

## **Quasi-Tautologies: The Case of the Birch Moth**

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### **ABSTRACT**

The purpose of this paper is to analyze quasi-tautological statements which would provide few information about reality and, therefore, would be difficult to refute. The method employed was to analyze the birch moth problem: (i) comparing two epistemological positions and (ii) investigating a functional pattern of Transcursive Logic. It was found that quasi-tautologies arise by unlinking a statement from the rest of its theory. In addition, it was found that the deductions of the systemic epistemological position and that of the Transcursive Logic coincide. The result enables Transcursive Logic as a powerful method of inquiring into reality.

**Keyword:** quasi-tautology, theory, evolution, enunciate, Transcursive Logic

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### **1.0 INTRODUCTION**

There are authors who claim that, in certain empirical theories, there are expressions difficult to refute because of their low empirical content, and they are quasi-tautologies or quasi-empty laws or symbolic generalizations or guiding principles. Such expressions would be found in theories such as Darwin's natural selection, Newton's mechanics, electromagnetism, or quantum mechanics as the most named by contemporary epistemology.

The noted practice is shared by authors of different currents, such as Ernst Mach of Empiriocriticism in “Historical-Critical Development of Mechanics” (1949, [1883]); Karl Popper's “Critical Rationalism in Objective Knowledge” (1982 [1972]); Thomas Kuhn of Historicism in

“The Structure of Scientific Revolutions”, (2004 [1962]); and the semantic conception, in the structuralist version of C. Ulises Moulines in “Metascientific explorations”, (1982) and Jose Diez Calzada and C. U. Moulines in “Foundations of Philosophy of Science”, (1999).

It should be remembered that a tautology literally says the same thing twice. In a broad sense they are, or logical forms such as 'raining or not raining', or definitions such as 'singles are those who are not married'. Tautological expressions do not say anything about reality and, therefore, are not refutable (Popper, 1980, p. 292). On the other hand, quasi-tautological statements would be difficult to refute because they have very little empirical content, because the information they give about reality is very scarce. This would be precisely the case of 'survival of the fittest' what this work is about, which is another way of naming Darwin's theory of natural selection.

In contrast, the authors of this work argue that the quasi-tautological character of the expressions mentioned is a consequence of isolating them from the rest of the theory to which they belong. The theoretical support of this position is found in: the properties of information; the linguistic and systemic character of the theories introduced by Hilbert; the epistemological holism of Duhem and Quine; and the analysis of the situation made with Transcursive Logic. Then, to exemplify their point of view, we present the case of the moth (nocturnal butterfly) of the birch, signaled by Popper for 'survival of the fittest'. This case was chosen because of its notoriety in current epistemology.

The objective of this work is to analyze the positions of Popper, Kuhn, Diez Calzada and Moulines that support the existence of quasi-tautologies. Then, it is shown that the selected case of 'survival of the fittest' becomes refutable, if one accepts the views of Agazzi, Frege, Hilbert, Masuda, Duhem and Quine, and the Transcursive Logic (Salatino, 2009). The contribution of this work is to show that the Transcursive Logic has a power comparable to that of the logical-linguistic used in situation analysis.

## **2.0 LITERATURE REVIEW**

In this paper, we characterize the positions that determine the existence of quasi-tautologies and those that do not support it. Among its defenders are notorious figures of diverse epistemological currents, like Mach, Popper, Kuhn, Moulines. While the authors of this work argue that quasi-tautologies arise from isolating statements of their theory and support their position in the ideas of Hilbert, Duhem, Quine, Masuda and Transcursive Logic. The confrontation of both positions is made using a case of industrial melanism.

Quasi-tautologies generate questions such as: What is their role within an empirical theory? What kind of informational content do you provide? Some authors assign a role related to the practices of the user community of theory. Thus, for Mach, for example, they are definitions; Popper considers them elements of metaphysics that guide research, as is the case of 'survival of the fittest'. Kuhn and the structuralists of the semantic conception, Moulines and Diez Calzada, argue that these are schemas, which are only refutable when applied to a particular case where they acquire a specific form, as with Newton's second law or Ohm's law, for example.

There is no doubt that in theories that are expressed mathematically, such as mechanics, thermodynamics, electromagnetism, to name the most known, mathematical tautologies and the empirical content of them are complementary. Moreover, when Popper (1991, p. 312) treats refutation as a criterion of demarcation, he argues that the division between metaphysics and science is not categorical, and in order to face the transition between them he resorted to quasi-tautological utterances, which would be difficult to refute because of their scarcity empirical content.

