Epistemologically progressivist and traditionalist analyses of scientific error in Rescher's Allchin's and Feyerabend's philosophies

DEIVIDE GARCIA DA SILVA OLIVEIRA
LILIA FERREIRA SOUZA QUEIROZ

§1. Introduction

THE TWENTY–FIRST CENTURY HAS WITNESSED how the public trust in scientific knowledge seems to be on edge. So, to talk about errors now does not look like the right thing to do since it may just add more fuel to the fire. However, when we better understand what error is, and how it is related to science, then the trust in science does not have to fear any threat. It improves public trust in science, whereas it helps philosophers better understand the nature of error in science, its relation to truth, reality, communication, and practices. Traditionally, philosophers like Bacon and Bachelard have shown why errors are inevitable in human affairs, like science. Generally, Bacon claimed that errors are part of human cognition or senses, whether individual or collective ([1620]2003), but also that despite this inevitability, with the help of some instruments and a method, we could eliminate errors. His true induction is exactly a result of this kind of elimination of errors by induction.

As it is well known, from an epistemic perspective of the study of errors, such an inevitability is largely accepted. However, different from what we are calling here traditionalists, those who support what we are calling progressivist view usually do not think it is possible to eliminate errors in any sense. Thus, from different perspectives, traditionalists and progressivists, develop ways to achieve knowledge while learning to deal with errors. Traditionalists like Bacon, believe that we are able to take errors out from the process of developing scientific knowledge, once we apply his true induction, and get rid of the Idols.

D. G. S. Oliveira (✉)
Universidade Federal do Recôncavo da Bahia, Brasil
e–mail: deividegso@ufrb.edu.br

Disputatio. Philosophical Research Bulletin
Vol. 10, No. 17, Jun. 2021, pp. 77–106
ISSN: 2254–0601 | [EN] | **ARTICLE**

In this sense, a general manner to define how we can distinguish from these two epistemic perspectives, traditionalists and progressivists, is taking a criterion as a guide. As we suggested above, the one we are going to propose here is how persistent errors are epistemically treated within knowledge. More specifically, taking error as something removable or not from the process and result of scientific knowledge. So we propose that the more one supports the possibility of total removability of errors from the process of building scientific knowledge, the more traditional he/she will probably be. Conversely, the distant one is from this possibility of removability, the more progressivist he/she will be. Of course, this is still a generally loose criterion, but since this paper only intents to observe how this criterion has been in different forms present in epistemological debates, like in the authors we introduce, pointing to great contributions made by both views, traditionalists and progressivists, then we will try to develop this criterion through the views of three great contemporary philosophers.

Regardless this above temporal demarcation, we start exploring that criterion from modern philosophers, and hopefully it will be clearer this way. For instance, if we take Bacon as an example of a philosopher who in some form dealt with error in manner that we are calling traditionalist, we will notice that for him, epistemic errors are present in scientific knowledge, but once we identify and put aside the influence of the Idols, we will reach the truth.

For Bacon, one way to do this is by true induction, the method of elimination to which the preconceptions that originate errors must "be adjured and renounced with firm and solemn resolution, and the understanding must be completely freed and cleared of them" (Bacon, [1620]2003, p. aphorism 68). Bacon thought that eliminating errors was a possible task with the help of method and human limitations, because "all the perceptions, both of the senses and of the mind, bear reference to man and not to the universe" (Bacon, [1620]2003, p. aphorism 41).

Descartes (1637 [2000]), similarly assumes human fallibilism, and the same confidence in overcoming errors through the notion of scientific method. According to him, the method of analysis reveals some self–evident truths, as *cogito ergo sum*, which are completely error–free and serves as the foundation for scientific knowledge, freeing ourselves from the mistakes of the senses. Bachelard, to whom the problem of knowledge cannot be solved by a Cartesian or a Baconian project, argues that to reach truth, we must overcome the epistemological obstacles, i.e., the primary illusion from common sense.

For Bachelard, scientific thinking is a product of rectification of knowledge.

Where there is knowledge, there is no more error (at least not in acts, only potentially). According to him, the new scientific spirit achieves knowledge by conquering epistemic obstacles as a set of "rectified errors" (Bachelard, 1996, p. 293, translated). Notwithstanding, scientific knowledge is always within a transformative process, a historical wake, moving forward, getting each day closer to the truth. From a psychologic perspective, "there is no truth without rectification" (1996, p. 293, translated).

In a traditionalist manner, Rescher says that errors are inherent in human affairs (for *incapacity* and *incompetence* (2007, p.7), but still "in every case error is the same sort of things, a matter of counterproductivity" (2007, p.3). In some way, similar to Bachelard, Rescher says that error and truth are interwoven (2007, p.6), although he instead argues for coherence and reliability.

Generally, traditionalist views also postulate an autonomous existence of errors, while progressivists argue that errors are dependent on many aspects, such as context, theories, methodologies and processes. As a consequence, the confidence that science is self–sufficient in identifying and correcting errors changes from traditionalist and progressivists.

Traditionalist usually tend to be more confident in the ability of science to correct itself. This is noted by Allchin's study of the myth of self–correction (2015b). According to this progressivist author, the myth of self–correction presumes that science can correct itself, as if there were something self–sufficient about science to deal with its own errors without external help, even from other scientific fields or theories from the same field. Allchin (2015) reminds us that science is still a humane activity, and in spite of being a very successful one, it has limitations and needs to work with other fields or theories to correct its mistakes, at least, more efficiently.

Similarly, Feyerabend (1993) does not think that science can correct itself, nor that errors are independent of the process and disputes around the theories involved in the solution of the problem. He thinks that scientific knowledge can gain many advantages from the plurality of theories in competition, regardless of the stage of the development of knowledge. These theories, which are permeated by many aspects — internal and external, scientific, philosophical, sociological, external reference, methodological — may never have a chance to resolve their issues without help.

From different aspects (epistemic error progressivist and traditionalist), these three philosophers introduce very interesting and, in some aspects, complementary proposals, helping us to think about errors in critical and different ways.

In this paper, we will study these writers' individual and collective contributions to the error debate. Section two will explore how Rescher's coherent and reliable view of knowledge (cognitive, practical, and axiological) impacts the problem of errors. From our interpretation, Rescher gives a detailed account of errors and general distinctions, exposing several angles of the topic. In section three, we will move towards a progressivist view of errors from Allchin. He uses a version of pluralism related to anomalies in a Kuhnian perspective. He classifies errors with the help of pluralism, saying that errors are necessary to obtain the truth, but without diminishing or putting errors aside. In section four, we will also explore a progressivist view. Differently from Rescher and Allchin, Feyerabend does not dedicate a text to errors. This is another reason we open this road, to point out how his pluralist view deals with errors while avoiding philosophical relativism. Accordingly, Feyerabend would agree with part of Allchin's proposal, but he would also boldly go beyond it, presenting new elements, like definitions and general conceptions.

