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The correspondence theory of truth and scientific confirmation

La teoría correspondentista de la verdad y la confirmación científica

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Abstract

Historically, implicit in the main philosophical analyzes of the concept of 'truth' it was implicit what is now known as the correspondence theory of truth, which can be traced from Aristotle to Immanuel Kant. In the early nineteenth century, detractors of the correspondence theory of truth began to argue, among other things, that this position is obscure, too narrow and self-indulgent or argumentatively circular. However, in the scientific field some contenders of certain realistic positions of science have considered that truth is the most important cognitive aim of scientific activity. This study was conducted to establish the plausibility of this realistic argument. By analyzing the validity of some ontological, semantic and epistemic arguments proposed by some defenders of different versions of the so-called 'Scientific Realism', with which an attempt is made to relate the empirical and predictive success of the best scientific theories with the truth, it is shown that, from a logical point of view, seems difficult to confirm that such theories provide with a reliable knowledge of the natural world. It is suggested that scientists are not confirmatory agents; but rather probabilistic agents, that is, agents that seek to calculate the probability with which a truthmaker makes a truth-bearer true, with which science communicates its results.

Keywords

Science, truth, confirmation, correspondence, realism, logic.

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Resumen

Históricamente, en los principales análisis filosóficos sobre el concepto de 'verdad' estuvo implícita lo que hoy se conoce como la teoría correspondentista de la verdad, la cual puede ser trazada desde Aristóteles hasta Immanuel Kant. A principios del siglo XIX, los detractores de la teoría correspondentista de la verdad comenzaron a argumentar, entre otras cosas, que esta postura era oscura, demasiado estrecha y autocomplaciente o argumentativamente circular. No obstante, en el ámbito científico algunos defensores de ciertas posturas realistas de la ciencia han considerado que la verdad es la meta cognoscitiva más importante de la actividad científica. Este estudio se realizó para establecer la plausibilidad de este argumento realista. Mediante el análisis de la validez de algunos argumentos de tipo ontológico, semántico y epistémico propuestos por algunos defensores de distintas versiones del llamado "realismo científico", con los que se intenta relacionar el éxito empírico y predictivo de las mejores teorías científicas con la verdad, se muestra que, desde un punto de vista lógico, parece difícil confirmar que tales teorías puedan proporcionar conocimiento confiable del mundo natural. Se sugiere que los científicos no son agentes confirmadores; sino agentes probabilísticos, esto es, agentes que buscan calcular la probabilidad con la que un hacedor de verdad convierte en verdadero a un portador de verdad con el que la ciencia comunica sus resultados.

Palabras clave

Ciencia, verdad, confirmación, correspondencia, realismo, lógica.

Introduction

The topic of truth has been the subject of various analyzes throughout the history of philosophy and the philosophy of science. Historically, a correspondence position of truth was implicit in the main philosophical analyzes on this concept, which can be traced from Aristotle to Immanuel Kant. However, at the beginning of the 19th century, some philosophers interested in the subject began to systematically problematize what is now known as the correspondence theory of truth. It was questioned, among other things, what exactly corresponds to the natural world.

Opponents of this theory have argued that this position is, among other things, dark, too narrow, and self-complacent. However, in the scientific field, some advocates of certain realistic positions of science have considered truth to be the most important cognitive goal of scientific activity. To sustain the above, ontological, semantic, and epistemic arguments have been proposed to relate, for example, the empirical and predictive success shown by the best scientific theories of the truth, arguing that such theories can provide reliable knowledge of the natural world. However, it has not been established precisely how this relationship can be confirmed, so it remains unclear exactly what a scientific truth is. Likewise, insufficient attention has been paid to the role of the concept of 'correspondence' in

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the construction of the concept of 'scientific truth'. Bearing in mind *epistemological scientific realism*, this text presents some logical arguments that represent a challenge to a finished notion of confirmation that seems essential to a correspondence theory of truth that seeks to explain the supposed correspondence between those who are called 'doers of truth' and 'bearers of truth'. Finally, this study suggests that scientists are not, after all, confirmatory agents, but probabilistic agents; i.e., agents seeking to calculate a real doer making true from scientific discourse.

