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STANDING UP FOR SCIENCE AGAINST POSTMODERNISM AND RELATIVISM

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The purpose of this article is to tackle the way postmodernists have attacked science. Departing from the doctrine of relativism, postmodernists have long claimed that science does not deserve any priority over pseudoscientific or even anti-scientific approaches. Regrettably, in the 20th Century, some philosophers were part of this trend. Claude Levi Strauss' views on rationality and irrationality, Ludwig Wittgenstein's notion of "language games", Paul Feyerabend's epistemological anarchism, and Thomas Kuhn's theories about paradigms and their incommensurability, are objects of critique in this article. This article also defends some of Karl Popper's views on the philosophy of science, and addresses the way some postmodernists have erroneously used Popper's philosophy to advance their own views.

INTRODUCTION

Science has been one of the institutions most frequently attacked by postmodernists (Marcel Kuntz, 2012). This comes as no surprise, given that science relies on rational procedures, and postmodernism is to a large extent a reaction against Enlightenment rationality.

Furthermore, science has been an enterprise developed in a very specific context. Modern science, with a well-established method, was born in Europe during the 17th Century. And although science has expanded globally, it is nevertheless true that the greatest scientists do come from Western nations. Inasmuch as postmodernists favor relativism, they argue that science cannot pretend to be universal in scope, and science's hypothesis are only true in the cultural context in which they have been formulated.

Science aspires to formulate hypotheses that describe how the world works. In this sense, science presupposes the existence of objective truths, and the duty of a scientist is to discover such truths. But predictably, postmodernists oppose this. In their view, there is no such thing as truth. The distinction between truth and falsehood

is relative to a context, and thus, the pronouncements of science are only true in the scientific context.

Scientists assume that they do a better job than others when it comes to discover truth. Scientists trust that the following of enquiry procedures will allow them to know the world more efficiently. But, as postmodernists see it, the performance of a scientist is no better or worse than the performance of a witch doctor. Inasmuch as there are no objective truths, there is no criteria that allow us to claim that what a scientist does is more valuable than what a witch doctor does.

Philosophers of science have long tried to refute this, by attempting to find a criterion that may allow them to establish a firm distinction between scientific disciplines and non-scientific disciplines. During the first half of the 20th Century, these philosophers believed that verification is the fundamental criterion to make such a distinction (Ayer, 1952). Science seeks to formulate hypotheses that may be verified. Those hypotheses that are constantly verified, maintain their scientific status. Those that are not verifiable, or that fail to be verified, cannot be considered scientific hypotheses.

Pronouncements about God, or invisible cosmic energies, or the Spirit that guides History, are clearly not verifiable, and thus, cannot be considered scientific. Pronouncements that fail to be verified because in autonomous trials they have different results from the original experiment, cannot be considered scientific, either. For example, the alleged paranormal abilities "discovered" by parapsychologists have never been properly replicated in other experiments (Hess, 1993).

Nevertheless, Karl Popper (2002a) reacted against this criterion based on verification. In Popper's view, we should not seek to verify scientific hypotheses, because it is impossible to verify propositions with universal quantifiers. Consider, for example, the proposition "All swans are white." Apparently, this is easy to verify: we just need to find many white swans. But, regardless of many white swans we find, that will never be enough to be certain that, indeed, *all* swans are white. For, there is always the possibility that there may be a non-white swan that we still have not found.

On the basis of this, Popper recommended not to verify hypotheses, but rather, to attempt to refute them with some counterexample. Thus, when considering the statement "All swans are white," scientists must attempt to find a non-white swan. If she ever found it, then the original hypothesis would be refuted, and there would be a need to reformulate it. If, on the contrary, no non-white swan is found, then that original hypothesis must be preserved, but the scientist must continue seeking counterexamples.

For that reason, Popper considered that scientific theories are not just susceptible of being verified, but rather, susceptible of being refuted, yet no evidence has been found for refutation. Thus, in opposition to just verification, Popper proposed a falsifiability criterion, as the real distinction between science and pseudoscience. Disciplines such as psychoanalysis purport to be scientific, but they are actually pseudoscientific, inasmuch as there is no possibility of a counterexample to refute their claims. Consider, for example, Freud's views on dreams: if someone has an explicitly sexual dream, it confirms his theory; yet if someone has a dream completely unrelated to sexuality, it also confirms his theory, as psychoanalytic theory makes the claim that lack of sexual content in dreams would in itself be evidence of repression. That is clearly not science (Webster, 2005).