§2. Rescher's three dimensions about how to obtain coherent and reliable knowledge, despite the inevitability of errors

Rescher reintroduces, in his book *Error: On Our Predicament When Things Go Wrong* (2007), a debate on errors from three interrelated dimensions: cognitive, practical and axiological. The topic of error is not new, but as he stated, it almost disappeared at the end of the 20th century.

Rescher, in a certain way, makes a connection between research conducted before, during and after the 20th century. On this account, in the 21st century, Rescher offers an indispensable general and clear perspective on the presence of errors, their origins, degrees, and possible solutions. He addresses the relationship between error and truth, considering human cognition as a natural limitation, as well its implication for different problems, such as the very possibility of knowledge.

Rescher's view on errors in knowledge is that we should pursue coherent and reliable knowledge, since truth in a definitive sense cannot be reached by limited beings. According to Rescher, in the search for truth and knowledge, we realize that errors will inevitably appear sooner or later, as a result of incompetence or incapacity. In this sense, the representation of temporary truth only exists when coupled with error, and by consequence, in "acknowledging the reality of error, one cannot avoid acknowledging the reality of truth as well" (2007, p. 6).

Rescher is proposing that since error rears its ugly head in all human affairs, even in matters of knowledge, then we should at least search for reliable processes, which means to avoid things that can be avoided at some extension, like "cognitive impropriety" (2007, p. 7) and incoherence. Consequently, regarding the distance between certainty and possible knowledge, Rescher's view is that all that we can do as humans is "connecting the dots" (2007, p. 7), such as when all information at our disposal points to the wrong direction and the most reasonable thing to do is base our conclusions on this information.

In a sense, this view is an advance if compared to the treatment given by some philosophers on errors, like when he said that error is not always "the product of the misuse of our faculties". He says that errors might also be, by strong invitation of our limits (2007, 24), a question of "incomplete information" about the world (2007, p .7).

Considering that error is a reality in human affairs, whatever we do, it would always be there waiting to ensnare us. Even so, knowledge is real, which also means that errors are real. This is why we can do both. First, to build a reliable process of collecting and analyzing information (Bacon believed that his true induction was a machine of grinding natural laws). Second, to connect the dots, raised by a reliable process, in a coherent fashion.

However, since we know that there are errors somewhere in our hypothesis, Rescher argues that until we acknowledge each one of them, they are invisible to rectification, something known as "*the preface paradox*" (2007, p. 26). In this case, an immediate question is how would we know that there are errors underneath our theories, and how we will know what is an error and what is truth when we stumble upon them? Rescher's response is that we need to seek coherent processes and reliable sources, i.e., a "suitable source of information" about the object (2007, p. 27–8). That is the best we can do.

Of course, this does not solve the problem. It only postpones it. In the end, despite the claim that all we can have epistemically is putative knowledge, the idea of real things, errors and truths, leads us towards a question of the ontological status of errors, as if they were not only putative, but independent of the theories that generate them. In a more traditionalist approach to errors, Rescher argues about a version of ontology where "real things have hidden depths" (2007, p.27) which are inaccessible to us.

Nonetheless, since our "fundamental intention is to take real objects to be at issue, objects as they are in themselves" (2007, p.28), Rescher's attempt is less to assume any ontological commitment, but find ground where we could share a starting point collectively. He thinks that without such a fundamental and

conventionalized intention, "we would not be able to convey information […] about a shared 'objective' world" (2007, 28). Rescher calls it a communicative parallax, which consists of two aspects: our conceptions about the world, and the actual world.

One problem entailed from Rescher's view is that there are other ways to establish a successful communicative contact about an objective item without necessarily assuming that our discourse must be guided by the idea of "things themselves" (2007, p. 28). An undesirable consequence of this is the assumption that we know that there is a real thing in itself of which its actual properties are hidden from us.

Thus, considering our cognitive limitations about the real things of the world, an interesting way out from it is through fallibilism and a coherent system of beliefs. In this perspective, our knowledge about the world becomes "merely *putative* knowledge" (2007, pp. 14, 15), and the place of revealed errors is paving the road for scientific progress (2007, p. 26).

Another notable aspect is that Rescher argues that the commitment of an error "involves a counterproductive act" (2007, p.2). He says that errors are part of a road to scientific progress, but on the other hand, he says that "in every case, error is the same sort of thing: a matter of counterproductivity […] in achieving what are — or should be — our purposes" (2007, p.3). The idea of counterproductivity of error in every case does not pave the road for scientific progress, but actually the contrary. It puts the cart before the horses, it devaluates errors in advance, and for all cases and purposes.

Epistemically, since "realizing the truth of things" (2007, p.3), as Rescher himself said, is his own crux, then a possible conclusion that we, the readers, can reach is that there is an ultimate immutable "truth" and "error" about each purpose we investigate. This being the case, Rescher reminds us that when "an error produces a positive result, this does not alter its status as such." (2007, p.8), i.e., an error is still an error whatever its outcome might be.

However, the next authors seem to allow ourselves to think otherwise. Rescher would be missing the point, for what is described as an error could be considered productive in the future even for the same purpose. The idea that error is not always a counterproductive act, at least not necessarily for every case, is something not broadly accepted in progressivist views. The emphasis on the productive and progressivist powers of errors captures the attention.

Furthermore, since to err is human, whether by omission (failing to acknowledge true facts) or by commission (accepting falsehoods), Rescher thinks that there is a middle ground to be reached, which is the intent "to make

objectively true statements" about the things we address (2007, 29). This intent is important because, first, without an intent to get things right, objectively, we deliberately turn our naturally cognitive limits and ontological difficulties into incapacitated problems. Second, because of the intent to formulate putative, coherent and reliable knowledge is a recognition of an ontological status by "downing realism", it "also opens a route to error" (2007, 32). It takes for granted that, to communicate our beliefs about the world with objectivity, we need to do it through the only way we can, which is recognizing "the prospect of a discrepancy between our (potentially idiosyncratic) conceptions about them and the true character of these things as they exist objectively in 'the real world'"(2007, p. 33). Even so, the intent to make objectively true statements is the bridge between the real world and our conceptions about it.

As a result, although errors are inevitable due to the distance between these two realms, it seems that Rescher is assuming in one way or another that errors, as truths, have an absolute existence, but that "none of us have privileged access" to them (2007, p. 33). So, what we can do to decrease error is commit ourselves to an intent of getting things right, using experience as a basis that stands on the idea of a "relatively stable world" (2007, 34). On this account, the objects of our "experience are the *subjects* and not the *product* of our inquiries" (2007, 34), that is, experience (despite its incompleteness) would be the stable ground for the evaluation of our theories and errors.