A review is made on how some philosophers have understood the concept of truth. Later on, some of the correspondence theory of truth is presented in the field of scientific research. Then there are some confirmation problems in the framework of the ontological, semantic and epistemic commitments defended in the so-called *scientific realism*. Finally, some conclusions that can be inferred from this study are discussed.

The correspondence theory of truth: A Historical Approach

According to the Royal Spanish Academy (2020), the concept of 'truth' is defined as "conformity of things with the concept that forms the mind". Note that this definition uses the verb 'conformity'. It is not by chance that the dictionary uses this verb since it reflects one of the first philosophical positions on this concept, i.e., the correspondence theory of truth. According to this position, truth—or true—corresponds to or is in conformity with a fact. So, it is possible to tentatively explore a first philosophical definition of the concept of 'truth', namely:

Definition 1a:

x is true if and only if it corresponds to a fact.

x is false if and only if it does not correspond to any fact.

Here is an example. According to the correspondence theory of truth, snow is white if and only is a fact that snow is white. Of course, facts can be current or potential, so the following definition includes this possibility.

Definition 1b:

x is true if and only it corresponds to a state of things that are the case or that are obtainable.

x is false if and only it corresponds to a state of things that are not the case or that are not obtainable.

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In this case, the above example can be reformulated as follows: snow is white if and only if snow whiteness is possible. Note that definition 1a is Aristotelian in the sense that this definition does not mention abstract properties, as definition 1b does, which is platonic in nature, since such properties are accepted, i.e., the property of whiteness.

It can be said that the truth consists of a relationship with a fact or a state of things. Such a relationship can be of correspondence or conformity, but historically there has also been congruence, agreement, representation, reference, satisfaction, etc., not only with facts or things, also with portions of reality such as conditions, situations, events, objects, sequence of objects, sets, properties, and so on.

Before continuing, a brief historical review will show how the correspondence theory of truth is implicit in the way several major philosophers conceived the concept of 'truth'. In his *Metaphysic*s, Aristotle (384-322 B. C.), defined 'truth' as:

> To say of what is that it is not, or of what is not that it is, is false, while to say of what is that it is, and of what is not that it is not, is true (Metaphysics, 1011b25).

In other words, what Aristotle claimed is what makes true or false what we 'say', is the being – or not being – of things. In Aristotle's words:

> We say that things are false when they do not exist or because their appearance does not exist either. A false *explanation*, as a false one, refers to non-existing objects. For the above, any explanation is false when applied to something other than what makes it true; for example, the explanation of a circle is false when applied to a triangle (*Metaphysics*, 1024b25).

For Aristotle (1999 [1690], the statements issued on reality may be true or false:

> The truth or falsity of a statement depends on the facts and not on the power of the statements themselves to admit contrary qualities (*Categories*, 4b5).

In Aristotle's concept of 'truth' the correspondence that has been characterized by definition 1a is intrinsic because what we 'say' is true when somehow, yet to be defined, it corresponds to the being of a thing. Almost a millennium and a half after the existence of Aristotle, during the Middle Ages, the philosopher and theologian Saint Thomas Aquinas (1225-1274), who was an apologist of the 'Philosopher' (as Aquinas refers

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to Aristotle), wrote his classic book *Summa Theological* (also known as Summa of Theology) dated between 1258 and 1265. In this book, Aquino took up the question about the concept of 'truth' in question 16 precisely entitled 'on truth'. In Article 1, question 16, he wrote:

> Instead, there is what the Philosopher says in VI *Metaphys*: *True and false are not in things, but in understanding them* (2001, Aquinas, Article 1, Objections 3).

And he added:

> It must be said: As was already mentioned (a.1), the real thing, in terms of its first reason, is in the understanding. As all things are true as they have the proper form of their nature, it is necessary that understanding, as known, be true as soon as it has the image of the known, that is the form of understanding as is known. And so, truth is defined as the adequacy between understanding and object. Therefore, knowing such an adequacy is knowing the truth (2001, Aquino, Article 2, Objections 2).