RELATIVISTIC ANTHROPOLOGY AGAINST SCIENCE

Some postmodernists consider that there is no demarcation criterion to separate science and pseudoscience. In such a manner, astronomy is on equal pairing with astrology, and creationism has the same epistemological value as the theory of evolution. Consider, for example, Paul Feyerabend's (2010, 18-19) assessment: "To those who look at the rich material provided by history, and who are not intent on impoverishing it in order to please their lower instincts, their craving for intellectual security in the form of clarity, precision, 'objectivity', 'truth', it will become clear that there is only one principle that can be defended under all circumstances and in all stages of human development. It is the principle: anything goes."

Other postmodernists are willing to admit that, indeed, it is possible to demarcate science and pseudoscience. But, according to them, science and pseudoscience (or non-science in general) are merely different, and no hierarchical relationship can be established amongst them. In other words, they are *incommensurables* (a term much beloved by postmodernists), as per Thomas Kuhn's (1996, 1103) description: "The normal-scientific tradition that emerges from a scientific revolution is not only incompatible but often actually incommensurable with that which has gone before."

This neatly fits with the doctrine of relativism. For these postmodernists, there is no such thing as truth, or in any case, there is no ultimate truth that transcends us all, but instead, each truth is constructed by each cultural system, especially if mediated by language. For example, philosopher Richard Rorty states (1989, 159): "I do not think there are . . . any truths independent of Language."

Thus, under this view, the theses of astronomy are true in planetariums, but not in horoscopes; and vice versa, the theories of astrologists are true in horoscopes, but not in planetariums. Therefore, science is confined to its space, and it should not pretend to have universal scope. Postmodernist Sandra Harding thus argues that "the professed universality of Western science was established as an empirical consequence of European expansion, not as an epistemological cause of valid claims" (see Sardar, 1994).

Postmodernists that defend this stand claim that, when approaching disciplines such as astrology or Feng Shui, one must search for its "internal rationality." Once we understand the principles that guide these disciplines, so it is claimed, we will comprehend that they are actually a coherent whole, and in that sense, they preserve their own rationality. Thus, in this approach, astrology actually makes sense. There is a coherent effort to order the world, and the constitutive elements of astrology are well-structured. On the basis of the initial premise (according to which the position of the stars influences our destinies), then we will understand that it is perfectly rational to follow the recommendations from horoscopes.

Anthropologist Claude Levi-Strauss (1966) enthusiastically defended this idea. In his view, science cannot pretend to have the monopoly of rationality. Those theories that seem to be erroneous, so he claims, actually have the same level of rationality as scientific theories, because they are organized in the same manner as science organizes the world.

Consider, for example, the belief of some tribal societies, according to which, they descend from totemic animals (Levi-Strauss, 2016). In the scientific view, this is irrational. But, Levi-Strauss argues that we must further investigate these beliefs, in order to understand that they are actually rational. For, the belief that members of a tribe are descendants of totemic animals is actually a form of social organization. Descendants of the bear have some assigned roles, descendants of the deer have other assigned roles, and so on. Thus, the apparently irrational belief regarding totemic origins is in fact a very rational way of structuring the division of labors and functions in society. According to Levi-Strauss, modern societies have logical abstract thought; non-modern societies have an equally logic thought, but instead of using abstract concepts, rely on concrete concepts that are organized in logical structures. Yet, he insists, they are both equally logic.

On the basis of these arguments, Levi-Strauss was clearly a relativist. For him, the rationality or irrationality of a belief will be relative to its system. Yet, on the other hand, Levi-Strauss was also a universalist, in the sense that all systems of thought fit into the same rational pattern. The manifestations of that rationality may vary, but underneath those manifestations, there is a common rational ground.

Levi-Strauss argues that all human systems of thought seek to organize the world in categories; in other words, all systems of thought do some classification. And, according to him, classification is intrinsically a rational activity. Levi-Strauss would presumably argue that Feng Shui, homeopathy and astrology are perfectly rational, because they classify elements.