This is noticeable in the famous example, used by Rescher, of the six blind men and the elephant, from John Godfrey Saxe's poem. In this poem, there were six blind sages, touching the same object, and each one of them produced six different pictures of the same object (an elephant) (2007, p. 24). The lesson intended by Rescher is that disagreement and error is very much possible, regardless of our wisdom in getting things right.

Of course, there is the question that these sages are not touching the same parts of the object, so disagreement is not only possible, but reasonably expected, and from a privileged perspective, the reasons of their disagreement are trivial. The sages are not even talking about the same object. Of course, unless by the same object we mean the elephant, which for obvious reasons would make all of them right, and dissolve the disagreement. The point is, whether the elephant is the same object or not, how would we know that without privileged access (something that Rescher rejected)?

In scientific activity, we can hardly say that we have privileged access to the phenomenon studied. We are not even sure if there is or not, such a thing as privileged access, or if there is any other access besides that which we have. We

cannot know if we are touching the same object. All we can do is share and test the epistemic responsibility of our research with other people. In this case, let us explore more about it from Allchin's and Feyerabend's pluralism.

§3. Douglas Allchin's Pluralism about scientific errors

The thinker, historian, and biologist Douglas Allchin is a contemporary and well–established author on the subject matter of scientific errors. Unlike Rescher, Allchin is interested in focusing on scientific errors, from the epistemic sense, which already gives us an idea of how unique his perspective can be from a traditionalist view.

That being said, Allchin brings up the idea of the occurrence of errors in all stages of the development of knowledge (Allchin, 2000b)[1], which is something close to Feyerabend's view of errors (1978, 1993). Like Rescher, Allchin relates the issue of errors with the limits of human cognition. However, Allchin stresses its repercussions for science as a human activity traditionally haunted by the need of certainty (Hull, 1973), so within the scientific knowledge, limits of human cognition is maybe a source, not the error themselves.

Rescher recalls that errors are present at any stage of scientific research. Since "scientists are human. And science is a human enterprise. So, when someone reminds us that 'to err is human,' no one should be surprised that scientists, too, err" (Allchin, 2000b, p. 1). All scientific activity is carried out in some way by a human being. Even where sophisticated technological equipment and computer programs perform some part of the scientific activity, science still needs humans, whether to interpret data, explain, develop and choose a theory, a methodology, or simply to carry out the next step of the research.

In this account, to Allchin, "humans may be a 'source of error' indirectly (why the justification was flawed), but they (or their behaviors) are not the error themselves" (Allchin, 2021). In other words, his main concerns about errors arise from his epistemic definition of error from justification, i.e., taking that an "error is a scientific claim whose justification is (later) found to be unwarranted."(Allchin, 2021). According to the author, the types of errors, explored in the paper "Error types" (2001) are foundational once it clarifies that there are many sources of errors, at many levels, not all of which can be adequately isolated for human cognition (confirmation bias, availability bias,

[1] It is important to highlight that proposals made in this work "To Err is science" (2000b) should be taken according to its own limits, within a meeting presentation, so as a sketch, as a source of inspiration.

cultural blind spots and so on onwards) (Allchin, 1998). In that sense, reference to humans as the ultimate source of all errors is a distraction from the actual problem, that is, the problem of epistemological justification (Allchin, 2001, 2021). Therefore, the commentary is convenient to draw attention to and debunk the romanticized view of science as a perfect scientific method. But not valuable beyond that.

In this sense, Allchin recognizes the existence of errors, which is prevalent in science as much as in any human activity. However, many times errors are not easy to identify, their existence is not obvious (Allchin, 2000b). We need to identify them.

Allchin proposes that if we want to identify errors, the first thing to do is to find a ground from where we can distinguish error from anything else. To do this, the "key epistemological distinction is thus not between true and false, fact and artifact. Instead, it is between empirically unresolved questions, or uncertainty, and resolved questions, where fact and error have been differentiated" (Allchin, 2000a, p. 9). As the author clarifies, uncertainty in "itself (as a form of indeterminacy or ambiguity) is not error" (Allchin, 2000a, p. 2). Rather, uncertainty gives an idea that there is something undefined or unknown (Allchin, 2000b), whereas it is not by itself error. Uncertainty marks the possibility of error, because of its inevitable aspect of indeterminacy, and within scientific research, the possibility of error is an artifact interpreted as a fact (Allchin, 2000a, p. 9).

This artifact, in reality, leads to false statements about the construction of knowledge. But how is this possible? Allchin clarifies that we could not distinguish between knowledge built on false statements (negative knowledge) and knowledge free from false statements (positive knowledge), i.e., "error occurs when ultimately negative knowledge passes as positive knowledge in some evidential context" (Allchin, 2000a, p. 2). In this sense, error is seen as a form of the product of negative knowledge, in which false statements are seen as correct. On the other hand, errors are also a form of reaching positive knowledge, because errors result in the quest for a solution, regardless of their origins from negative knowledge.

The very difference between negative and positive knowledge seems to align Allchin with fallibilist views, although not as an escape clause. Rather, he pushes the question further(2000a), given a step forward from these views, which is a "Popper's blindspot", according to "falsified claims are non–knowledge and hence discarded." (Allchin, 2000a, p. 8). These kind of views are unable to see beyond fallibilist's limits. Rather, "[i]ndeed, collected knowledge

of past errors may productively guide research" (Allchin, 2000a, p. 8). As a result of this way of viewing errors, for Allchin, scientists work with errors and facts in a complementary way. Scientists commit themselves with some epistemic justification basis, but we cannot discard errors because we have some knowledge that later on it is revealed an error. Error and positive knowledge contributes to a constantly growing catalog of past errors with heuristic and analytical value. According to Allchin, the use of educational, philosophical, and sociological background "will clarify the nature and scope of the task by conceptualizing or characterizing error" (Allchin, 2012, p. 906).

However, how would we know what a case of negative or positive knowledge is? Since all we know is that in theoretical disputes we are all taking the same facts (like established facts) as a starting point, Allchin proposes that the progress of knowledge should take advantage of alternative hypotheses, although working from what is taking in the moment of the debate as a reliable available empirical evidence (Allchin, 2012). In a few words, this proposition is our basis for attributing a form of pluralism in Allchin's view in errors and alternatives that play an important role in the discovery of positive knowledge (2000a).

However, what we consider to be Allchin's pluralism seems to thrive in special occasions, as in historical cases of anomalies within normal science periods, which is a very Kuhnian perspective about pluralism (Allchin, 2000b, 2001, 2015a). On the other side, trying to avoid a common criticism of Kuhn's notion of anomalies and normal science, Allchin proposes that it is necessary to investigate those alternatives to the paradigm, whether they emerge in the presence or in the absence of anomalies (Allchin, 2000b). One of the reasons of this is because "anomalies is itself theory–dependent" (Allchin, 2015a, p. 161). That being said, it is important to highlight that with this view on alternatives, Allchin is not proposing that everyone is entitled to have his own paradigm. This is not pluralism, at least not as we posed here for Allchin or in Feyerabend's section, but rather it is relativism.

