Forthcoming in *Revista Colombiana de Filosofia de la Ciencia* (Vol. 38, 2019).
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Are you a selective-realist dialetheist without knowing it?

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ABSTRACT| *Selective Realism* is the new most-common type of scientific realism. It groups many diverse approaches to science, theories, and truth, and so, it is very difficult to define it with precision. However, in the corresponding literature, it has been suggested that there are three elements that selective realists share –and which are sufficient for a general characterization of this type of realism: the Non-Miracles Argument motivation, the selectivity character, and the Pessimistic Meta-Induction motivation.

Here I contend that the standard characterization of selective realism might be not robust enough for pointing out all the elements that selective realists actually share. In particular, I argue that such characterization prevents selective realists to forbid the possibility of things such as true contradictions, *dialetheias*, even if selective realists consider them to be not desirable.

RESUMEN| El *realismo selectivo* se ha convertido en el tipo de realismo científico más común. Este tipo de realismo agrupa diversas perspectivas de la ciencia, las teorías científicas y las teorías de la verdad, por lo que ha resultado muy difícil definirlo con precisión. Sin embargo, en la literatura correspondiente, se ha sugerido que hay tres elementos que comparten los realistas selectivos, y que son suficientes para ofrecer una caracterización general de este tipo de realismo: la motivación del Argumento de No Milagros, el carácter selectivo y la motivación de la Meta Inducción Pesimista.

Aquí sostengo que la caracterización estándar del realismo selectivo podría no ser lo suficientemente robusta para señalar todos los elementos que los realistas selectivos de hecho comparten. En particular, sostengo que tal caracterización impide que los realistas selectivos prohíban la posibilidad de que las contradicciones estén conectadas con la verdad, es decir que sean contradicciones verdaderas (*dietheias*), incluso si los realistas selectivos las consideran no deseables.

1. Introduction

Scientific realism is a philosophical standpoint that could be characterized by an epistemically optimistic attitude towards certain outputs of the scientific inquiry. For many scientific realists, such outputs tend to relate the epistemic achievements of the scientific theories to the truth (or to the approximate truth) of such theories appealing to the successful reference of theoretical terms to observable and unobservable things in the empirical world (Chakravartty, 2017a). However, recently there has been a tendency on the part of some scientific realists to weaken their philosophical theses with respect to the success of science. For instance, some of them have suggested that a satisfactory realist standpoint should be an extreme epistemically modest and pluralist approach to scientific success (Saatsi, 2017), leaving many with the impression that scientific realism nowadays is nothing like what we once thought it was (Chakravartty, 2017b).

The main concern of this paper is methodological: to address the questions *when being a selective realist, how much Pessimistic Meta-Induction at the methodological level, is too much? When does Pessimistic Meta-Induction cause realists to start losing control of their philosophical claims*? In particular, I deal with the issue of how the standard characterization of 'scientific selective realism' (arguably, strongly motivated by the Pessimistic Meta-Induction) might be not robust enough for pointing out all the elements that selective realists actually share.

Selective Realism is the new most-common type of scientific realism. It groups many diverse ─and not always mutually compatible─ approaches to science, theories and truth, and so, it is very difficult to define it with precision. However, there is a common agreement on the fact that the indicative features of selective realism are the following:

a) The Selectivity Feature: The conjecture that, while scientific theories as a whole often cannot be true, particular sections of our best scientific theories can actually be linked to the approximate truth.

b) The Pessimistic Meta-Induction motivation (henceforth, PMI-motivation): This implies the defeasibility of the realist commitments: "scientific success is (highly) indicative of truth, but does not guarantee it" (Vickers, 2018: 2)

The shared intuition that realist should be cautious and not make or dismiss any realist commitment to any theory, however successful, without first checking that her studied theory is not an instance of scientific success merely out of luck or an instance of legitimate success being neglected by the philosophical or scientific pertinent communities.

In the corresponding literature, it has been suggested that (a) and (b) are sufficient conditions for satisfactorily characterizing 'selective realism' (Chakravartty, 2017a, 2017b; Lyons, 2006; Saatsi, 2017; Trizzio, 2015; Vickers, 2015, 2016).

Here I contend that (a) and (b) might be not robust enough for pointing out all the elements that selective realists actually share. Here I show how a very minimal type of selective realism, committed to (a) and (b), will necessarily allow for true contradictions, namely, *dialetheias* –even if selective realists consider them to be not desirable –and I blame (ii) for it.

In order to do so, I proceed as follows: in Sec. 2, I introduce the traditional debate about scientific realism, in particular, I focus on the Non-Miracles argument and the Pessimistic Meta-Induction argument. In Sec. 3, I present the generalities of the selective realist position. Sec. 4 is devoted to introducing a type of selective realism that is based only on PMI and the *selective character*, which I show that cannot forbid certain entities, such as contradictions, to be linked to the (partial) truth. In Sec. 5 I problematize the general characterization of selective realism. Finally, in Sec. 6, I draw some conclusions.