Levi-Strauss' argumentation is rather weak, and should be challenged. We may admit that, on a basic level, yes, all humans are rational. In that sense, Levi-Strauss is indeed right to claim that there is a universal structure for the human mind, and this forms the basis of rational thought. Yet at the same time, we should understand that there are different levels of rationality, and in that sense, it is ridiculous to claim that science is not more rational than pseudoscience. We may tentatively admit that totemic beliefs are not absolutely rational, because indeed, these beliefs may have an important social function. But common sense also dictates that totemic beliefs are irrational, and simply inferior to the scientific belief that members of the tribe do not descend from totemic animals, but rather, from hominids in Africa.

Levi-Strauss seems to rely on the coherence theory of truth, and this is a very problematic approach. Just because a system of belief has an inner coherence, does not imply that those beliefs are true or even rational. Likewise, the mere fact that a system of beliefs is coherent and uses some basic logical procedures, does not imply that it is rational in the full sense of the term.

Coherence is a necessary condition, but not a sufficient one, for rationality. In order for a belief to be rational, it must not just come from an attempt to classify things in the world. A rational belief must also have some sort of empirical evidence in its favor. There is no empirical evidence that supports the claim according to which a group of human beings descends from a totemic animal; instead, there is plenty of empirical data that do support the claim that human beings descend from hominids. Carl Sagan famously

expressed it thus: "extraordinary claims require extraordinary evidence" (Sagan, 2011). Unfortunately, Levi-Strauss and his followers are willing to admit as rational, some extraordinary claims that have no extraordinary evidence whatsoever in their favor.

Certainly, classification is an aspect of rationality. Inasmuch as we classify things, we organize the world, and rules of thought are followed. But, we should not conclude that all taxonomies have equal rational value, contrary to what postmodernists seem to think. Michel Foucault (1989, xvi), for example, was fascinated by an alleged ancient classificatory system in China (it was actually invented by Jorge Luis Borges), in which animals are divided in these categories: those that belong to the emperor, embalmed, tamed, sirens, fabulous ones, strayed dogs, those that become agitated. Foucault believed that this was a proof of non-scientific rationality.

But is it really true that this classification system has the same level of rationality as, say, Linnaeus' binominal system? To suppose that all classification levels have the same degree of rationality is terribly naïve, to say the least. To assume that the "logic of the concrete" (as Levi-Strauss calls it) is not better or worse than the abstract logic of philosophy is a major disrespect to Russell, Frege, and so many other philosophers who have gone to great lengths in order to refine the rules of rational thinking.

Very much as Levi-Strauss, other relativist anthropologists have labeled as "rational" practices that are clearly irrational. For example, anthropologist E.E. Evans-Pritchard (1976) considered that beliefs about witchcraft and consultations of oracles amongst the Azande (a tribe in Sudan) are perfectly rational, as long as their premises are accepted. According to his argument, the belief in witchcraft helps in preserving diplomacy and good manners, because there is always the risk of being accused of witchcraft. Likewise, oracles that rely on killing a chicken, has the ultimate purpose of discovering witches, and it is good to make accurate decisions. Evans-Pritchard confessed that he consulted the oracle himself, and he even claimed that such a method proved to be as efficient as any other method that he could have used.

This is extremely difficult to accept. Does consultation of oracles really work? Should we accept detective work on the basis of consulting how birds fly? This is just plain absurdity. It is astonishing to find that relativist anthropologists such as Evans Pritchard are willing to claim that witchcraft beliefs are not irrational, but only as long as they occur in non-Western settings. Would they be willing to admit that the witch hunt craze of the 15th-17th Centuries were rational? Of course not. When it comes to measuring rationality, they have a different standard for Western societies, which is a proof of the hypocrisy that relativism usually entails.

In any case, although Evans-Pritchard held that Zande beliefs in witchcraft and oracles can be considered rational, there came a time when he acknowledged that not even these beliefs preserve a minimum of coherence. The Azande believe that a substance found in liver is the culprit of witchcraft, and that this substance is transmitted from mothers to daughters and from fathers to sons; in other words, witchcraft is inherited. Yet, the Azande also belief that they all come from one common ancestor. Given these premises, then it logically follows that *all* Azande are witches. Yet, the Azande believe that only some members of the tribes are witches, and that is precisely why they consult oracles.

Evidently, the Azande suspend the use of logic in this case. And Evans-Pritchard accurately observed that they were being logically inconsistent. However, Evans-Pritchard was ultimately criticized by authors even more relativistic than he was. According to philosopher Peter Winch, (1964) Evans-Pritchard was making a "category mistake," by requesting the Azande to think with the same logic that rules Western thought. According to Winch, the rules of logic are not universal, but rather, relative to context. And in such a manner, the rationality of Zande beliefs must be evaluated "from the inside" of their culture.

