifically, why the TESN is considered irrefutable, and so a metaphysical program— showing that these problems spring from the method and not from the theory. This fact is demonstrated through the Duhem-Quine thesis. Secondly, what the IBE consists of and why it allows an approach which overcomes the difficulties proposed by the H-D for the evaluation of theories will be stated here. Finally, the fact that using the IBE is better than the H-D when applied to the TENS will be shown.

2. THE IRREFUTABLE CHARACTER OF THE TESN

According to Popper (1974, 171), the TESN is irrefutable. Following his example, stating that if we were able to find life in Mars, consisting only in three species of bacteria, which were similar to the ones existing on Earth, the TENS would not be refuted, in spite of the differences between the environment in both planets. The TENS argues that both are suitable for surviving, and the same could be affirmed if it were only one. "Thus Darwinism does not really *predict* the evolution of variety. It therefore cannot really *explain* it" (Popper, 1974, 171). At most, the TENS can predict the evolution of one species under favorable conditions. However, describing the favorable conditions is not an easy task, except when they have already demonstrated that they are favorable. The terms 'adaptation' and 'selection' can be used in such a way that we state that 'if the species is not adapted, then it is eliminated by natural selection'; but in the same way, we say 'if the species has been eliminated it is because it has not adapted to the conditions.' According to the H-D, the TENS is not refutable

because whether the species survives or not, it is still in force. "Adaptation or fitness is defined by modern evolutionist as survival value, and can be measured by actual success in survival: there is hardly any possibility of testing a theory as feeble as this" (Popper, 1974, 171).

According to Popper, the refutable character of the TENS is directly associated to the fact that the central statement of the theory—"the survival of the fittest"—is tautological. "To say that a species now living is adapted to its environments is, in fact, almost tautological" (Popper, 1974, 171). The fact that the TESN is irrefutable deprives it from any value: "the theory is invaluable. I do not see how, without it, our knowledge could have grown as it has done since Darwin" (1974, 171). The TENS is metaphysical but it means an essential contribution to practical investigations. In later works, Popper takes his words back in his affirmation about the irrefutable character of the TENS, and he states that "It does appear that some people think that I denied scientific character to the historical sciences, such as paleontology, or the history of the evolution of life on earth. This is a mistake, and I here wish to affirm that these and other historical sciences have in my opinion scientific character; their hypotheses can in many cases be tested" (Popper, 1981, 611). Anyway, the problem persists since the fallible character of the TESN is affirmed, and as to how the H-D is applied specifically to the TESN is not clearly shown.

The question here is if the problem is to be attributed to TESN or to H-D. Stated in other words, if the problem resides in the theory or in the method used to evaluate that theory. The impossibility of strictly refuting a theory, which in the case of the TESN is explicitly recognized, actually affects any theory analyzed with the H-D. This fact can be demonstrated through the 'Duhem-Quine thesis.' According to Elliott Sober (2004), the problem posed by the Duhem-Quine thesis can be so summarized when a conjunction of a hypothesis (H) and the auxiliary hypotheses (HA) is derived from an observational prediction (O), which does not turns out to be true; the H or HA should be rejected? This problem affects the capacity of the H-D to evaluate any theory because a possible negative prediction does not carry with itself the epistemological force to reject H. For this reason, Stathis Psillos (2009, 181) affirms that "H-D is minimally epistemically probative, since it does not have the resources to show how the undercutting defeaters can be removed." From this last evidence, we can infer that the infallible character assigned explicitly to the TESN affects, in fact, all the theories analyzed in light of the H-D. In other words, if we question the scientific character of the TESN regarding it as metaphysical, we can then say that it is not a problem of the theory but of the method.

The fact that the problem lies in the method but not in the theory is appreciated when we analyze the responses to Popper's criticism. For example, Rasmus Whinther (2009), taking two study cases, "parallel evo-

lutionary change in *E. coli*" and "the origin of eukaryotic cells through endosymbiosis," demonstrates that, contrary to Pooper's affirmation "in addition to explanatory unification and model fitting, predictive capacity (i.e., the ability to make surprising, risky, and correct novel predictions) is a central theoretical virtue of selectionist evolutionary theory" (Whinther, 2009). However, if we accept the Popperian criterion, these virtues of the theory does not count when establishing if the theory is fallible since we can apply to them the same considerations mentioned above: whether the predictions are fulfill or not, the theory will still be infallible.

3. THE INFERENCE TO THE BEST EXPLANATION

If we stem from the fact that the problem is not the theory but the method, the key is to look for another method which offers enough epistemological force and is ampliative at the same time. "Any attempt to characterise the abstract structure of scientific method should make the method satisfy two general an intuitively epistemic compelling desiderata: it should be ampliative and epistemically probative" (Psillos, 2009, 174). Evidently, the ampliative character is essential if we understand that science is an activity that develops our knowledge. However, this growth is merely illusory if we do not have a way to prove this knowledge. To refute this hypothesis we need to know in concrete where the problem lies: if in the H or maybe in the HA. However, "All these considerations go a lot beyond the deductive link between hypotheses and data that forms the backbone of HD and are not incorporated by the logical structure of HD" (Psillos, 2009, 181). At this point, the problem of the tautological character of the TENS lies in this: as the H-D does not recognize the forms of connection between the data and the hypothesis beyond deduction, it does not really acknowledge the predictive capacity of the theory. This limitation appears clearly in David Miller (2011), when he speaks about the role of the experience inside the H-D: "When I say that the role of experience in learning is to exclude, I do not mean that experience can teach an organism to avoid mistakes, but not how to get things right."