2. Scientific Realism: Basic Arguments

This section aims to briefly introducing two of the most important arguments for the realist-antirealist debate. In order to do so, in what follows I will briefly introduce the so-called 'No-Miracles' argument (Putnam, 1975) and the argument from the Pessimistic Meta-Induction (Laudan, 1981).

2.1. No-Miracles Argument

it is well accepted that one of the main aims of our (empirical) scientific theories is to provide us with information about the external world, information that can help us to measure, predict, anticipate, and modify some aspects of particular empirical domains (Hempel & Jeffrey, 2000). As a matter of fact, it seems that giving explanations and predictions is the main goal of a scientific theory since without predictive or explanatory power an empirical theory would not be anything but a collection of sentences that talk about empirical entities in the same way they could be talking about fantastic tales.

If a theory's predictions are fulfilled and its explanations actually help us to understand in a better way the empirical domain that we are studying, it seems that we are justified to consider this particular theory as scientifically successful (rather predictively or explanatorily successful). More important, when having scientific success regarding a particular theory, one is justified to believe in that theory (Davey, 2014), *i.e*., to treat that empirical theory as if one believed it.

Now, the question that unsurprisingly emerges here is: *why should we establish a link between scientific success and our realist commitments regarding empirical theories?* Along the last century, many philosophers of science have tried to respond to that question and – despite the fact that some of them differed in their particular realistic proposals- in general, realist philosophers of science have agreed that the best explanation for scientific success could be expressed in terms of the *No-Miracles Argument* (henceforth, NMA).

NMA is a central argument in defense of scientific realism that was first introduced by Putnam (1975) and that aims to show that we could reasonably believe our best scientific theories to be approximately true. The argument goes as follows:

> The positive argument for realism is that it is the only philosophy that does not make the success of science a miracle. That terms in mature scientific theories typically refer (this formulation is due to Richard Boyd), that the theories accepted in a mature science are typically approximately true, that the same terms can refer to the same even when they occurs in different theories –these statements are viewed not as necessary truths but as part of the scientific explanation of the success of science, and hence as part of any adequate description of science and its relations to its objects (Putnam, 1975: 73)

So, in general terms, NMA:

> aims to defend the realist claim that successful scientific theories should be accepted as true (or, better, near true) descriptions of the world, in both its observable and its unobservable aspects. In particular, the realist claim is that accepting that successful scientific theories describe truly (or near truly) the unobservable world best explains why these theories are empirically successful. That is, it best explains why the observable phenomena as they are predicted to be by those theories (Psilos, 1999: 71).

Yet, even though the NMA seems to be a strong motivation for a realist position, it doesn't privilege any particular type of realism.

2.2. Pessimistic Meta-Induction

As a response to the NMA, Laudan (1981) provided an argument that aimed at convincing the realist community that some of their strongest commitments were not justified by the history of science.

In order to present such an argument, Laudan required that first, philosophers of science agree on the fact that philosophical theses could be, in a sense, 'empirically tested'. This meant, for the particular case of the philosophical debate on scientific realism, that history of science was assumed to work for the philosophy of science as empirical evidence works for the empirical sciences.

> A growing number of philosophers (including Boyd, Newton-Smith, Shimony, Putnam, Friedman, and Niiniluoto) have argued that the theses of epistemic realism are open to empirical test. The suggestion that epistemological doctrines have much the same empirical status as the sciences is a welcome one: for, whether it stands up to detailed scrutiny or not, it marks a significant facing-up by the philosophical community to one of the most neglected (and most notorious) problems of philosophy: the status of epistemological claims. (Laudan, 1981: 19)

It is important to notice that for Laudan's project (at least, by 1981), history of science was expected to play the role of the final judge in the debate of scientific realism vs. antirealism. The main assumption of Laudan's methodology was that, if (convergent) realism was the case, then historical evidence should show that, for any historical case of scientific success, relations and referents from old theories were preserved in successor theories, as well as that new successful theories were explanatory of the success of their predecessors.

However, the history of science was, according to Laudan, not so benevolent with scientific realism. As a matter of fact, it showed that some old successful theories were not necessarily preserved by their successors; this is, we now know that some of our previous theories were false and that is the reason why they were abandoned (not preserved) in the first place. In order to illustrate this, Laudan provided a list of twelve theories that, at their time, were believed to be successful and that are now known to be false. Such a list includes the crystalline spheres of ancient and medieval astronomy, the humoral theory of medicine, the effluvial theory of static electricity, the phlogiston theory of chemistry, the caloric theory of heat, theories of spontaneous generation, among others (Laudan, 1981: 34).