Evans-Pritchard had already tried to "understand" witchcraft and oracles from "the inside," by accepting its premises. But not even doing that, could he evade the inconsistencies in that belief system. Winch, in turn, pretended to go even further, and claimed that each system has its own criterion of consistency and coherence, and that we have no authority to judge its rationality from the outside. This, of course, is just relativism out of control.

Winch had been influenced by Wittgenstein's philosophy. In his early philosophy, Wittgenstein had argued that language works as a picture of reality; i.e., the function of language is representation. But Wittgenstein (2009) eventually changed his mind and believed that language is actually a tool that, instead of just representing reality, actually constructs it. Therefore, the meaning of words is found in their use. There are no sentences that are intrinsically absurd; depending on how a sentence fits into a particular context, and depending on the use that it gets in that context, it will have different meanings.

On the basis of these ideas, Wittgenstein came up with the concept of "language games." According to this concept, each language plays a different game, and therefore, each language has its own rules. Inasmuch as each language has its own rules, they are incommensurable, and the meaning of each word must be evaluated from the interior of each language game. Football has its rules, and basketball has its rules. To grab the ball by the hand is forbidden in football, but it is allowed in basketball. In the same manner, we must not extrapolate the rules of one language game to another language game.

The problem with Wittgenstein's argument is that he seldom explained what, exactly, is a "language game." When we speak about languages, we think of Mandarin, Spanish, Arabic, and so on. But Wittgenstein seemed to have a wider understanding of what a language is. In his philosophy, a "language game" is more akin to a way of thinking in a given community. A French astrologer and a French astronomer may both speak French, but in Wittgenstein's philosophy, they come from different language games. And, inasmuch as each language has its own rules, the rules of the one cannot be extrapolated to the other. Thus, the astronomer has no authority to judge the astrologer wrong, because again, they belong to different spheres.

There is some debate about how relativist Wittgenstein truly was, but these ideas have a clear relativist semblance (Baghramian 2004, 74). Very much as Evans-Pritchard, Wittgenstein was willing to admit that consultation of oracles is neither better nor worse than the study of physics. Consider a famous passage from *On Certainty*: "Supposing we met people [who want to know if water boils at one hundred degrees]…

Instead of the physicist, they consult an oracle. (And for that we consider them primitive). Is it wrong for them to consult an oracle and be guided by it? If we call this "wrong" aren't we using our language game as a base from which to combat theirs?" (Wittgenstein 1969, 609).

Wittgenstein's implied answer to his own rhetorical question is very clear: we have no authority to scold on those who consult the oracle, because those people are using a different language game than ours, and under their rules that is a legitimate procedure. Wittgenstein believes that, with different language games, the physicist does not have the possibility of offering explanatory reasons to those who consult oracles.

In academic discussions, it is not sufficiently understood that Wittgenstein was a major enemy of science, but it is time to come to terms with this. His later philosophy is replete with the same relativist themes that have been recycled ever since Protagoras. Taken to its logical conclusion, in Wittgenstein's philosophy, homeopaths, faith healers ad witch doctors have their own language game. But not just that. Nazis, gangsters and psychopaths also have their own language game. Even students who fail an exam may claim that they have their own language game, and that the professor has no right to fail them, because they are applying the rules of the language game of professors, which is incommensurable with the language game of students.

Wittgenstein's relativism faces the same difficulty as with any other form of relativism: it is a self-defeating idea. I may perfectly argue that, under my own language game, the concept of "language games" is rubbish. And thus, in the same manner that, according to Wittgenstein, a physicist has no firm reasons to attempt to build sense into those who consult oracles, Wittgenstein would have no reasons to try to persuade me to abandon my views, because we belong to totally incommensurable worlds. Therefore, I would have no reasons to believe that "language games" even exist.

KUHN AND FEYERABEND'S MISCONCEPTIONS

Relativism denies that there is such a thing as absolute truth. In this sense, it holds that truth is just a convention that emerges from the interior of each group, or according to the more extreme forms of relativism, from the interior of each persons. Thus, relativism in its extreme form leans towards the idea that the external world does not exist. If we accept that there are absolute ideas, so the argument goes, then we accept that there is indeed something outside our own system. Under this presumption, truth exists on its own, independently of what we believe, and in that sense truth exists, so to speak, "out there." Relativism denies that truth is "out there."