Note that Aquino's concept of 'truth' also has an intrinsic correspondence of truth in defining it as the 'adequacy' between understanding and object. However, his notion of truth differs from that of Aristotle in terms of what corresponds to or adapts to reality or objects in the world. According to Aristotle, 'say' is a verbal act, which corresponds to reality; while Aquino emphasized 'understanding' as a mental process. During modernity, Baruch Spinoza's notion of truth (1632-1677) no longer refers to 'understanding' as Aquino did; it refers to ideas:

> The true idea must be in agreement with what is conceived by it (Ethics, of God, axiom vi. My emphasis)

Indeed, Spinoza did not clarify whether the idea of 'true ideas' is something external to the ideas themselves, i.e., whether it is referring to an external world or some kind of link between ideas. John Locke (1632-1704), in his *Essay on Human Understanding,* tried to be more precise by distinguishing two types of propositions and two types of signs:

> Then the truth itself belongs only to propositions: there are two types, mental and verbal; just as there are two kinds of signs that we commonly use, namely, ideas and words […] when ideas are placed together or separated into the mind, in the way things they represent agree or disagree, it is what I call mental truth […] But, then, propositions will contain a real truth, when those signs have been united according to our ideas, and when those ideas are such that we know they are capable of

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> having an existence in nature (Locke, 1999 [1690], 4.5.2, 4.5.6 and 4.5.8. My emphasis).

As can be seen, Locke also defends a type of correspondence truth by asserting that propositions, understood as the signs of ideas, are sensitive to an 'existence' in nature. The same was said by Gottfried Wilhelm Leibniz (1646-1716), who argued that truth consists of a kind of *connection* between the parts of a proposition:

> […] in truth there is also a connection between the terms, i.e., there is truth, even if such truth cannot be reduced to the principle of contradiction or necessity through an analysis of their identities […] It is true that there is a connection between the subject and the predicate in every truth (Leibniz, 1989 [1690], p. 29).

Subsequently, David Hume (1711-1776) in his *Research on Human* made a fundamental distinction between two kinds of objects of human reason, namely, the relationships of ideas and facts, in order to understand the truth:

> Sciences of Geometry, Algebra and Arithmetic are part of the first type of objects […] These propositions [first] are discovered by the mere operation of thought regardless of whether [such objects] exist in the universe. Even if there is never a circle or triangle in nature, these truths, demonstrated by Euclid, will retain their certainty and evidence. The facts [on the other hand] which are the objects of human reason of the second type, are not determined in the same way [as those of the first type] nor is our evidence of their *truth*, however great it may be, of a nature similar to the previous one. The opposite of each fact is possible because it cannot imply a contradiction and is conceived by the mind with the same ease and clarity as if it were *conformed* with reality (Hume, 2007 [1748], Section IV, Part I, 25. My emphasis).

According to Hume (2007 [1748]), facts — and their potential and opposite imaginaries — also imply a relationship of correspondence or 'conformity' with reality, however, the evidence of 'truth' is contingent and unnecessary as is the case with the objects of mathematics. Finally, there is the position of another important philosopher, Immanuel Kant (1724-1804), who in his *critique of pure reason* also spoke about correspondence truth as:

> What is the truth? The nominal definition of truth is the concordance of knowledge with its object, it is granted here and assumed. But it is clear that, since in such a criterion, all content of knowledge (reference

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> to its object) is abstracted and the truth concerns precisely that content; it is impossible and absurd to ask for a sign of truth of that content of knowledge, and is therefore not possible to give a sufficient, and at the same time universal, characteristic of truth (Kant, 2000 [1787], A58, B83 and A59).

This historical review shows that for a long period of time, most philosophers defended, in one way or another, what is now known as the 'correspondence theory of truth'. It was not until the late nineteenth and early twentieth centuries that some philosophers who were interested in the subject began to problematize this theory in a 'systematic' way. Indeed, in the notions of 'truth' created by philosophers that have been revised so far, there is no consensus, for example, on what exactly corresponds to reality, whether it refers to assertions, understanding, or propositions. Certainly, these can also be ideas, beliefs, thoughts, judgments, statements, sentences, etc.