Putting together all the above, Laudan presents a threatening argument against convergent realism. Such an argument is the so-called *Pessimistic Meta-Induction* (PMI) and it can be summarized as follows:

> The history of science is full of theories which at different times and for long periods had been empirically successful, and yet were shown to be false in the deep-structure claims they made about the world. It is similarly full of theoretical terms featuring in successful theories which do not refer. Therefore, by a simple *(meta-)induction* on scientific theories, our current successful theories are likely to be false (or, at any rate, are more likely to be false than true), and many or most of the theoretical terms featuring in them will turn out to be non-referential. Therefore, the empirical success of a theory provides no warrant for the claim that the theory is approximately true. There is no substantive retention at the theoretical, or deep-structural, level and no referential stability in theory-change. (Psillos, 1999: 101. My emphasis.)

The argument from the PMI is well known to be part of a larger project: Laudan's project for integrating history and philosophy of science —in such a way that history could be used also as evidence for testing philosophical theses. In that sense, Laudan assumes that while philosophical doctrines about science tend to provide (good) theoretical reasons for endorsing certain attitudes regarding science, historical evidence supporting the theses in question is always required and plays a privileged role for the validation of certain philosophical commitments. So, even if the arguments in favor of scientific realism are valid, if they lack historical evidence, then, those arguments might seldom tell us anything about science, and history might be not filling up philosophy as it is expected to happen. So, Laudan's PMI could be seen (in its weakest version) as an invitation for scientific realists to provide, as part of the core of their realistic standpoint, an explanation of the future and the past failure of our best and most reliable scientific theories.

2.3. A methodology based on PMI

However, PMI is more than just a recurrent argument from the debates about scientific realism, it is a privileged instance of a fruitful methodology, namely, the confrontation of philosophical theses with historical evidence. As a matter of fact, PMI reinforced the idea that historical evidence can be of great use when discovering the scope and the limitations of our own philosophical theories. It is in that sense, in which philosophers have employed the intuitions behind PMI to confront different types of philosophical theses with different types of historical evidence (either from the history of science or from the history of philosophy, among others). An exemplar of the uses of such methodology can be found in [Saatsi, 2017], where the author provides a PMI-type of reflection on the lessons from the history of philosophy regarding the success of our theories of scientific realism.

Saatsi argues that the history of philosophy has shown that unified theories of scientific realism seem non-achievable. History has taught us that the greatest accomplishment that our general philosophical realist theories have gotten is a partial success; this is, while they have been explanatory of some case studies, they have left unexplained other relevant cases. As part of his analysis, Saatsi examines a diversity of realist theories and the different ways in which they have failed. The result of Saatsi's scrutiny is that, in order to prevent the constant failure of realist theories and maximize the explanatory power of such accounts, philosophers should endorse a more pluralistic understanding of scientific realism.

This is, nonetheless, a very controversial proposal. Scientific realism has been always considered to be a philosophical phenomenon with only one correct explanation, and if history of philosophy has taught us that, maybe, the correct approach to scientific realism is via a multiplicity of explanations (different types of philosophical explanations for different chunks of cases from the history of science), this is definitely a challenge for the traditional view.

Regardless if Saatsi's solution is satisfactory, his approach is revealing in two senses: first, it illustrates a peculiar use of the PMI-methodology in the scientific realism-debate; in particular, it shows that if applying PMI in the methodological realm, confronting philosophy with its own history, realists can still enlighten possible routes for the philosophical defense for scientific realism. Second, it shows that PMI type of arguments motivates philosophers to contemplate two different scenarios:

- when the early successful theories are no longer considered to be as successful as before, and
- when allegedly mistaken theories are discovered to be (more) successful than expected.

Take the above to be the two sides of a *Pessimistic Meta-Induction motivation* –at the methodological level. On the one hand, the first option addresses the worry of confusing cases of legitimate success with cases of apparent success. On the other hand, the second alternative addresses the worry of mistaking cases of success with cases of 'lucky accidents'.

Much more can be said about the scope and the limitations of these two traditional arguments, but I hope this suffices for the purposes of this paper. In what follows, I introduce selective realism and explain why this type of realism is motivated by both NMA and PMI.

3. On Selective Realism.

This paper aims at testing the robustness of the standard characterization of 'selective realism'. In order to do so, in this section I broadly introduce *selective realism* and discuss which are the sufficient conditions that a realist standpoint should fulfill in order to be considered as 'selective realism'. Later on, I present a realistic position that possesses exclusively those features, I call it *minimalist selective realism* –which robustness I further evaluate in Sects. 4 and 5.