In this regard, relativism is rather similar to radical skepticism. This brand of skepticism (as opposed to the soft approach that seeks to rationally evaluate dubious claims) posits that we cannot know anything for certain. Under this view, traditionally associated with Sextus Empiricus, we must doubt everything (Bailey, 2002). Ultimately, it also doubts the reality of the external world, i.e., that which happens outside our system of perception and understanding. This posture seems close to relativism;

inasmuch as it doubts everything, it offers no motives why one belief should be more accepted than another. All beliefs are equally valid, for we will never have certainty about any of them. Thus, inasmuch as the astronomer cannot be certain about his beliefs, and the astrologer cannot have that certainty either, then astrology and astronomy lay at the same epistemological level.

Postmodernists have frequently appealed to this variant of hard skepticism in order to attack science. According to their argument, science is fundamentally inductive, and we can never have certainty in induction. Therefore, given the absence of certainties about the world, we may admit alternative hypotheses to science, and this opens the gate for pseudoscience and all sorts of irrational claims.

Postmodernists are right in claiming that science is inductive. And, indeed, there is no certainty in induction. If we have ten sacks of oranges, and we verify that in nine sacks all oranges are ripe, can we assume that the tenth sack also has ripe oranges? Of course we can. But, can we be certain about it? No, we cannot.

David Hume famously approached this problem. According to Hume, knowledge of the past is no guarantee for the knowledge of the future, and in that sense, we can never be certain in our predictions. We cannot even be absolutely sure that tomorrow the sun will rise. It is irrelevant if, up till now, the sun has risen for millions of years. Hume warned that our experience is limited, and we cannot know experience the totality of the universe. There may very well be a yet to be known phenomenon that somehow prevents the sun from rising tomorrow (Govier 2013, 256).

Indeed, this is a fundamental limitation of science. Yet, even if we may not be absolutely sure that, upon jumping from a building, a person will be crushed, it is simply irrational to suspend our judgement regarding gravity, and accept as equally valid some alternative theory that claims that those who jump from buildings may be able to fly. We may not be certain about the laws of gravity, but we consider them highly probable. And once again, skepticism regarding one scientific theory does not imply that we must consider it as valid as any other non-scientific hypothesis. A healthy dose of skepticism should not lead to relativism or the attack against science.

Very much as Hume, Popper (2002a) also approached the problem of induction. Popper also argues that our experience shall always be limited, and will never be able to totally apprehend reality. Science will not be able to reach absolute certainty regarding its hypotheses, because these hypotheses pretend to be universal, and propositions with universal quantifiers cannot be demonstrated as true, except those that are self-evident by virtue of their very meaning (such as "No bachelor is married").

Precisely for this reason, as mentioned previously, Popper recommended to attempt to refute hypotheses, and to accept as scientific only those hypotheses that could in principle be refuted in some possible scenarios, but that have thus far not been refuted. There is no objection to this argument. Yet, some postmodernists are fond of abusing Popper's theories. Under a very questionable interpretation, it is sometimes argues that, inasmuch as we can have no absolute certainty about scientific hypotheses, there is always the possibility that those theories that we do not consider scientific today, may be vindicated in the future; and inversely, those theories that we consider correct today, may be disregarded in the future.

Thus, Popper is frequently invoked when making the relativist argument that we must not mock homeopathy, acupuncture, astrology, Intelligent Design and so on, because science has no definite postures. According to this argument, someday we may have to admit that those theories that today are considered questionable, are not truly so questionable. In the same manner that, in their time, Galileo was mocked by geocentrists, but ultimately the Italian scientist was proven right, we should be far more respectful of with doctors, faith healers, and so on.

This is a grossly incorrect argumentative leap. We may accept the premise that, indeed, we may be mistaken regarding our own understanding of the world. But this should not lead to the conclusion that any claim is as valid as scientific theories. We must admit the possibility that science may be mistaken, but we must also assume that it is very unlikely that this is the case, given the huge set of data that supports scientific theories. We should definitely not disregard new theories, but there are some theories that are so outrageous and lacking in evidence, that we should not lose time with them. The fact that I may be wrong does not imply that I am likely wrong.