Because of the latter, it has been proposed to use a neutral term, namely 'truthbearer' to refer to each of these possible entities. On the other hand, any fact, event, phenomenon, situation, process, thing, object, sequence, set, property, etc., that makes a truth bearer be true, has also been called, in a neutral way, 'truthmaker'. Schematically, the following table represents the three constituent elements of the correspondence theory of truth:

Table 1. Correspondence theory of truth

Truthbearer	Relationship	Truthmaker
Belief	Correspondence	Fact
Thinking	Conformity	Event
Idea	Congruity	Phenomenon
Judgment	Agreement	Thing
Enunciated	Representation	Set
Assertion	Meaning	Object
Statement	Reference	Property
Proposition	Satisfaction	Process

Source: Own elaboration

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Some problems of correspondence theory of truth and its relationship to science

The correspondence theory of truth not only shows a problem of consensus of what corresponds to reality. It also shows a problem with regard to how a real doer 'makes' a real bearer[1]. Of course, there are several debates surrounding problems of a more general nature exhibited by the correspondence theory of truth[2].

This text will develop a specific set of problems that exhibit the correspondence theory of truth in relation to the scientific field. In particular, three criticisms of this position will be analyzed, (i) that it is dark and mysterious; (ii) that it is too limited to explain certain aspects in some areas of scientific research; and (iii) that it appears to be a self-complacent stance.

Argument (i): The correspondence theory of truth is d ark and mysterious

According to this argument[3], the correspondence theory of truth is dark because, if the correspondence referred to implies some kind of similarity between the bearers and the real doers, it turns out that the former – the real bearers – do not resemble anything that exists in reality like things, facts or phenomena. Given the mental (beliefs, thoughts, ideas, judgments) or linguistic (statements, assertions, statements, propositions) nature of the truth bearers, they cannot resemble anything 'real' in the world, whose ontological – or metaphysical – nature has certainly another nature. In other words, if there is any similarity between a belief or an idea and something else, it could only be another belief or idea. If this argument is correct, there is no connection between the truth bearers and the truth-doers as suggested by the correspondence theory of truth.

On the other hand, the correspondence relationship is not only dark; it is mysterious, since it seems to involve the most distant regions of space and time. Certainly, one might wonder in this regard how to explain the correspondence from the point of view of a temporal relationship between a real bearer and a far-truth doer in time, as is the case of historical or archaeological events.

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Argument (ii): The correspondence theory of truth is too limited

Two possible definitions of the correspondence theory of truth (definitions 1a and 1b) were provided in the previous section. Although both definitions apply to certain domains of scientific knowledge, they do not apply to other domains such as Ethics. For example, because there are no 'moral facts', there is no real doer for this type of discipline. On the other hand, the correspondence between a judgment and a specific ethical virtue such as 'righteousness' might be, in principle, relative to specific ethical systems, leading to a type of epistemic relativism; but, moreover, it would remain in the scope of abstract ideas such as whiteness, i.e., it would possibly satisfy definition 1b, but not 1a.

Likewise, correspondence theory of truth seems to be too limited by not making any distinction between falsehood and the absence of truth, a crucial distinction to explain certain claims that are neither true nor false. This is the case with statements that presuppose the existence of things that do not actually exist. Likewise, this theory also does not explain certain paradoxical truth bearers, who for their understanding, require the notion of 'clusters of truth', whose statements would be both true and false[4]. This last point will set aside the first distinction between falsehood, and the absence of truth will be deepened. For this, here is an example drawn from the history of Chemistry.

In the chemical revolution of the 18th century, Joseph Priestley (1773-1804) used language containing terms such as 'phlogiston' or 'principle', which is now considered to be of no reference in the natural world. Although later, Antoine Lavoisier (1743-1794) used a theoretical framework containing expressions such as 'oxygen' and 'element' whose references correspond, as Philip Kitcher says to "natural classes that Priestley could not identify" (Kitcher, 1993, p. 97); the fact is that the concept of 'phlogiston' does not refer to any element or substance existing in the world. Hence, sentences containing terms that do not designate anything (called empty sentences) express propositions that are neither true nor false, i.e., these enter into what can be called a 'gap of truth values'. Here is an example to clarify the point of this type of semantic gap:

(P) "Kant's wife was protestant."

According to the correspondence definition 1a 'x is true if and only if it corresponds to a fact' while 'x is false if and only if it does not correspond to any fact'. In this case, x would be equivalent to 'being Kant's wife' and the fact x should correspond to 'being protestant'. Hence, the

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proposition 'Kant's wife was protestant' would express a falsehood only in the case that the proposition 'Kant's wife was not protestant' is true. However, since Kant was a single man, it is not true that (P) nor is the denial of P (not P) true. When a proposition is neither true nor false, it is then an empty sentence[5].