Nonetheless, despite our interpretation of a plural approach, Allchin seems to leave the question of how he coordinates his and Kuhn's pluralism unanswered, since part of the consequences of Kuhn's view([1962] 1996) is to limit the development of proliferation around the paradigm, whereas Allchin's view does not seem to be interested in any pre–limitation of any possibility of revealing errors. He thinks that concrete historical cases, within scientific evidences and trustworthiness, will be a better guide for the debate.

As posed by Allchin (Allchin, 2000b), in the presence of an anomaly, a sign

of the presence of an error also arises. That is why limiting pluralism would make no sense, although we should also note that the emergence of error does not mean that everything in the paradigm was a mistake and should be discarded (Allchin, 2000b).

Allchin tries to propose alternatives, but in a way that they do not need to wait for anomalies. This proposal of alternatives, that is independent of anomalies, is clearly a partial deviation from traditionalist Kuhn's program of paradigms within normal science. This deviation allows Allchin to argue that alternatives should be pursued regardless of the existence of anomalies. Alternatives help with the identification of errors, and anomalies signal the possibility of errors, but they would have some independence.

The search for errors and the use of alternatives, combined, help to progress knowledge, as seems to be proposed by Allchin (2000a, 2012). This would result in a form of reliable knowledge which is reached by looking for a demonstrable conclusion (Allchin, 2000a). Reliability needs the rectification of errors, with the help of resolving facts, that is, facts well–established and able to solve some fundamental issues. This is how "Resolving fact and error through such further work yields deep reliability." (Allchin, 2000a, p. 2).

But what does Allchin mean by reliable knowledge? And how should errors be seen from it? First, the notion of reliability seems, according to the above quotation, to be graduated between reliable and deeply reliable. Reliable is a notion that seems to be able to be achieved despite hidden errors, disguised as established facts. Deeper reliability, regardless of its idealized nature, is free from errors. In his words:

> Because error can masquerade as fact, neither agreement between observation and theory nor concordance of results can, by themselves, guarantee reliability. Deeper reliability depends on demonstrating that the conclusions are also free from error. This gap between ostensible verification and ultimate reliability is a basic principle of error analytics. "Nothing's concluded until error's excluded" (Allchin, 2001, p. 49).

Of course, the first thing to notice here is how much Allchin's view assumes some of the traditionalist aspects, regardless of its opposition to it. For instance, the lack of completely guaranteed reliable knowledge, is a widely endorsed point among traditionalist and progressivist views. But an indication of distinction between those views lies on how, as limited beings in a complex world, we deal with errors (Allchin, 2001). For instance, we could keep struggling to find knowledge free from errors with guaranteed reliability, or choose to accept to live and deal with errors and no guarantees, even with

respect to things that we once considered well–established and guaranteed. A second detail to note is how the methodological issue, an ostensible verification, seems to be tacitly associated with an epistemic increase in trust.

Furthermore, a previous step is required. Allchin's view of deep reliability must rely on an epistemic analysis that gradually accumulates trust from demonstration. Through this step, it would be more and more clear what is uncertainty (unestablished empirical evidences), and what is reliable, well–solved and established empirical knowledge. Such analysis is conducted by many ways, such as error probing, ostensible verification, comparison and typology of error. For instance

> Error analysis thus ideally includes searching for or imagining possible collateral errors (in other experimental contexts) that might reflect a global error. One might thereby discover a suite of disparate or undetected anomalies that reflect a deeper, unresolved problem (Kuhn 1962, Allchin 1992). (Allchin, 2001, p. 50).

This analysis leads to a form of classification which, according to Allchin, allows researchers "to isolate, identify and remedy error, once an anomaly is encountered" (Allchin, 2000b, p. 14). This is how Allchin's classification of errors would solve anomalies which emerged, since this characterization of types of errors plays a major role in the "analysis of anomalies or discordant results that signal the likely presence of error" (Allchin, 2001, p.47). Thus, such a program of an analysis of errors, Allchin says,

> holds promise in several ways. First, scientists may try to prevent or reduce certain types of error. (In many cases, they already do — and we may document and assess their methods.) Second, when they encounter anomalies, a framework of error types may help guide them in diagnosing and localizing the latent error. Third, in cases where an error type seems ineliminable, researchers may seek mechanisms for detecting such errors and accommodating them (Allchin, 2001, p. 50).

With this purpose in mind, he developed a wide typology of errors which would be allegedly recurrent in science, allowing an in–depth analysis of errors. Hence, scientists could be able to avoid, reduce and locate errors in order to deepen the reliability of scientific claims. According to the author, the sources of errors stretch from simple errors in the laboratory to more complex errors that reach cultural issues. From this source, Allchin proposes a typology of errors based on four categories: Material, Observational, Conceptual and Discursive.

Material errors involve procedural aspects of the process of obtaining materials that express a phenomenon, such as impure sample, contaminated culture, violated experimental protocol, deficient technical skill and placebo effect, among others. According to the author, these "types of local errors, one trusts, are easily found or prevented, perhaps contributing to an impression that they are not epistemically significant. But they are a major concern and topic of discussion among researchers in a lab or at a field site." (2001, p. 44).

Observational errors involve the methods of perception and data collection. These include insufficient controls to establish mastery of data or observations, observer perception bias, sampling error, etc. An important epistemic issue in this type of error is the impact of human observation soaked with theories. Although from Allchin's view "Theory–laden perception is normal. Still, while such bias can lead to error, one may search for and counteract it (e.g., double–blind studies that eliminate the factor of observer bias)." (2001, p. 45). Clearly, although it is true that many philosophers accept the presence of observational bias in our theoretical practices, Allchin does not problematize the question. He assumes that we could counteract against theory–ladenness. This optimism about this fight against theory–ladenness, especially from inside a paradigm, is a debatable point among philosophers.

For instance, Feyerabend, who we are going to see next, does not think that we could counteract theory–ladenness, at least not so easily. He thinks that we must embrace it, so we act from the assumption that our observations are biased. However, from the viewpoint of the credibility of science, Allchin assumes that we should accept that our cognitive limitations make our research inherently biased. He thinks that this limitation and inevitable bias "need not threaten credibility in science. One merely needs to be aware of it and apply a system of checks and balances " (2001, p. 45).