Popper himself never drove his thought towards the relativist attack against science. Indeed, Popper sought to impose some limitations on science's pretensions, but it was all with the purpose of improving science. However, other authors have made that move; very much as Popper, they argue that science can never have certainties about the world, but additionally, argue that neither science nor any other discipline will ever get ahold of ultimate reality, and therefore, no theory is superior to another.

Thomas Kuhn (1996) was perhaps the best representative of this view. Kuhn believed that scientific hypotheses operate under a set of presumptions that work as conceptual schemes to interpret the world. For example, geocentrists assumed that God had created the universe, and that humans had a special place in creation. Thus, under those presumptions, the idea that the sun orbits the Earth nicely fit in.

Kuhn called those conceptual schemes "paradigms." Upon analyzing the history of science, Kuhn considered that there have been a series of scientific revolutions, whose impact leads to the rupture of the ruling paradigm, and the imposition of a new paradigm. When new data amounts and it does not fit with the presumptions of the prevailing paradigm, a new period begins in which the set of presumptions are questioned, and if that data becomes cumulative, it leads to a revolution, a total rupture with the previous paradigm.

Thus, very much as Popper, Kuhn argues that we must not rule out the possibility that, in the future, our current paradigms will be broken, a new paradigm will be imposed, and a new set of theories may be validated. There is the possibility that today we may be wrong, and we may have to review everything we considered as true.

Again, it is hard to argue against this. Indeed, there is the possibility that, in the future, our understanding of the world may change. Yet, regrettably, Kuhn went beyond. He also claimed that when one theory substitutes another, it does not truly refute it, because paradigms are incommensurable. Inasmuch as each theory is framed on a particular paradigm, no theory can have the pretension of being more valid than the other. Each theory belongs to each paradigm, and each theory must be evaluated in the context of its own paradigm.

Therefore, theories are incommensurable, in the sense that they cannot be compared. They each have their own criteria of validity. In this regard, Kuhn does not seem to be far removed from the "language game" concept of Wittgenstein: the astrologer works under one paradigm, and the astronomer works under another paradigm. Inasmuch as they belong to two different paradigms, we cannot claim that one theory is better than the other.

The logical conclusion of this reasoning is that there is no progress in science. The implication is that there is no objective and transcendent reality, against which theories can be contrasted, in order to evaluate how proximate they are to truth. In the absence of an absolute truth, the value of theories is only relative to the paradigm whence they come.

Paul Feyerabend (2010) had even more radical views than Kuhn. He is the originator of the infamous "anything goes" slogan in philosophy of science. His doctrine, known as "epistemological anarchism", holds that, when attempting to gather knowledge about the world, there simply are no rules. When predicting the forecast, the same value should be allotted to the meteorologist and the shaman who consults spirits. In fact, Feyerabend frequently requested that science be separated from politics (in the same manner that in secular states religion is separated from politics), and argued that in public education science should not be given privileged status over other theories.

Naturally, these views are outrageous, and above any other author related to postmodernism, Feyerabend has been considered the *bęte noir* in the philosophy of science. Feyerabend's views are so extreme, that Sokal and Bricmont, (1997, 73) in their celebrated tirade against postmodernism, considered him a "court jester," and he may not have even been convinced of his own claims, but may have just produced them to earn money and fame.

Nevertheless, we must address some of his claims. Feyerabend's attack against science relies on his view that in the history of science, some of the grand theories that are accepted today were precisely formulated against the prevailing epistemological rules of the time. According to Feyerabend, science's great innovators have speculated and dismissed rigorous observations and rules, but precisely this activity has given rise to great scientific innovations. Very much as Kuhn, Feyerabend believed theories are incommensurables, so that no theory is closer to truth than any other. But regardless of whether or not there is an objective truth to which we may get closer, Feyerabend believed that the rebellious spirit of scientific innovators is precisely what gives vitality to human knowledge.

Feyerabend dedicated special attention to the case of Galileo. Contrary to what is commonly believed (and on this point Feyerabend is indeed right), opposition to Galileo did not come exclusively from a dogmatic adhesion to the Bible or Aristotle. Instead, scholars of the time appealed to observations that, apparently, refuted Galileo and reaffirmed the idea that the sun orbits around the Earth.