3.1. Selective Realism and the selectivity feature

As I argued in Sec. 2, since the beginning, the Non-Miracles Argument has been in the core of scientific realism; however, as NMA is an abductive argument, its role cannot be other than motivational. But NMA is not the only guidance available for realists. During the last decades, scientific realists have also shaped their views by endorsing the historical challenge that the Pessimistic Meta-Induction poses. This has made any contemporary scientific realism to be motivated by both, PMI and NMA. However, as the role that NMA plays in the defense of scientific realism might seem obvious to the reader, here I focus particularly on the importance of PMI for any selective realist standpoint.

First, in the corresponding literature, PMI has also been labeled as the 'historical challenge', and it has been systematically argued that

> [A] refined version of realism will take up the challenge deriving from a pessimistic reading of historical records. A realist knows or at any rate expects that our current scientific theories will be modified by future scientific research in ways that cannot simply be equated to emendation, completion or

> improvement. The way out of the difficulty of mediating between the realist intuition that the success of science is a sign that its theories cannot be completely false on the one hand and the various arguments akin to the pessimistic meta-induction on the other is often given in terms of positions that can be defined as "selective or preservative realism" (Trizio, 2015: 139)

All selective realists share what here I call the *selectivity feature*. This is, the conjecture that, while scientific theories as a whole often cannot be true, particular sections of our best scientific theories can actually be linked to the approximate truth. Depending on the type of selective realism that is being endorsed, one can identify very different types of explanations of how this connection with truth takes place in science; so far we have almost as many ways to link science to the truth as there are selective realists (Saatsi, 2017).

In other words,

> Selective realism is a philosophical standpoint defending that every instance of the novel success of a scientific theory is related to *specific relevant parts of the theory in question* and that scientists are justified to commit specifically to those parts of the theory in a realistic way. Which are those parts of the scientific theories that we could interpret realistically depends on the particular type of selective realism we choose; there is structural realism, semi-realism, divide-et-impera, eclectic realism, among others (Chakravartty, 2017a. My emphasis).

Second, the selectivity feature is not the only result of PMI in this debate. As a matter of fact, an additional feature that all selective realists have in common is what here I call the *PMI-motivation*.

3.2. Selective realism and the PMI-motivation

Regardless the particular type of selective realism that one stands for, one of the greatest challenges for the scientific realist is to explain that previous scientific theories that were accepted for a long time appealing to their predictive or explanatory power, ended up being abandoned (and believed to be false). Thus, the selective realists' commitment to the historical challenge has made this broad type of realism to be PMI motivated in, at least, two senses:

i. *Regarding 'truth':* Since the emergence of Laudan's PMI, scientific realism has been seen as involving merely "a defeasible commitment: scientific success is (highly) indicative of truth, but does not guarantee it" (Vickers, 2018: 2). So, every time that a selective realist provides an explanation for the scientific success of a specific theory, there is a chance of her explanation being mistaken or of the alleged success being only apparent. In order to reduce the chances of being wrong, selective realists tend to narrow as much as possible the set of elements of a theory that they considered being connected to the partial truth -knowing that their standpoints can always fail when facing PMI.

ii. *Regarding 'falsehood':* selective realists have become extremely cautious giving up the possibility of saying anything *definitive* about falsehoods. So they have prevented PMI-type of counterexamples about falsities in science. In particular, cases of the types: a segment of a theory that once was thought to be false ends up being a candidate for the approximate truth; or (a segment of) a theory that was considered to be successful only by coincidence, end ups being a legitimate candidate for the partial truth years later –like, allegedly, happened to the "The Sommerfeld puzzle" (Cf. Vickers 2018).

These two components, (i) and (ii), have been considered to be constitutive of any selective realist standpoint. However, while (i) has been often made explicit in the literature as *one of the most distinctive features of selective realism*, (ii) has somehow been neglected. Nonetheless, (ii) is of vital importance for understanding why selective realism is an especially cautious standpoint. Let me press further this point by appealing to an example of its importance.

3.2.1. Sommerfeld and PMI regarding the 'falsehood'

The so-called 'Sommerfeld's puzzle' is a case study from the early quantum physics (early XX century) that has been used to illustrate 'miraculous' scientific success, and it has been constantly considered as strongly problematic for scientific realists. The case goes as follows:

> In (Sommerfeld [1916])—building on Bohr's 1913 model of the hydrogen atom—Sommerfeld derived the fine structure formula for the allowed energy states of unperturbed hydrogen, and thus via $\Delta E = h\nu$ the possible frequencies of the hydrogen spectral lines (for $Z=1$):
>
> $$E_{n_r, n_\varphi} = m_0 c^2 \left[1 + \frac{\alpha^2 Z^2}{\left[n_r + (n_\varphi{}^2 - \alpha^2 Z^2)^{1/2} \right]} \right]^{-1/2}$$ (Vickers, 2018: 3)

From which m_0 represents the rest mass of the electron, c corresponds to the speed of light, α is the fine structure constant equal to $e^2 / \hbar c$, n_r, and n_φ are the radial and angular quantum numbers, and Z indicates the proton number.