For the above, it can be stated that any proposition that affirms or denies anything about the phlogiston will be an empty proposition whose semantic content cannot express any reference in the natural world.

Argument (iii): The correspondence theory of truth is self-complacent

It has been mentioned that the correspondence theory of truth asserts that a truth bearer x corresponds to a truth doer *z* located in some space-time region of the natural world. This relationship can be expressed as follows:

"*x* corresponds to *z*".

One of the questions that can be asked to this relationship is: How can be confirmed that there is indeed an optimal correspondence, i.e., complete, total and not empty between *x* and *z*?

The answer to this question must, in principle, avoid a kind of confirmatory complacency or, in other words, avoid circular argument that makes it possible to confirm the correspondence relationship between *x* and *z* in an 'objective' way. For the above, a confirmatory instrument is required 'beyond' the relationship. In philosophical literature, this confirmatory instrument is often referred to as the 'eye of God'. In the following lines, some of the problems presented by the 'eye of God' argument for the correspondence theory of truth will be analyzed.

Certainly, a correspondence theory of truth requires, for the sake of objectivity, a confirmation mechanism that allows corroborating the supposed correspondence between the two domains *x* and *z*. This objectivity can only be achieved if the confirmation mechanism is independent of both domains. However, in the case of scientific activity, scientists themselves are the ones who establish, from a theory, the type of entities acceptable to the theory—or group of theories—called a paradigm, tradition, research program, or theoretical holon. But it is also the scientists themselves who specify how such entities can be confirmed, so such a mechanism seems to be a circular argument.

However, it could be argued that scientists act with full honesty and epistemic objectivity. Nevertheless, epistemic biases are not always

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conscious or voluntary. There are also biological and cognitive reasons that risk the objectivity of the confirmation process by scientists such as visual incompetence or lack of scientific training, among others. The fact is that, if scientists take this kind of 'involuntary' epistemic biases seriously, there seems to be no entirely sure observation, free from the danger of misinterpretations.

Hence, the notion of the 'eye of God', as a confirmatory ideal, is relevant in pointing to the need for a neutral and independent criterion to confirm (or, if desired, verify) the extent to which both domains *x* and *z* actually correspond.

At this point, it could be argued that the correspondence between two domains may certainly not be total and free of uncertainty; in reality correspondence can occur in degrees, which allows to construct a notion of non-absolute correspondence, as in the case of some astronomical scientific propositions. For example, today it is known that the *approximate* distance between our planet and the Sun is 149 600 000 km. Of course, a notion of absolute correspondence between the Earth and the Sun assumes that there is indeed an objective distance—or real— at a specific time t1 between Earth and the Sun, and that the increasingly accurate calculation of this distance depends on factors such as the development of more advanced measurement technology. Hence, from this position, correspondence is becoming more precise. Unfortunately, although this stance eliminates the requirement for absolute empirical corroboration, it does not evade the problem that, even by accepting that correspondence can occur in degrees, the degree of correspondence – or approximation – between the two domains x and z must be established.

What is interesting to note from both postures, which can be called absolutist and gradualist of correspondence, is that scientists, in both, are considered as 'confirmatory agents' of the truth bearers accepted in the framework of scientific research. According to Carl Hempel (1966), this confirmation process begins when scientists raise hypotheses that are used to make predictions about scientific phenomena. If the experiments show that the predictions are 'true', or from a less strict epistemic point of view, that they are 'empirically adequate', then the hypothesis is said to have been 'confirmed'. This latter problem is interesting given that it seems essential to a correspondence theory of truth to explain how, from a logical and empirical point of view, the supposed correspondence between the doers and the bearers is confirmed; this topic will be discussed in depth in the next section in the context of current *scientific realism.*

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Confirmation problems in the framework of scientific realism

Scientific 'confirmation' faces two types of problems, some empirical and some logical. Here, some of the logical problems and their implications for the correspondence theory of truth[6] will be discussed. One of the philosophical positions that defends the thesis of scientific confirmation emerges from the so-called *scientific realism*, so the idea is to start this section by making some conceptual clarifications about the realistic stance. *Scientific realism* is made up of several heterogeneous theses that share a common characteristic, namely the acceptance of the entities, organisms and processes that are not observed (many of them unobservable) and that are postulated by science. In this sense, it is reasonable to believe that scientific claims about these entities, organisms, and unobserved processes are true or at least approximately true.