According to Psillos, the difficulties presented by the el H-D can be overcome by the IBE. This can be summarized as follows:

> D is a collection of data (facts, observations, givens).
> H explains D (H would, if true, explain D).
> No other hypothesis can explain D as well as H does.
> Therefore, H is probably true (Psillos, 2009, 183).

The evaluation made by the IBE implies, in the first place, that we never works 'in the emptiness,' to call it some way. This means that the causal-nomological connection between the *explans* and the *explanandum* is rele-

vant, because not only the data are taken into account, but also the available grounded knowledge (Psillos, 2009, 183-4). Based on this, we understand why the IBE permits to compare hypotheses. H_1 y H_2 can be considered comparatively in respect to their verisimilitude grade. Scientists with their activity indicate which hypothesis gives more possibilities of development. Psillos (2009, 184-5) points out six key points which serve to establish which the best hypothesis is:

1. *Consilience:* if there are two hypotheses H_1 y H_2 and the "relevant background knowledge" favors H_1 rather than H_2, unless any relevant change appears, H_1 must be considered the best explanation.
2. *Completeness*: if there is an explanatory hypothesis H which explains all the data, in spite of the appearance of others which partially explain the data, H must be considered the best.
3. *Importance*: if there are two hypotheses which do not explain the totality, but H_1 explains the most salient ones, H_1 is the best.
4. *Parsimony:* if H_1 and H_2 explain all the facts, but H_1 uses less assumptions than H_2, then H_1 is the best.
5. *Unification*: if H_1 y H_2 are compound hypotheses, but H_1 has less auxiliary hypotheses than H_2, H_1 is the best.
6. *Precision:* if H_1offers a more precise explanation of a phenomenon, "in particular an explanation that articulates some causal-nomological mechanism by means of which the phenomena are explained," H_1 is better than H_2.

Together with the six points indicated above, there is another key element of the IBE which we should take into account: coherence; "in the end, IBE enhances the explanatory coherence of a background corpus of belief by choosing a hypothesis which brings certain pieces of evidence into line with this corpus" (Psillos, 2009, 188). When we affirm that H is the best hypothesis, we assume coherence not only between the corpus of knowledge, but also with the data intended to explain. Contrary to what we pointed out in the case of the H-D, for the IBE the virtues of the theory do count in two concrete cases indicated by Whinther (2009): "parallel evolutionary change in *E. coli*" and "the origin of eukaryotic cells through endosymbiosis." Apart from the previous cases, the well-known micro-evolutionary processes, such us the specialization processes —the founder effect, the genetic variation, or the bottleneck effect—make the TENS a theory which has proved to have effective models. For this reason, Neo-Darwinists like Ayala (2006) or Ruse (1988) always use these classical examples to demonstrate the TENS. Through the IBE we save the ampliative character which a method evaluating theories must have.

The problem of having two theories competing, H_1 and H_2, which share the same criteria can be posed. In this way, the case of having H_1 being

superior to H_2 in three criteria and H_2 in the rest can also be possible. Considering such problem, the IBE replies that the criterion never 'works in the emptiness', which means that the election is related to the state of the situation, where the scientific community has the last word. Besides, the fact that there are several hypotheses is not only unhealthy from the point of view of scientific knowledge, but it is also a fact. We also have to consider that the IBE does not state that the theories are absolutely true. This interpretation is based in the way in which the IBE takes the notion of verisimilitude (*truth-likeness*). "In our interactions with the world, the exact truth cannot generally be bad, especially concerning the unobservable and spatio-temporally remote aspects of the world. A perfect match between theories and the world is almost impossible" (Psillos, 1999, 276). This situation is due to several reasons. One of them is that the complexity of the natural phenomena prevents the representation of these phenomena by scientific theories, unless idealizations and simplifications are introduced. For this reason, "demanding the exact truth in science would amount to demanding the exclusion of all approximations, simplifications, idealizations, approximate derivations, sources of error in measurements and calculations. Even were this sort of science possible, it would not be the science which we are familiar" (Psillos, 1999, 276). We also must point out that the verisimilitude idea implied by the IBE is an intuitive notion which is not formalized and it does not require it either, since "the conceptual schemes that science use to study the world are revis*able* and revi*sed*" (Psillos, 2009, 32).

4. CONCLUSION

The Popperian characterization of the TENS as a metaphysical program considered infallible is a source of permanent questioning to this theory. This questioning acquires greater relevance for the fact that Popper is a well-known admirer of the TENS and which he even uses it to explain his own theory of knowledge. However, as we stated, the problem lies not in the theory but in the method. The H-D does not take into account the relation between the data and the theory: the *explanans* and the *explanandum*. According to the IBE, theories are never absolutely true. They are the best explanation given the current state of knowledge.

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