Natural selection explains evolution by 'survival of the fittest'. The expression was coined by Herbert Spencer and states that animals that do not adapt to their environment perish, and those that survive are those that are well adapted.

Popper, in "Objective Knowledge" (1982, p. 73, p. 223) argued that this formula was almost tautological, since 'well adapted' was equivalent to 'surviving', consequently applying the

corresponding substitution results 'those who survive survive' which is a logical triviality and not an empirical theory. However, Popper (1995, pp. 256-258) in his lecture "Natural selection and its scientific status", pronounced in 1977 at Darwin College of Cambridge, retracted and acknowledged that his previous valuation was incorrect and stated that it was a metaphysical criterion to guide the scientific research. The conference was compiled by David Miller on Popper Selections. (1995 [1985]).

Other authors, such as Kuhn (2004, 280-282), Moulines (1982, 88-98), Diez Calzada and Moulines (1997, 314) speak of symbolic generalizations, guiding principles, quasi-tautologies or quasi-empty laws, which function as definitions or as expressions of a pure mathematical system shared by members of a scientific community. They are abstract formalisms, empty expressions of meaning or empirical application that can be expressed in symbolic form, such as Newton's second law or Ohm's law. They may also be enunciated in natural language as "action equals reaction" or "the chemical combination occurs according to constant proportions of weight". These function in part as laws, and also as definitions of some of the symbols they display.

Faced with these positions, the authors of this work argue that the quasi-tautology condition comes from the decision to isolate, a statement from its theory to analyze, refute or validate it. When it is isolated it functions as a definition or a mathematical expression with little empirical content - and for that reason - it is difficult or impossible to refute it. However, if they remain within the theory they have a very significant empirical content, as it is to be demonstrated here.

The position indicated is based on the following reasons: 1) Gottlob Frege warned in §62 of *The Foundations of Arithmetic*, [1884] that "Only in the context of a proposition do words mean anything." David Hilbert, in his work *Foundations of Geometry*, 1899, extended Frege's criteria from the proposition to the theory. Consequently, each term used in theory is implicitly defined by the combination of the axioms of theory, thus, signaling the systemic and structural condition of the theories. While Evandro Agazzi (1978, 101-103) emphasizes that in a broad sense, scientific theories are languages to describe knowledge of certain areas of reality.

In keeping with the arguments put forward, Duhem (1906, 301) argued that "...in Physics an experience can never condemn an isolated hypothesis, but refutes the whole theoretical set." Whereas Williard Quine (1962, 76-78) in his 1951 article, *Two dogmas of empiricism* argues that given a set of propositions, the meaning of each proposition depends on the whole set. For that reason, the meaning of each cannot be considered separately.

Moreover, if it is accepted that an empirical theory is an information system oriented to know certain aspects of reality, then it retains the inherent properties of information, including that which holds that it is indivisible because it can only be used as a single whole, according to Joneji Masuda (1984, 96).

### **3.0 METHODOLOGY**

Supported by the TL, the method used in this paper is based on: A) economic facts, because they belong to the social sciences, depending on the subjective reality and not on the objective reality that frames traditional natural science; B) the basic elements that intervene in the definition of the fact or phenomenon analyzed must form a relational pattern; C) the minimum pattern thus formed must form a group to demonstrate the presence of symmetry (Salatino, 2017); That is, it must give evidence of the conservation and invariance of the fundamental laws governing the fact or phenomenon being studied; And D) the ontological projection of the developed scheme emphasizes the presence of a common relational pattern (Salatino, 2009) that chains different apparently unrelated real facts.

Natural selection is a difficult theory to test, but there are some experimental tests, such as industrial melanism, that show how selection works with several species of *Lepidoptera* (Popper 1995, 257). Darwin discovered it in the birch moth (*Biston betularia*). During the day, this nocturnal butterfly rests on tree trunks and branches covered with gray lichens and the butterfly is

camouflaged with the birch, since their wings are marbling and clear. There are also dark moths called 'carbonaria', to distinguish them from the typical form.

Michael Majerus, in his Springer Science paper (2008), "Industrial Melanism in the speckled moth, *Biston betularia*: An Excellent Teaching Example of Darwinian Evolution in Action" exposed research by Bernard Kettlewell in the mid-1950s; *see* (Figure 1).