Conceptual errors involve errors related to theoretical interpretations, reasoning failures, inadequate specification of the theory model, incomplete theory, lack of alternative explanations and even problems with the domain of theories. The latter is often seen by Allchin as only a question of difference between the domains of each alternative. That is, "notions of theory competition typically imply that one theory is 'right', while the other is 'wrong'." (Allchin 2001, p. 46). But this implication has many undesirable consequences, like the notion of superiority. Therefore, "the key question may be not whether one theory is inherently superior, but how each theory is warranted in separate contexts or domains. One may differentiate their domains to reduce error" (Allchin 2001, p. 46).

Lastly, there are discursive errors, which cover aspects of communication, evaluation and regulation among members of a community of researchers, as well as among other communities, while still relying on scientific knowledge. Examples of such errors are communication failures in the dissemination of research results, sociocultural biases (gender, ethnicity, economic class), public misunderstanding of scientific results and a lack of understanding of science by science education and scientific dissemination.

The author draws our attention to discursive errors arising from prejudices, which are certainly part of "the diversity of influences that shape how scientists inevitably think." (Allchin 2001, p. 47). Despite scientists' idiosyncrasy, Allchin says that "the mechanism of error, in my view, is similar in each case. That is, all these biases operate (causally) in a scientific community through the minds and actions of individual scientists" (2001, p. 47).

In other words, there would be a biased community acting upon individuals. This is another reason why a taxonomy of errors would be a good way to catch widespread errors.

Generally, this taxonomy of errors would establish a ground for classifying and correcting error, based on the catalog of already known errors. That is how positive reliable knowledge is reached, that is, cataloging errors. Allchin says that the "taxonomy of error proposed here identifies in broad strokes elements that, minimally, must function properly — that is, without error to ensure the production of reliable conclusions in science" (Allchin, 2001, p.50)[2].

Allchin explains that science has not yet managed to have an efficient system to correct its errors, so it may need external help, and the taxonomy of errors is a way to move in this direction. For instance, he says that there are many cases in history of science where errors were not often shown, and even so when it happened, the correction was relatively slow and generally occurred by chance (Allchin, 2015b, 2016). For Allchin:

[2] Notwithstanding, there is an occult debate here which for the sake of the introductory character of the paper, we will not be able to explore. We are talking about how and what are the consequences of identifying what must function properly. Who said that by identifying errors, scientists will avoid them? If we assume that this is the case, then we will be engaging ourselves in a causally fragile argument. The fragility of the argument is similar to the difference between knowing what virtue is and its practice. For instance, in science it is well–known that generally the claims one makes must be in some form reproducible. However, nowadays scientists have been discussing if we are facing a crisis in replicability. According to a famous paper, "more than 70% of researchers have tried and failed to reproduce another scientist's experiment" (Baker, 2016, p. 452). Naturally, we knew about this before 2016.

> "For example, researchers typically develop an informal catalog of past mistakes: an error repertoire (Mayo 1996, 5, 18). Where this memory guides avoiding similar mistakes again, standards of proof escalate. Reliability deepens. How should scientists document and communicate errors – or negative results – towards more effective science (Allchin, 2000a, p. 14).

The closest thing that science has to this system is the use of negative knowledge from an informal repertoire of past mistakes. However, without a more systematic account, like the offered typology of errors, Allchin thinks that such an informal catalog may also end up hiding errors. An example is the case of double–blind tests for drugs, which "essentially embody concrete experience with errors. An error repertoire has been transformed into a methodological principle" (Allchin, 2020, p. 12).

This transformation case brings up a question about the limits of our knowledge, and to what extension we are able to have knowledge free from errors. Allchin considers that knowledge free of error is not completely possible because, as we saw, science is an unfinished enterprise, that is, from "a more pragmatic view, error is not entirely eliminable" (Allchin, 2020, p. 14).

So even when part of our knowledge is deeply reliable, the advance of research upon new theories, fields and problems, carries with it new errors, and those old errors remain unidentified. Throughout the progress made and established, we will be able to avoid some old errors and incorrect solutions. From a methodological perspective by "using error repertoires (and the methodological heuristics derived from them) the process [of trial and error] becomes, rather, trial and learn—and, hence, progressive" (Allchin, 2020, p. 14, brackets added) .

The progressivist process assumes that we gradually learn more what is an error and what is not. From this we advance the research. But also, in this account, we will gradually need pluralism less and less, since after a long time, the repertoire is supposed to allow a great focus on solutions. Therefore, the idea is that if we want to classify and learn from errors, we are going to need new alternatives.

But the more we propose new alternatives, the greater the chance to find more errors, and catalogue them. Once we learn from the proposed methodology and the typology of errors what an error is, it seems that we will not discuss that matter again. We catalog the errors found. The more we advance, the more our catalog increases, and the less we will need new theories.

In this manner, there is also an intent to gradually unify theories and views, so a repertoire would serve "as a significant structure for unifying science studies" (Allchin, 2001, p.47). In a certain sense, Allchin's pluralism emphasizes the importance of alternatives, but at the same time, he does that by focusing on the establishment of paradigmatic theory. Under such a Kuhnian view, it is at least debatable if Allchin is really proposing new alternatives, and actually pluralism. The reason is because it does not seem to assume pluralism from beginning to end, but only as a means to unity. (Kellert, Longino, & Waters, 2006; Ruphy, 2016).

That being the case, in Allchin's view, despite errors being part of all stages of scientific knowledge; their repetition becomes gradually reduced, and because we catalog them, we allegedly increase the reliability of our knowledge, which also means avoiding the already classified errors. A more defiant view of traditionalist and progressivist values will be presented in the next section.

§4. Feyerabend's pluralism and scientific error

The way error has been underestimated and taken as part of just a single stage of scientific research has been frequently contested by Feyerabend (1993). Unfortunately, there are not many debates on the topic of errors among Feyerabend's scholars. The reason is not difficult to assert, that is, Feyerabend has not devoted specific papers to this topic, at least not like we see in other thinkers (Allchin, 2004, 2012, 2015b; Allchin; & Werth, 2017; Mayo, 1996; Rescher, 2007). However, this lack of focus on this topic does not mean that Feyerabend has not given valuable contributions to this issue of errors. We intent to show that since the seventies, he introduced challenging and spearheading questions.

For instance, to Feyerabend, knowledge asks for a form of chaos (1993), which indicates that knowledge is a process of permanent learning and of uncertainty. Nonetheless, error is not always a counterproductive element. From his viewpoint, the place of errors, as a permanent element of scientific knowledge, does not pose a threat to science productivity or progress. This is because a pluralist account keeps science alert to the fact that, in Allchin's words, whatever we consider to be a resolved fact or empirical knowledge, is rather just another trial. It could stand up or fall down, and until we finish with the problem, nobody knows if and how much our considerations of knowledge are soaked with errors.

The traditionalist view is aware of the relevance of errors, but once the errors are revealed, they are rectified, or else the accepted account must be

discarded. Furthermore, the traditionalist way of identifying errors poses a problem. From the moment we spot the error, we eliminate it and stick to the theory, or else discard the theory, taking the revealed error seriously. However, this does not coincide with what happens in science.