For example, if the Earth moves, we should then feel the wind against our faces constantly. Even more, when a rock is dropped from a tower, it falls vertically. Galileo's opponents argued that this was evidence that the Earth is immobile. If it were mobile,

the rock would fall diagonally: when reaching land, the Earth would have moved, and the rock would have been left behind, inasmuch as being suspended in air, it would not have moved with the Earth.

In order to counter this objection, Galileo formulated yet another theory that attempted to change the understanding of impulse and relative movement (which would explain why the rock descends vertically from the tower), but with little empirical support. At most, as it is well known, Galileo appealed to a thought experiment: imagine that a horse rider, upon riding at higher speeds, drops a ball. The ball would land right beside the horse, just as it would happen if the horse were not moving. On the basis of this, Galileo inferred that the movement of the ball is transferred to the ball, through the rider's hand (Brown 1991, 77). Yet, Galileo did not summit this hypothesis to a rigorous empirical verification. And according to Feyerabend, (2010, 49) he appealed to an *ad hoc* hypothesis in order to save his theory.

In our contemporary understanding of the scientific method, *ad hoc* hypotheses are very suspicious. For example, when experiments of alleged paranormal activities do not reproduce the same results of previous experiments, enthusiasts frequently try to explain that by arguing that the observers' skepticism inhibits paranormal abilities (Alcock 1981).

According to Feyerabend, Galileo similarly violated the rules of the scientific method. But precisely because of that, Feyerabend approves of Galileo. He sees Galileo as a rebel against the alleged tyranny of the scientific establishment; in Feyerabend's narrative, Galileo dares ignore the requirements of the scientific methods, and thanks to this, he comes up with a new explanatory schema that works well. Thus, in the same manner that we do not condemn Galileo for having broken the rules of the scientific method, we should not condemn homeopaths, parapsychologists and astrologers. Anything goes.

Feyerabend argues that Galileo already had a preconceived idea, and on that basis, he sought data that confirmed it, and in case that theory did not fit in with the prevailing data, he formulated *ad hoc* hypotheses in order to explain away those apparent inconsistencies. According to Feyerabend, all scientific theories work like that.

On this point, Feyerabend resonated significantly with the notion of "undetermination of scientific theory," a relatively controversial concept defended by Duhem and Quine (Stanford 2017). In this view, whenever a theory comes up, it starts on the basis of a general conceptual scheme. And thus, it will always be possible to adjust the theory to some data that, apparently, refute the theory. For, this data proceeds from a generalized conceptual scheme, but if this scheme were abandoned, they could be adjusted to the theory under consideration.

Thus, as Duhem and Quine would have it, upon encountering any set of data, there is always more than one possible explanation. For example, someone could claim that Earth is flat. In the face of elementary evidence, such as the pictures of rounded Earth taken from outer space, defenders of a flat Earth could claim that those pictures come from a conspiracy that produces fake pictures. Thus, pictures of a round Earth do not automatically refute the hypothesis regarding the flatness of the Earth, because in

turn, this refutation is built on other premises (for example, that those pictures are reliable), and these on others, and so on. If instead we rule out those premises and accept others (such as, for example, that there is a conspiracy), then those pictures are not a problem for the defender of the flatness of the Earth.

Duhem and Quine's argument is ingenious, but it is open to criticism. It is true that, in the face of any set of data, there are always many possible explanations. But, it does not follow that we must assume that all explanations are equally valid. A principle widely defended by philosophers is Ockham's razor: entities should not be multiplied beyond their necessity (Kogan 1988, 153). In other words, parsimonious explanations are more preferable. In this sense, even if a set of data can be explained by many theories, the correct one will likely be the most parsimonious one, i.e., the one which recurs the least to *ad hoc* hypotheses. Even if the pictures from outer space can be explained on the basis of two theories (the Earth is round; or there is a conspiracy to produce those pictures), the first explanation is more parsimonious, and therefore, preferable. We should likewise extend this criterion to all pseudoscientific disciplines: while it is true that *ad hoc* hypotheses could be used to adjust to the data that seemingly refute them, precisely the fact that they constantly appeal to *ad hoc* hypotheses makes them very weak.