An important feature of Sommerfeld's fine structure formula was that, despite the fact that, at that exact moment, physicists had a very little understanding of the atom and the principles of quantum physics, Sommerfeld's formula allowed scientists to arrive at novel and extremely accurate predictions of spectral lines –in addition, it was successful when applied to ionized atoms of more elements than just hydrogen. However, despite its success, scientists at the time did not feel comfortable endorsing realist commitments towards Sommerfeld's formula, basically because the formula seemed to neglect different important features such as wave mechanics and spin –being spin a causal element of the fine structure splitting. In addition, due to the lack of understanding of the atom at the time, scientists felt that Sommerfeld's success lacked an explanation, and so, it was considered to be a merely 'lucky accident' (See for instance: Heisenberg, 1968: 534; Biedenharn, 1983: 14; Brown et al.,1995: 92; among others). "Curiously, physicists have often described this case as a 'miracle', and even as a 'cosmic joke', directly contradicting (unintentionally!) the 'no miracles' or 'no cosmic coincidences' argument for scientific realism" (Vickers, 2018: 7).

Nonetheless, in [Vickers, 2018] a defense of a realist reading of the Sommerfield's formula is presented. The main argument goes as follows:

> First, there is a common agreement among scientists and philosophers of science on the fact that the Sommerfeld formula is an exemplar of remarkable scientific success.
>
> Second, it is well known that Sommerfeld himself did not have a neat explanation of why his formula was so successful. And as a matter of fact, because it neglected the spin property –which was considered to be fundamental for the analysis of fine structure–, the formula was taken to be false.
>
> Third, any realist, as cautious as she wants to be, would feel motivated by the NMA and would be inclined to look for an explanation of such success regardless if it was available to the scientists at the time or not.
>
> Fourth, for the Sommerfeld case, in the long run it became clear that his formula was a direct derivation of the relativistic Dirac Quantum Mechanics (and as it is possible to formulate Quantum Mechanics in such a way in which spin is not a fundamental

property, so it seems that, according to such type of interpretation, Sommerfeld's formula was not contradicting any basic principle of the Quantum theory).

Finally, considering all the above, Vickers explains the fact that, despite the intuitions of the scientists at the time indicated common agreement regarding that no realist commitment should be held towards the Sommerfeld formula, in the long run, scientific realists could provide an explanation of why such a success was the case.

Now, I presented this case study to illustrate the importance of allowing past theories that were once believed to be false to be latter on, candidates for the partial truth. In this sense, as the contemporary realist is especially worried by being sensitive to the historical information in order to avoid damaging PMI counterexamples, she would have to be open to the two possibilities: successful theories being partially false, and allegedly false theories being candidates for the partial truth.

If what I have presented in this section is along the right lines, the PMI motivations are what leads the contemporary realist to selectivity, as more precise and abstract the elements that she selects are, it is easier to track them in the new successful theories and to inspect the old ones.

As the initial motivation for this paper was to defend tat selectivity and PMI-motivations are not enough to characterize the standard selective realist, in the next section I will introduce the *minimalist selective realism*, which is the realist standpoint that only uses NMA, selectivity, and PMI-motivations, in order to evaluate its robustness in Sec. 5.

4. On the possibility of Selective Realism Dialetheism

This section aims at problematizing the minimalist characterization of selective realism. In order to do so, I will focus only on the role that falsehoods play for this realistic standpoint – something that we have already anticipated in the previous section.

Despite the fact that many versions of selective realism could be identified in the literature, a *minimalist way* to characterize this philosophical position is to recognize that "they all share the features of being based on a discussion of actual historical case studies and of being compatible, to a certain extent, with the prospect of future major changes" (Trizio, 2015: 139). Considering what has been presented in Sec. 3 as the common features of selective realism: NMA, selectivity, and PMI-motivation regarding truth and falsehood, here I will assume that a *minimalist selective realism* will be a standpoint which shares at least all those features (Chakravartty, 2017a; Trizio, 2015).

Now, considering that the characterization of minimalist selective realism presented above is accurate, and that the defenders of this standpoint cannot say anything definitive about falsehood (as it was argued appealing to the Sommerfeld's case study); a question naturally emerges: despite the fact that we have strong intuitions somethings being 'always' false, *if one is a minimalist selective realist, does one should abandon irremediably those intuitions?* In what follows, I present true contradictions as candidates for (definitive) falsehood in sciences and I argue that one would face a dilemma: either it is not possible for the minimalist selective realism to dismiss the possibility of true contradictions in the sciences or selective realists share more than just NMA, selectivity and PMI-motivations.