For instance, it is well known that Newtonian's gravitational theory predicted Uranus' orbit. However, the prediction of "the observed orbit of Uranus consistently differed from what Newton's theory predicted." (Okasha, 2016, p. 15). Nonetheless, scientists not only did retain Newton's theory, they also took the error seriously, promoting it in order to better understand the consistent error of prediction. Another example is Lavoisier's theory of oxygen, which has, among many problems surrounding his chemistry, one like the very name of "oxygen" (acid–generator) which embodied "a mistaken theory of acidity, and Lavoisier's theory of combustion rested crucially on the concept of caloric, an imponderable fluid just like phlogiston." (Chang, 2012, p. xvii).

Not rarely, scientists stick with theories, and their mistakes, despite spotting these mistakes. They do not necessarily rectify the mistakes immediately, nor do they have any clue about how to do it. Sometimes scientist may replace theories, other times they just modify them, and others, they retain them (theory and spotted error), because there is nothing better nor a more productive thing to do. As Feyerabend put it, "contradiction may stay with us for decades or even centuries." (1993, p. 61). Besides that, sometimes, even when the correction of an error is at hand, offered by some divergent small group of scientists, the scientific community of the paradigm is not always ready to accept that correction, especially when it entails that their own view will be seen as a mistake.

For instance, Darwin faced a lot of pushback from the scientific community against his view, even by those who supported his general view (Hull, 1973). They saw Darwin's natural selection as a mistake, or based on unproven claims. For instance, Huxley asked Darwin, in what was called the swapping problem, "to drop the notion of very small, gradual increments as the object of selection." (Richards & Ruse, 2016, p. 124). Of course, Darwin did not drop it, regardless of Huxley's acceptance of evolutionism. Huxley thought that Darwin had not explained a central piece of his theory, "how natural selection picks out minute traits and finely shapes the structure of organisms" (Richards & Ruse, 2016, p. 124). Mill, to whom science was based on proof and inductive method, argued that Darwin only speculated, but didn't prove natural selection. To Mill, actually "Darwin has never pretended that his doctrine was proved." (Mill, 1874, p. 328).

As we have seen, errors might play different roles in science, and

Feyerabend (1993, [1970]1981) seems to follow up on that variety. He stresses the relevance and presence of errors, and human limitations, but without necessarily undermining scientific knowledge. To do this, he simply explains why and how scientific theories live with errors on a regular pluralist basis, even within accepted theories.

To start with, he objects to the common argument that, despite human limitations being reflected on science, science knowledge has a special status. As if science were less vulnerable to such inherent limitations and errors. If we assume that special status, there could be many consequences. For instance, errors in scientific knowledge could look less linked, and their acknowledgment reserved to scientists, the only ones who are supposedly educated enough to understand science's special status.

Nonetheless, let us remember that there is nothing inherently special about science, which is even truer about the permanent place of errors in that enterprise. What is actually problematic for the description of science, and not only for its trust, is the attempt to cover up the existence of failures of scientific research, of the specialist, "acting as if it does not exist". (Feyerabend, 1993, p. 251). This is a misunderstanding of how scientific knowledge is constituted and developed.

Feyerabend (1993) seems to call our attention to the link between human limitations and science limitations as a human activity. He reminds us that science is a human enterprise, and like any other, fallible and flawed, so it should be treated as such when we are investigating the world.

Furthermore, due to our limitations and science fallibilism, as Chang said, it calls for a "reasonable humility about human capabilities" (2012, p. xx) which, in Feyerabend's and Chang's view, is very well coupled with by pluralism. Of course, the next question is "why is it better to be pluralistic? […]. The immediate reason for this is the sense that we are not likely to arrive at the one perfect theory or viewpoint that will satisfy all our needs" (2012, p. xx). This is how a pluralistic account links our cognitive limitations, and science errors, i.e., pluralism "is about knowledge–building, not just knowledge–evaluation." (2012, p. xx).

In a similar manner, Feyerabend supports pluralism and errors as part of the process of developing and evaluating knowledge, a constituting part of the increasing ocean of alternatives (1993). To him, errors and progress are interwoven. Thus, to advance our knowledge, Feyerabend argues that "these 'deviations', these 'errors', are preconditions of progress." (1993, p. 158). By errors, he was not just referring to things that happened in the initial stage of

research, but since science research is an ongoing process, errors are constantly there, in the so–called discovery and justification context.

On this account, errors would be part of what "characterize the context of discovery" (1993, p. 116), but not only that. As preconditions of progress of complex and ongoing scientific research, errors are everywhere. On this account, errors are also part of the discovery and justification context because such a distinction of contexts should be abolished once it does not play "a role in scientific practice" (1993, p.147).

Something that calls our attention is how Feyerabend's views allow us to infer that error is an aspect which is strongly related to time and pluralism. Error would be coupled with time because our theories and efforts to progress knowledge change over time, and with time, errors and our goals change as well. Since scientific criteria for assessment and interests change along the progress of knowledge, errors change as well. Not only epistemically or methodologically, but also ontologically. So, there is not such a thing as 'the error', 'the real error behind the ultimate reality' regarding The Nature as She is.

Another indication of error's chronology is that, in many cases, we do not know if our efforts to explain or understand something will result or not in error. That is why Feyerabend says that scientific knowledge built by scientists is like buildings of different sizes and shapes, so the knowledge constructed "can be judged only after the event, i.e., only after they have finished their structure. It may stand up, it may fall down — nobody knows". (1993 p. 2).

The temporal aspect in the quotation, indicated by the word 'after', means that any judgment of the success or failure (and the reasons for them), is conditioned by time. Of course, another important question is what did Feyerabend mean by "finished structure"? It only means that, from a certain point, let us say the standing up or falling down perspective of a building X within a period of time of observation, it is possible to make an objective assessment of a temporary result. After all, Earth's shape is round–like and the Sun is placed at the center of our Solar system. When Darwin presented his finished version of evolutionism, he then had to submit it to scientific criticism. This is part of the process of chronologically finishing a building. The theory was evaluated, some errors were revealed, some of them even endured beyond any solution from Darwin. After six editions of his book *Origin* ([1859]2009), Darwin's viewpoint of the problem of evolutionism was solved in that context. The building did not fall down, neither was it freed of any error.