In any case, Feyerabend insists that theories prevail, not because of their correspondence to reality, or because of the rigor of their observations, but rather, because of the propagandistic rhetorical techniques that they rely on. Feyerabend judged Galileo to be a superb propagandist, who used irony, insults, sarcasm, ridicule and other rhetorical sleights of hand, in order to persuade readers of his non-proven idea at the time. Richard Rorty (2009, 330) also frequently argued that Galileo prevailed, more because of his rhetorical tricks, than because of the real empirical support of his theories. Postmodernist critics of science likewise come to believe that scientific theories prevail, above anything else, due to advantageous social factors, and not because of the theories themselves.

We may admit that, indeed, Galileo was very skillful in the use of rhetorical techniques. But we would go too far, and we would be distorting the history of science, if we argued that rhetoric is ultimately more influential than rigor and empirical evidence. For example, creationists have a massive propaganda machine in their favor, and they use very clever and skillful rhetorical tactics. Indeed, they have persuaded half the American population; but the immense number of creationist films, books, songs, brochures, juvenile camps, museums, and so on, will never persuade scientists that God created the species six thousand years ago. Creationism will not prevail, because even if it has in its favor billions of dollars in propaganda techniques, it simply does not have the empirical evidence to support its outlandish theories.

Feyerabend and Rorty have wisely focused on an important aspect of the history of science, i.e. that rhetorical techniques often supplement the substance of scientific discoveries. But, these authors (along with their postmodernist enthusiasts) lose sight of the fact that evidence will always be more important than mere rhetoric. Truth does prevail.

Likewise, Feyerabend's historical reconstruction of the case of Galileo is also very questionable. It is true that, by admitting the argument of the tower put forth by geocentrists, postulating a mobile Earth would have gone against the rules of science at the time. But Galileo was prominent, not only for attacking geocentrism, but also for attacking the then-popular notions of impulse and movement. While it is true that Galileo did not make rigorous observations on these matters, this by no means implies that science works better when there is no rigor in observations.

In a sense, Galileo was fortunate, because later observations confirmed his initial intuitions. But, had later observations refuted Galileo's initial hypotheses, he would have fallen into oblivion. Again, contrary to what Feyerabend and Rorty believed, the weight of evidence, coherence, and parsimony, are the ultimate determinants of a theory's degree of truth.

Feyerabend based his work on interesting facts (admittedly, Galileo's original story has been somewhat distorted, and we should be grateful to Feyerabend for setting the record straight in some aspects). But ultimately, as with all postmodernist attackers of science, his theories became outrageous. "Anything goes" suppresses any distinction between fact and fiction, and therefore, any outlandish nonsense claim would be admissible. This is irrationality in the name of relativism.

CONCLUSION

The 21st Century faces immense challenges ahead. Perhaps one of the most pressing problems is massive inequality, not only within countries, but also between different socio-cultural regions of the world. Although cross-national economic inequalities have multiple causes, the legacy of colonialism is certainly not an unimportant one.

The harm that colonialism caused on the so-called Third World countries is beyond dispute, and in that regard, it has much to repent for. Postmodernist critics ae quick to point out the immorality of colonialism (rightly so, of course). Yet, many times, in their zeal against colonialism, they have mistakenly believed that science itself forms part of the colonialist project, and that full decolonization requires an abandonment of the hegemony of science, and embracing alternative non-scientific approaches.

This view is mistaken. Apart from inequality, our planet faces major threats in the 21st Century, such as global warming, epidemics, malnutrition, etc. All these problems, which mostly affect the so-called Third World, can only be tackled with science. Postmodernists may be well-intentioned in embracing criticisms of science, as a way of revendicating marginalized peoples. But ultimately, they fail to recognize that the welfare of those very marginalized people hinges upon the full development of science.

This full development of the scientific mindset is not compatible with relativist anthropological views, such as those of Levi-Strauss, Wittgenstein, and Peter Winch. Science is rational, and any discipline or procedure that goes against the basic principles of science (such as oracles, etc.), cannot be considered on a par with science.

In fact, in order to tackle many of the most pressing problems that we face in the 21st Century, we need a consistent set of rules about how to get to know the world, via

a process of formulation of hypothesis and recollection of data. For that reason, it is simply cannot be the case that, in science, "anything goes", contrary to Feyerabend's unfortunate expression. Likewise, in order to attempt a solution at many of our problems, we must assume that there is such a thing as "truth", and that some hypotheses are closer to truth than others; in order to advance towards the solution of our problems, we must acknowledge that, in science, there is such a thing as progress, and not simply that paradigms are incommensurable, contrary to Kuhn's views.

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