4.1. Minimalist Selective Realism and true contradictions

First of all, it is common wisdom that contradictions are logically false, hence never true, and this is taken to be known by any scientist. Furthermore, it is commonly thought that anyone knowingly believing a falsity is an irrational agent. From this, it seems to follow that a scientist believing an inconsistent theory must be irrational. The idea behind this assumption is that if while examining our empirical theories we presuppose the basic principles of classical logic (or any other explosive logic), then because of the explosion principle, "an inconsistent theory implies any conceivable observational prediction as well as it's negation and thus tells us nothing about the world" (Hempel 2000; 79), which is widely understood as the absolute failure of the theory for scientific purposes.

However, a more recent view has claimed that, more often than we'd like to believe, scientists tolerate inconsistencies in science. This perspective has been enriched by the study of paraconsistent logics and the emergence of case studies from the philosophy of science that seems to illustrate how the presence of some contradictions do not necessarily mean the explosion of the theory in question. The main assertion of those defending this standpoint is that, contrary to what the traditional view might suggest, inconsistent theories do not always have to be rejected (Lakatos, 1970; Laudan, 1977; Smith, 1988; Meheus, 2002; Priest, 2002).

Nonetheless, it has been said that the reason why scientists usually tolerate the presence of inconsistency is that they do not believe that such contradictions are true

(Vickers, 2013; Pincock, 2014). As a matter of fact, they tend to explain that those contradictions are harmless basically because they are used as fictions, idealizations, heuristics, among other things. But even those who endorse inconsistency toleration theses tend to agree to the fact that "if a body of accepted claims has a model, then we can hope that there is some less than perfect isomorphism between that model and the world. But an inconsistent body of claims has no model. So it seems such a body of claims can't be even approximately true" (Brown 1990; 282).

But, there is a philosophical standpoint that takes the inconsistency toleration a bit further and claims that some inconsistencies are tolerated not only because they are not explosive, but because they are true. The defenders of such positions are called *dialetheists*.

> A *dialetheia* is a truth-bearer, *p*, such that both it and a negation of it, *not-p*, are true. *Dialetheism* is the view that there are dialetheias. A *contradiction* is a pair of sentences, one of which is a negation of the other, or a conjunction of such sentences. Therefore, dialetheism amounts to the claim that there are true contradictions.
>
> Roughly, to be a realist about some kind of entities and its (lack of) possession of properties is to maintain that such entities objectively exist and possess (lack) their properties apart from, and antecedently to, anyone's thought of them, and that thoughts, beliefs, and theories concerning such entities and their properties are made objectively true or objectively false by them, apart from what is thought of them. If one accepts realism, the truth of some contradictions entails the existence of inconsistent objects or states of affairs, namely those that contribute to make them true. To say that the world has inconsistent parts just is to say that some true purely descriptive sentences about the world have true negations. Realist dialetheism is characterized then as the conjunction of dialetheism and a mild realism: There are true contradictions, and at least part of what makes them true exists objectively and independently of anyone's thought, language, etc. (Estrada-González, 2014: 197-98)

Given such characterization of what means to be a realist dialetheist, in what follows I present two different minimalist selective realist positions: one that endorses dialetheism and one that aims at rejecting it.

4.1.1. (Minimalist) Selective-Realist Dialetheism

If PMI-motivation regarding falsehood is just along the right lines, regardless our intuitions about contradictions being logically false (and hence, never true), if a case of remarkable scientific success is linked to the presence of a true contradiction, the minimalist selective realist should accept that contradictions might be connected to the partial truth –in a similar sense in which she had to accept that the Sommerfeld puzzle was not a mere case of luck.

If the selective realist had to accept the possibility of true contradictions, she would be considered to be sympathetic to a minimalist selective realist dialetheism, which can be defined as follows:

> **Minimalist Selective-Realist Dialetheism**: This is the standpoint in which (minimalist) selective realist not only allows for the possibility of contradictions in science, but also for the possibility of some of those contradictions being connected to the theoretical truth.

Now, if the minimal characterization of selective realist is correct, and if selective realist cannot say anything about what will be necessarily false in science, then to be a realist dialetheist will depend only on the possibility that one has to find true contradictions in science; this is, on the possibility that one has to find scientific success linked to contradictions.