The expression 'to be finished' is nothing more than just a temporary

observation of the state of the building. Scientists can, and should, return to the basic problems and foundations of buildings. Among the reasons for this is because the victorious theory can still be developed further, just like the debunked theories. Feyerabend (1993) said that debunked theories may have to be retained forever, even in the face of plain and "unshakable contrary evidence" such as what happened with Bohr's atomic model (1993, p. 40). History has shown us that debunked theories, maybe due to their underdeveloped stage, could have been eliminated prematurely, or mistakenly. This happened with the phlogiston theory (Chang, 2012), Lamarck's evolutionism, and with the Copernican system. The first could have made many important contributions if it had not been prematurely rejected (Chang, 2012). The latter had a triumphant return (1993, p. 146). Lastly, part of Lamarck's theory is returning nowadays under the combination of genetic causes for variation and the Lamarckian proposal that environment can, in a heritable manner, alter phenotype. This duo brought many contributions to our modern evolutionary theory and epigenetic explanations as well (Pfeifer, 1965; Skinner, 2015).

This debate guided us to the question of why the analysis of error also benefits from pluralism. By reason of many aspects, our knowledge contains elements that can only be revealed by other theories, not by facts. Not only that, in many occasions our best theories offer "partial or merely 'plausible'" explanation based on "temporary periods of agreement on a general story" (Plutynski, 2018, p. 210). However, even so, this temporary period of agreement does not mean that the general story calmly settles down until some error or problem arises. Rather, this period is followed by many disagreements and "arguments for why this general account doesn't fit the facts" (2018, p. 210).

These are some of the reasons why we should invent "theories which are inconsistent with the facts" (Feyerabend, 1993, p. 61), i.e., because "hardly any theory is consistent with the facts. The demand to admit only those theories which are consistent with the available and accepted facts again leaves us without any theory." (1993, p. 50). Clearly, since we are limited beings, our best theories are fallible, have only partially plausibility, and are surrounded by many empirical arguments against them. Unsurprisingly, proliferation of our "theories is beneficial for science" (1993, p. 24).

That being so, errors are not only preconditions of progress in an epistemic sense, they are part of what leads us to explore new alternatives, and by consequence pushing tests, criticisms and changes in knowledge. Error is a piece of the motor of progress, and despite that, errors sometimes resulted in

many lawsuits which "have made physicians more careful, sometimes too careful for the good of their patient, but they have also forced them to consult alternative opinions" (1993, p. xiii).

It is true that errors could paralyze us, but they could also stimulate progress, and in association with plurality. Sometimes it is only with the help of alternatives that we test, contrast and discover "the errors of highly respected and comprehensive points of view" (1993, p. 132).

In a similar fashion, in *Science in a Free Society* (1978), Feyerabend repeats the idea of relevance of pluralism to spot errors in the *status quo*. Furthermore, and this is something to bear in mind, he categorizes errors in two ways:

(i) comprehensive or wide–ranging and (ii) small.

He says that differently from what happens with small mistakes, "involving restricted areas" (1978, p. 99), and where things "may perhaps be corrected from the inside" of the theory at hand (1978, p. 99); there is also another form of error, the comprehensive ones. These mistakes involve "the 'basic ideology' of the field" (1978, 99).

The problem with basic ideology, as Feyerabend said in another book, is that sometimes a basic ideology is so naturalized by language, theories, practices and cosmologies, that it may resist to anything considered as "widely divergent points of view'" (1993, p. 165). That is why sometimes comprehensive errors involving the basic ideology "can be and often were revealed only by outsiders or by scientists with an unusual personal history." (1978, 99–100).

From this point, the basic ideology, the paradigm, is useless for detecting a wide–ranging form of errors. The basic ideology is too compromised with all the above–mentioned elements, like language, cosmology, etc. As advertised centuries ago by Bacon's idols, we may not even be aware of these elements. According to Feyerabend, it is most likely that "we recognize their effects only when we encounter an entirely different cosmology" (1993, p.22). Unlike Bacon, to Feyerabend (1993), it is not the analysis, but the contrast between cosmologies that reveals wide–ranging errors beyond basic ideology. Thus, we need "an external standard of criticism, we need a set of alternative assumptions or, as these assumptions will be quite general, constituting, as it were, an entire alternative world" (1993, p. 22).

Of course, an important question to be asked is this; what if this alternative world is a dream world? Would this exchange be worthwhile? Would we not be

exchanging a partially plausible theory for a worse one? This is possible. However, Feyerabend remembers, first, we may "need a dream world in order to discover the features of the real world we think we inhabit" (1993, p. 22). Some errors may only be discovered, and the knowledge progressed, by assuming a new cosmology, even hypothetically, which is an even harder exercise than you may think. Second, who can tell if we are not already living in a dream world? As far as science has shown us, many of its real worlds were later unveiled as dream worlds. We cannot forget our basic presupposition of limited beings with a limited science. Third, even if we were "exchanging a powerful tradition for a mere dream…" or for an underdeveloped tradition, this "…need not reduce contact with reality." (1978, p. 169). This counter–induction is not necessarily counterproductive. A counter–inductive step, when it is committed to develop critical and reasonable thinking, is actually a first step towards the criticism of what we have seen as 'facts', and therefore "an attempt to break the circle" (1993, p.22). Thus, making use of new alternatives, the so–called outsiders — from the official paradigm — can propose new efforts to correct "the mistakes and so changed research in a fundamental way." (1978, p. 99–100).

On this account, although pluralism does not give guarantees, when it is discarded, we may forever lose the opportunity of evaluating our 'basic ideology', progressing our knowledge, finding errors, avoiding errors, or committing new productive ones. Feyerabend says that ideas "*arise* in a very disorderly way and that the *origin* of a particular point of view may depend on class prejudice, passion: personal idiosyncrasies, questions of style, and even on error, pure and simple." (1993, p. 115–116).

Nonetheless, the bond between progress and error, and its precondition in Feyerabend's view, also invites a development of a proliferation of theories and worldviews, and consequently, how we classify errors within a pluralist research .

A pluralist account might fundamentally change how we see errors (Oliveira, 2021). In Feyerabend's pluralism, he reevaluates the nature of errors by assuming their permanent place in all stages of knowledge. Considering that research is a continuum process, and despite a general agreement, it does not mean that an accepted theory is freed of problems, unexplained facts, and unstable evidences.

A temporary agreement is not based on a stable ground made of empirical evidence which is now independent of theories. A general agreement is constantly under attack by many alternatives because it is only partially supported by evidence and plausibility.

This also explains why Feyerabend uses the terms "errors" and "deviations" between quotation marks in the phrase "these 'deviations', these 'errors', are preconditions of progress" (1993, p. 158). In the paper "Classical Empiricism" ([1970]1981) Feyerabend says something, repeated in *Science in a Free Society* (1978), that sheds light on the reasons of how he uses deviations and errors as synonyms.

The first thing to note is quotation marks. By using "errors" and "deviations" within quotation marks, Feyerabend points to a broadly acknowledged fact, which is, when someone says that something is an error, i.e., an answer to something could simply be wrong. This is the cognitive limitation and fallibilism.