Three types of closely related commitments have been identified, which can be defended from different realistic positions. Such commitments are ontological, semantic and epistemological. *Ontological commitments* postulate the existence of a natural world independent of human mind[7]. In this sense, *ontological scientific realism* defends the idea that the natural classes that describe the best scientific theories exist independently of the scientist ability to know the natural world. On the other hand, *semantic commitments* hold that most of the statements that science makes about the natural world contain values of truth, so the best scientific theories must be kept as true, or at least approximately true, in the literal sense of these terms[8]. Defending this type of *semantic scientific realism* implies arguing about the observational terms and theoretical terms that postulate the best scientific theories. Finally, epistemological commitments defend the idea that the scientific assertions that make this type of theory, being true, provide reliable knowledge of the natural world, so that, for advocates of epistemological scientific realism, theories that show empirical and predictive success are, by this fact, confirmed[9].

Each of these realistic versions argue with different anti-realistic postures. For example, the ontological thesis tries to oppose postures such as defended verificationism, among others, by Michael Dummett (1993) and Hilary Putnam (1990, 1981); those who deny that it is possible to draw a clear dividing line between what exists in the world (the truth doers) and what our best epistemological practices establish as real (the truth bearers). The semantic thesis, for its part, opposes skeptical positions such as defended *instrumentalism*, among others, by Chang (2004) and Laudan (1977). The latter argues that it is irrational to adopt

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truth as a coherent cognitive goal for scientific research because, among other reasons, it is not possible to know whether or not that goal has been accomplished. Chang, in turn, considers that science is a system of knowledge that is self-correcting and enriching in relation to different cognitive goals that science has historically pursued such as simplicity, productivity, congruence, accuracy, consistency, problem solving, explanatory power, or predictive accuracy; hence, postulating a single cognitive criterion as truth to defend a realistic stance on science seems to face historical problems[10]. Finally, the epistemological thesis is opposed to skeptical empirical versions such as *defended empirical constructivism*, among other authors, by Bas Van Fraassen (2002, 1980). In this regard, Van Fraassen (2002) considers of little cognitive importance whether or not the theoretical terms of a scientific theory are true because, among other reasons, it is not possible to confirm with full certainty whether such hypotheses are in fact true beyond empirical evidence. What really matters, the author argues, is whether or not such scientific theories are empirically appropriate (Van Fraassen, 1980).

As can be seen, the three types of commitments that can be made from different realistic positions – ontological, semantic, and epistemic– are intimately related to each other. Some logical arguments will be presented with *epistemological scientific realism* in mind, representing a challenge to a finished notion of confirmation that, as has already been pointed out, seems essential to a correspondence theory of truth that seeks to explain how the supposed correspondence between the doers and the bearers of truth is confirmed. It will be presented from the simplest to the most complex.

(a) The fallacy of the affirmation of the consequent

If the empirical predictions made by science have the logical form: if ($P \rightarrow Q$). Where P represents general laws, central hypotheses, auxiliary hypotheses, auxiliary assumptions, initial conditions, the *céteris páribus* clauses, etc., used by a theory to establish an empirical prediction; and it turns out that this is the case of Q, this prediction commits, strictly speaking, the fallacy of affirmation of the consequent. So, no Q can confirm P without falling into this fallacy. But the other way of this conditional is also problematic:

(b) The regression to infinity or the problem of the epistemic foundation of knowledge

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If the empirical predictions made by science have the logical form: If (P → Q), it is always possible to ask for the justification of P. Such justification cannot be part of any element of Q, since it is Q which is intended to be justified. Therefore, R must be added, and: if (R → P → Q). And now, the justification of R would be: if (¿? → R → P → Q) *ad infinitum.*

(c) The raven paradox

This problem is known as the 'Raven Paradox' and was proposed by Hempel (1945). The following proposition: (1) 'All ravens are black', is logically equivalent to the proposition: (2) 'All non-black things are non-ravens'. So, a "red chair," which is certainly something that is not black and is not a raven, is positive evidence for (1). From a logical point of view, this is correct. However, intuitively it can be thought that something is not right with this argument. Finding a red chair cannot be evidence in favor of proposition (1) [11].