4.1.2. The Exemplar

In [Estrada-González, 2014] and [Flores-Gallardo, 2018] a case of an allegedly true contradiction in graph theory and category theory is presented. Such case goes as follows:[1] First, "A graph is a pair of sets F and V (sets of "arrows" and of "vertices", respectively) with a pair of functions s: F→V and t: F→V. If x is an element of F, an arrow, s(x) is its "source" and

[1] For such an example,

> It will be assumed that objects and their parts satisfy the following:
>
> (i) There are objects of different kinds, and an object X (of a certain kind) might be thought of as a type, collection of things, or generalized set – the X's.
>
> (ii) Among objects of a kind, there are subkinds, some of which are basic and others are derived.
>
> (iii) Objects might have parts, which are again objects of the kind in question, and in that case an object is a structured combination of its parts.
>
> (iv) The parthood relation is reflexive, anti-symmetric, and transitive. (Estrada- González, 2014: 204)

t(x) its "target" (Estrada-González, 2014: 204).

Second, one could identify the following types of graphs:

> – Vertices
>
> – Arrows whose source and target coincide
>
> – Arrows whose source and target are different.
>
> – There are also derived subkinds, given by any combination of the basic subkinds (for example, the derived sub kind of graphs consisting of naked vertices and arrows with different source and target, etc.). (idem)

With that in mind, given an object *O* and a part *P* (of *O*), its negation (NEG) is defined as follows: The not-*P*'s are the smallest part of O such that its union with the *P*'s contains all the objects (in *O*); i.e., the negation of an object is defined through an exhaustive strategy. Now, according to Flores-Gallardo, from NEG, it is possible to provide the criteria of truth and falsity for a formula *Pa*, if and only if *a* belongs to the *P* or non-*P* respectively.

> With this, Estrada González defines a propositional negation '¬' in the following way: ¬φ is false if and only if φ is true; ¬φ is true in any other case. Estrada González shows that, for graphs composed only of isolated vertices (or fewer sets of points), ¬ behaves like a classic negation; but in the case of directed graphs (or graphs with arrows), dialetheias can be found in broken objects in such a way that the arrows of *P* and not-*P* have a vertex in common (which is possible even if NEG is satisfied). (Flores-Gallardo, 2018: 55)

Now, the standard realist might protest against this exemplar of realist dialetheism. She might argue that even ingenious, this illustration of dialetheias in category and graph theory is far from requiring any realist commitments. However, a response to this objection is also present in [Estrada-González, 2014: 205-06]; there it is argued that graphs could be taken as describing objective structures of the world –as it is taken for granted that the world has a geometrical structure that is often studied with the notion of smooth spaces. So, graphs could be describing physical locations, and arrows processes for getting from one location to another. And "there are even more audacious claims, for example, that the entire world is a graph (of individuals and identity-giving relations; see Dipert 1997) or that the fundamental level of reality is a graph (cf. Bird 2007)" (Estrada-González, 2014: 206).

So, even if now we have not the certainty of dialetheias being connected to the empirical world via graph theory, if one is a PMI-motivated selective realist, one should accept the possibility of dialetheias being candidates for the partial truth.

4.2. (Minimalist) Selective-Realist anti-Dialetheist

Now, as one can infer from the literature on scientific realism, to accept the possibility of true contradictions is an unpopular view. As a matter of fact, much effort has been made in order to provide explanations about how the alleged cases of inconsistent science either were not really contradictory or were not cases of contradictions linked to the partial truth (see for instance: Saatsi & Vickers, 2011; Vickers, 20013; Saatsi, 2014). In that sense, it seems necessary to recognize another standpoint in the debate about scientific realism and true contradictions: the *(minimalist) selective-realist anti-dialetheist*. Such a standpoint could be characterized as follows:

> **Minimalist Selective-Realist anti-Dialetheist:** This is the stand point in which (minimalist) selective realism claims that theoretical truth (regarding science) can only be reached through scientific success, but that this success cannot be achieved through dialetheias.

As I mentioned before, in general, it is not a common maneuver to be realistically committed to contradictions, not even in the realm of philosophical studies of inconsistent science. As a matter of fact, even the ones who defend that contradictions could be and actually are tolerated in the sciences (Lakatos, 1970; Laudan, 1977; Smith, 1988; Brown, 1990; Meheus, 2002; Priest, 2002) would not necessarily agree on contradictions being candidates for the partial truth.

5. The problem

I devoted the last section to introduce two possible realist standpoints regarding true contradictions in science: on the one hand, one that allows for true contradictions, and on the other hand, one that forbids them. So far, this disjunction seems legitimate, one can choose either one option or the other according to one's philosophical and scientific commitments. However, here I argue that this is not so easy, and that might be the second option the one that is not available to the standard selective realist.

The argument is quite simple:

(1) The standard characterization of selective realism includes the NMA motivation, the

selectivity character and the PMI-motivations (regarding both truth and falsehood). In addition, as I discussed in Sec. 2.3, selective realists also tend to use a methodology inspired by the PMI.

(2) The PMI methodology usually is understood as the possibility of testing philosophical theses against the history of science (or of philosophy, etc.).