**Figure 1.** *Biston Betularia*



The first specimen of carbonaria moth was discovered near Manchester in 1848 and was a rarity. However, in 1895, 95% of birch moths were carbonaria, and by 1898 the proportion was 99%. The same process affected about two hundred species of urban areas and was also observed in Westphalia and in the vicinity of Hamburg.

It should be noted that dark moths existed before the industrial revolution. But since they stood out from the clear background of the birch trees, the birds easily located them and ate them. This situation reduced the population of the melanic forms and consequently the mutated gene could not be imposed. Then, with industrial pollution, the bark of the birch trees grew darker. With that change, clear speckled moths contrasted with the dark background of the trees, allowing the birds to locate and eat them easily.

Kettlewell studied the phenomenon in Dorset and Birmingham during 1955 and 1956. He conjectured that the obscure specimens already existed prior to industrialization and corroborated it by inspecting ancient collections of speckled moths. Then, to test the Darwinian interpretation of the phenomenon, he performed experiments, such as feeding moth caterpillars with leaves contaminated with soot and other industrial wastes. It had no effect since it only reproduced clear moths. The experiment discarded in this way the food as a factor of change.

He then performed crosses that proved that the inheritance was Mendelian. Clear and carbonaria moths were then marked in a ratio of three to one and released in a forest contaminated with soot. After a few days, the ratio changed to a ratio of one clear to six darks. In a forest without contamination, both types of marked varieties were released in a ratio of one to one. In a lapse similar to that of the other group, they were captured in a ratio of two clear moths by one dark.

In addition, it was found from observations throughout Great Britain that birds ate the moths that stood out most prominently on the trunks: the carbonaria survived more in environments contaminated with soot and less in the natural ones, and with speckled moths the opposite occurred. In conclusion, birch moths adapt by mimicking the environment to survive, whites in natural forests and carbonaria in forests contaminated with soot (Majerus: 1999, 637-649). In addition, it should be clarified that since the 1960s several decontamination activities began in England. For this reason, the present birch forests once again had a clear tone. The carbonaria declined and the speckled moths predominated again.



(nabla) = 00). The intermediate situations of adaptation, prior to achieving stable natural equilibrium or the unstable equilibrium of the pollution, correspond to codes 01 and 10.

We start from a situation on a natural equilibrium situation of speckled moths that slept on clear birch logs (11), as was the case in Manchester in 1848. As pollution increased, an intermediate imbalance occurred. The typical *Biston Betularia* population, which is clear, diminished because the night butterflies slept during the day leaning on the trunks of dark birches by pollution and were devoured by the birds, since their silhouette contrasted with the trunk where they were supported (10). The adaptation process led to an evolutionary equilibrium situation of the melanic form that slept on obscure trunks (00). In Manchester, in 1898, a mutation had been observed towards *Biston betularia carbonaria*, whose predominance was 99%.

The opposite situation to the previous one is the one that is verified today, since the results of the processes of decontamination that England realized, from 1960. At the beginning of the decontamination, the equilibrium situation was of dark moths that sleep mimetized on trunks of birches obscured by pollution (00). As the decontamination progressed, the birch trees lost their obscured bark and replaced them with the natural ones that are clear. Consequently, the population of the *Biston betularia carbonaria* went into a situation of imbalance of dark moths that sleep on the clear birch trunks (01), leaving no mimetic protection against the birds. Then, with the reproductive iterations and the activity of the birds, the carbonarias diminished and returned to dominate the speckled and clear moths, reaching again the natural balance that existed in Manchester in 1848. At the moment, in the forests that were contaminated, dominate the sleeping speckled moths mimicked the trunks of clear birches (11).

## 5.0 CONCLUSION

The way by which the evolutionary balance is reached does not matter. In that sense, at least theoretically, it is possible to return to the natural balance after of a new adaptation. The dynamics of this whole evolutionary picture can be reproduced by means of the respective operations represented in Figure 2, remembering that this scheme represents a functional PAU, where two entities, in this case, butterflies and birches, contrast.

It can be concluded that the results on the quasi-tautologies obtained through the logical-linguistic analysis are coincident with those that the functional PAU of the Transcursive Logic throws out. Moreover, the latter allows us to objectify the stable, natural or contaminated states, and the intermediate situations of transformation between them. In addition, the result achieved with the Transcursive Logic reinforces the idea that a theory is enriched with its forms of representation, because it allows us to introduce other communicative manifestations.

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