(d) The argument of pessimist induction[12].

According to this argument, whatever the supposed epistemic virtues of scientific theories are, as is the virtue of being true, there is no inductive guarantee that such virtue will be preserved during the theoretical change of science, for example, during scientific revolutions. Historically, several scientific theories of the past that proved to be untrue can be traced despite exhibiting remarkable empirical success, as is the case with the phlogiston theory mentioned above, which showed some success with regard to some chemical reactions, such as oxidation and reduction, according to Priestley (1783). Therefore, many of the core terms of today's best scientific theories could have the same result and not display a genuine reference in the natural world. If this argument is correct, several of today's best scientific theories may not have a real doer to make their core terms true.

(e) The epistemic context argument

The confirmatory test to which a scientific proposition can be scrutinized, more specifically, a hypothesis (H), has a conditional nature of the type:

BK, (IC → E)

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Where BK refers to previously accepted knowledge, IC denotes the set of initial conditions that have been previously established by the theory and E shows evidence in favor of H. It is important to note that H under evaluation is usually based on certain auxiliary hypotheses (HA) that link it to the evidence. However, even when a specific H can be considered to be 'well confirmed', it is not possible to assume it as 'true', because the empirical support of H is relative not only to BK and IC; it is also related to HA which, in turn, can be tested from other contexts. If this is the case, what is considered as H or as HA will depend on the epistemic context in which these variables arise, because both H and HA may be the hypotheses that are under analysis in different contexts. If this is so, that is, if the type of truth bearer (or hypothesis) for which reliable evidence is available is not clear, it can hardly be established what exactly that evidence is *properly* justifying, and thus confirming.

(f) The argument of circular argument

As mentioned, some advocates of realistic science postures have argued that the empirical success of the best scientific theories is a feature in favor of scientific realism. It is argued that entities postulated by such theories exist or have a reference in the natural world. Hence, it is argued that the empirical success of science—in the sense of giving detailed explanations and making precise predictions—is a feature of the supposed empirical confirmation of such theories. It is also argued that the theoretical terms — i.e., the terms with which unobserved entities are postulated and that have most of the finished scientific theories, should be thought of as genuine referential expressions, since the scientific theories are highly confirmable and, in fact, they are often inductively confirmed as true approximations by interpreting scientific evidence in accordance with ordinary methodological norms. Let us look in detail at one of the arguments in favor of this idea.

According to Bird (2007), the main cognitive goal pursued by science is "knowledge production" (p. 64). In fact, according to this author, science progresses by accumulating known scientific propositions. The concept of 'knowledge' advocated by Bird follows the traditional scheme of 'true justified belief', so there is genuine scientific knowledge when, in some way, yet to be defined, the truth content of scientific propositions, i.e., of the truth-bearers, has been justified through an epistemically reliable methodology.

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However, ensuring that a scientific proposition is 'known' implies that it is possible to have, in principle, a non-problematic idea of what knowledge in general and scientific knowledge are; but, the concept of 'knowledge' cannot be defined simply as 'true justified belief', because there may be beliefs that are 'accidentally true'. Bird (2007) accepts that these 'accidental' cases would not contribute to scientific knowledge. For the above, the only scientific propositions that can be 'known' are those that are sufficiently well-founded by the evidence, i.e., propositions that have somehow been properly confirmed.

Thus, this chain of scientific knowledge can be expressed as: (I) scientific progress exists when knowledge accumulates; (ii) knowledge accumulates when scientific propositions are true; (iii) scientific propositions are true when they are sufficiently justified; (iv) this type of justification is obtained by a scientific methodology that provides reliable evidence; (v) reliable epistemic evidence is obtained when scientific propositions are properly confirmed. But when can one claim that a scientific proposition is properly confirmed? In order to answer this question, it seems that we must go back to subparagraph (iv), i.e., we must reaffirm once again that confirmation is linked to the possession of reliable evidence, which seems to be a circular argumentative strategy. If this argument is correct, this stance suggests – tacitly – that the sufficiently well-founded evidence that can be possessed in favor of a scientific truth bearer is actually equivalent to asserting that such a bearer has been properly confirmed. Thus, the argumentative movement that this position makes from subparagraph (iv) to subparagraph (v) can be questioned.