(3) The *PMI motivation regarding falsehood* could be summarized as follows: Selective realists gave up the possibility of saying anything definitive about falsehoods. So they have prevented PMI-type of counterexamples about falsities in science. In particular, cases of the types: a segment of a theory that once was thought to be false ends up being a candidate for the approximate truth; or (a segment of) a theory that was considered to be successful only by coincidence, end ups being a legitimate candidate for the partial truth years later.

c) At this point, the problem that emerges might seem clear to the reader. If the standard characterization of selective realism is actually exhaustive of all the elements that selective realists share, by (3), it seems that selective realists might not be allowed to forbid dialethieas to be linked to the partial truth. In general terms, by (1) and (3), the selective realist cannot prohibit anything *a priori* in science, thus she cannot say that specific types of entities, such as contradictions, are necessarily false. Ergo it seems that the anti-dialetheist standpoint is impossible for minimalist selective realists –and in a sense, should also be impossible for the selective realist.

Of course, this could be non-problematic if selective realists would not endorse anti-dialetheist views. However,

(4) In the corresponding literature, it is extremely rare to identify any realist dialetheist about science –especially if concerned with sciences distinct from inconsistent mathematics, category theory, set theory, and graph theory. As a matter of fact, philosophers tend to agree on contradictions being at least not true, and so it seems counterintuitive that selective realists should allow for dialetheias in the realist realm (See Brown, 1990; Saatsi & Vickers, 2011; Vickers, 20013; Saatsi, 2014). In addition, even dialetheists do not seem to demand that contradictions, if true, are the link between the scientific theories and the partial truth, in particular, they do not argue either in favor of dialetheias to be preserved under theory change, for instance.

So, even if contradictions can be true (in a sense), it is not clear, that selective realism should consider them as candidates for the partial truth (Priest, 2002; Flores-Gallardo, 2018).

As the reader can notice (c) and (4) conflict with each other. I believe the source of this conflict to be (2) and the inefficient way in which PMI methodology has been understood.

It seems to me that the problem lays on the use of the PMI methodology required philosophical theories to be contrasted with the historical evidence in the same way in which physicists contrast their predictions with the experimental reports. However, one can argue that when discussing the pertinence of dialetheias in the scientific realism debate, what it is really in content is a logical principle –which is, in a sense, stronger than an empirical theory about science.

Finally, it seems to me that (c) could be indicating that something very fishy is going on with our standard characterization of selective realism. One suggestion might be that such characterization tries to group too many distinct standpoints that it ends up being mistaken –as it has been already indicated in (4), large groups of scientific realists privilege (logical) consistency (see for instance Chakravartty, 2017c: Chap. 6) over other epistemic virtues. I think that this suggests is that, if ever being as modest as a minimal selective realist, it is necessary to also endorse certain logical constrains that allow us to explain the success of science in the most metaphysically simple way available –and that maybe all scientific realist do, and that that fact should be incorporated to the general characterization of selective realism.

In sum, we could be facing the following dilemma: either minimalist selective realist cannot explain why and how to forbid dialetheias in science or our general characterization of selective realism is mistaken because it leaves room for dangerous possibilities that none of the selective realists has ever endorsed.

I hope to have shown that many more questions remain to be explored regarding selective realism and logical constraints, and also that this insight will stimulate further investigations in this field.

6. Conclusions

In this paper, I argued that the PMI could (and should) be understood as an invitation for scientific realists to endorse some historicists commitments and to provide, as part of the core of their realistic standpoint, an explanation of the future and the past failure of our best and most reliable scientific theories. I also defended that it is, in fact, the historicist challenge what has motivated many of the current standpoints of selective realism.

In order to explore the limits of the general characterization of selective realism, taking all the elements that allegedly characterize selective realism, I presented a realist view: minimalist selective realism. I argued that many selective realists are facing the risk of becoming, in some sense, a selective realist dialetheist realist if they ─as a consequence of their PMI motivations─ keep trying to avoid saying anything conclusive about what can never be true in science.

Acknowledgments: I am extremely grateful to Moisés Macías-Bustos, Alejandro Vázquez del Mercado and Luis Estrada-González for the feedback offered throughout the (long) development of this paper. In addition, would like to thank Emilio A. Flores-Gallardo, Marc Jiménez-Roland, Paula Conde-Pumpido and the reading group of Philosophy of Science-UNAM for the fruitful discussions on the subject of this paper. Special thanks are deserved to the anonymous referees for their comments and suggestions. Finally, I want to thank the editorial team of *Revista Colombiana de Filosofía de la Ciencia* for their assistance and their patience during the process of getting this paper published. This research was supported by the PAPIIT Projects IA401117 "Philosophical Aspects of Contra-Classical Logics" and IA401717 "Pluralism and Normativity in Logic and Mathematics".

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