Conclusions

All of these logical problems presented by the notion of 'scientific confirmation' suggest that scientists are not, after all, confirmatory agents; they are probabilistic agents, i.e., agents seeking to calculate the probability with which a truth doer makes a true bearer of truth emanating from scientific discourse.

A probabilistic agent could operate as follows: hypotheses are put forward when considering its probability given the available evidence. This relationship is expressed as the conditional P(H/E) probability. One way to calculate this probability is using Bayes's theorem (conditional probability of a random event).

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An interpretation of this theorem is P(H/E) = P(H) × P(E/H) / P(E). This indicates that the subsequent probability of a hypothesis (H), given the evidence (E), is calculated by multiplying the previous probability of (H) by the probability of the evidence (E), given the hypothesis (H), and all is divided by the probability of the evidence (E).

One of the attractions of this theorem is that (H) is more and more likely to the extent that it makes the evidence more likely. So, a probabilistic agent takes into account all relevant evidence, then calculates the values for P(E) and P(E/H) considering a previous P(H) value, and culminates by calculating the P(H/E) values. Thus, from two incompatible hypotheses, probabilistic agents will prefer (H) with the highest probability.

However, this probabilistic strategy of scientific confirmation is also questionable. It also appears to be too limiting. For example, ones might wonder what is the interpretation of the probability of P(H/E) for a causal hypothesis of unobservable entities that science postulates? It is known that probability has its clearest expression as frequencies in a population of observable events, so that the frequency of a die falling by 3 is 1/6. But what likelihood can be given, for example, to the idea that the extinction of dinosaurs has been caused by the collision of an asteroid in the Chicxulub area, Yucatan, Mexico and not by another event? Certainly, the causal hypotheses of unobservable and distant events in time, such as the extinction of dinosaurs, are also problematic for the probabilistic strategy; however, it suggests future lines of research for the construction of a finished notion of scientific confirmation, which is essential for the better understanding of the correspondence theory of truth.

Notes

1. For an analysis of the various philosophical implications of bearers and doers, see Jago, 2018 chapters 3, 4, 7 and 8; King, 2018; Dragulinescu, 2018; Frápolli, 2013 Chapter 5; Baron, 2013; Dragulinescu, 2012; Schulte, 2011 and Niiniluoto, 2004, among others.
2. For a review of various arguments for and against the correspondence theory of truth, see Wolensky, 2019 chapter 9; Sher, 2015; Rasmussen, 2014; Asay, 2013 chapter 4; Licata, 2011; Niiniluoto, 2011; Newman, 2004; Underwood, 2003; Fernández, 2001 and Field, 2001 chapter 7, among others.
3. For a more detailed analysis of this argument, see David, 2016, pp. 22 and 23.
4. For a deeper analysis of the notion of 'truth clusters', see Weber et al., 2014.
5. For a detailed review of this type of semantic gap, see Künne 2003, Chapter II.
6. Elsewhere, I analyze some of the empirical problems faced by the notion of scientific 'confirmation' (see Islas, 2014).

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7. To deepen the issue of the independence of the human mind from the natural world, see Fry, 2020; Frolov, 2018; Nicolai, 2015; Colyvan, 2008; and Cocchiarella, 2007, among others.
8. For an analysis of the distinction between what is true and approximately true, see Khalifa, 2020; Cevolani & Tambolo, 2019 and 2012; Andreas, 2016; Da Costa & French, 2003 and Niiniluoto, 1999, among others.
9. For an analysis between empirical success and confirmation, see Saatsi, 2018 and Psillos, 2009, among others.
10. Elsewhere, I analyze the different cognitive goals and values pursued by science and its implications for an integral notion of scientific progress (see Islas, 2015).
11. This argument has been extensively developed by several authors interested in the subject, see Goodman, 1979; Schiller, 2012; Maher, 2005, among others.
12. Elsewhere, I analyze the debate on the argument of pessimistic induction from the point of view of the philosophy of today's science (see Islas, 2019).

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