Second, and more interestingly, is how Feyerabend explains the disclosure of wide–ranging errors. Because an error is a result of an analysis coming from a certain reference, which is interest–driven, problem–driven, or theory–driven, then the discovery of errors, faults, mistakes, deviations could entail merely "that the two practices — the one that is criticized and the one that does the criticizing — don't fit each other" (1978, p. 22; 1993, p. 220). Since science is an ongoing research with temporary general agreement, followed by many views about the contradiction of many facts, and between many theories, then it does make sense to use quotation marks in order to point out that unfitting situation between two practices. A comprehensive (wide–ranging) "errors", "deviations", "mistakes", have "a most critical function in the development of those very theories which we today regard as essential parts of our knowledge of nature." (1993, p. 158).

Third, Feyerabend pushes the question further. The use of the word "error" does not refer to a future situation, where the now accepted theory will eventually be refuted. Rather, Feyerabend is talking about the present state of research where a competition between many theories, interpretations of facts, and cosmologies is always operating. Thus, an X hypothesis could be seen as a mistake, or not, in the present. It will depend on the perspective adopted, like the theoretical one. Thus, the use of quotation marks simply alludes to an alternative meaning of these words. Of course, there are forms of testing them, but whatever the result, it does not change the fact that sometimes the point of disagreement, like X being an error or not, could remain there and the dispute being solved by other means or just being pushed to the future generations.

That is how, still in the paper "Classical Empiricism" ([1970]1981), Feyerabend describes the meaning of deviations/errors, in a precise manner. It is entailed by his view that "deviations" are already an evaluation consistent with

the values of the basic ideology. Thus, whatever we might be pointing to as deviations, they can only be seen as "deviations from the accepted point of view" (1970, p. 38–9).

In other words, deviations are assessments shaped by a certain point of view, the accepted point of view, the manner it reads, describes and gives sense to the facts and other theories. In a few words,

(iii) *Error needs a point of view, generally the accepted one, as a basis for its existence.*

That being so, error is not a universal or absolute appraisal of a subject matter, but a contextual and theoretically referential one. For instance, the same phenomenon can have two completely incommensurable explanations at the same time, and both views be seen as errors, but only from each other's references. This happened with the dispute between the impetus theory and the theory of momentum, or with the theory of phlogiston and the theory of oxygen (Chang, 2012).

But one could contend against this argument, that empirical knowledge would solve the matter. Not necessarily. The theory of phlogiston had great evidence on its side, and despite criticisms, like the ones among Lavoisier's followers that phlogiston was an abstract entity, the theory had many direct proofs of support. In addition, the theory of oxygen also had its abstract entity, caloric (Chang 2012), which could perish by the same criticism applied to phlogiston.

Feyerabend calls attention to theoretical dispute and the ties with the conception of error. This is how, when we call something an error, deviation, mistake, failure, it does not represent an absolute perspective of what is or is not an error about specific matters. Errors are results from certain values, which may well be intersubjectively assessed, but still, are in no way universal or independent of theories.

In a certain sense, the status of error, within theoretical disputes, resembles the notion of Schrödinger's cat, where the cat could be alive and dead, simultaneously. Likewise because something could be interpreted as an error, and as not being not, at least in principle by two incommensurable theories, then the problem of error in science is not simply solving by pointing to 'The Error'.

A final point in Feyerabend's definition of error is the religious background used in both texts to talk about error (1993, 1970). This seems to infer that,

according to Feyerabend, if we give one view the power of determining what is an error and what is not, universally and independent of everything else, we will be practicing religion, not science. The reason, he explains, is that in religious beliefs, people are restrained by dogmatic positions, with error and truth being separated by clear–cut. From this background, it would be possible to say that an X "religion is the truth, everything else is error and those who know it, understand it, but still reject it, are rotten to the core (or hopeless idiots)" (1993, p. 218).

That is how we value and exert the power of one tradition and theory above others, i.e., making sure that someone's "knowledge of the bible is constantly tested, by examinations at school, in conversations with others; and mistakes, i.e. deviations from the accepted point of view, from the 'party line' are corrected at once." (1970, p. 38–9). Therefore, if epistemologists take a universal assessment of error, or truth, as a self–evident point, a crystal–clear fact, this activity would be more similar to a dogmatic structure of investigation than to a scientific one.

§5. Final considerations

The process of understanding, and explaining the role of errors in the constitution of scientific knowledge is a subject matter of which we just scratch the surface here. Rescher, Allchin and Feyerabend, should not be taken as representative of the only views and arguments on this matter. Still, these three authors could be taken as representing two main accounts of errors, the traditionalist view and the progressivist view.

Nonetheless, from the perspective of these authors, we can not only understand from where the debate is coming, and the challenges faced, but also possibly say how we are dealing with errors, and how we can push forward, as we did with Feyerabend, whose perspective on errors, besides our very effort here, is only a first step about his analysis of error. This is especially valuable because now we are offering something that was missing, a starting point, with categories and descriptions of the topic from Feyerabend's pluralist perspective of errors.

From Rescher's view (2007), who brought the topic of errors to center of the stage in the twenty–first century, substantially advancing it, we see how errors as a philosophical subject are more than just a slip of attention. He argued, despite his view that errors are counterproductive, that they were inevitable. To him, a middle ground for keeping errors under checks and balances would be a more modest aim for science, like coherence and reliability, instead of truth.

That is clearly controversial, but it points to relevant directions, like the need for a systematic approach for errors. On this account, we have shown that this is exactly what Allchin proposed. His progressivist view claims that philosophers make their contribution by systematizing errors, such as identifying and defining categories. That would enable scientists to gradually avert the same mistakes, progressing knowledge. Consequently, the contribution becomes an argument against the myth of self–correction in science, a topic to which Allchin helped call attention. Together, those authors revealed old problems, new treatments, and promising directions of research, which can and should now be under new criticism.

ACKNOWLEDGMENT

We would like to thank Douglas Allchin for giving us authorization to use some of his unpublished papers, such as: Allchin, D. (2020). *Error Repertoires.* In print. Retrieved from http://douglasallchin.net/papers/err-rep.pdf. Last access on jul–12. Also, the work "Err is science" is still a work in progress, so it should be seen here with caution.

Additionally, we also want to thank Douglas Allchin for all help and support in reading our paper and giving suggestions that definitely improved it. However, we are certain that we committed other mistakes which are of our exclusive responsibility.

REFERENCES

ALLCHIN, Douglas. (1998). Do we see through a social microscope?: Credibility as a vicarious selector. *Philosophy of Science, 66*, S287-S298.

ALLCHIN, Douglas. (2000a). The Epistemology of Error. Paper presented at the Philosophy of Science Association Meetings, Vancouver, B.C.

ALLCHIN, Douglas. (2000b). *To Err is Science.* Paper presented at the American Association for the Advancement of Science., Washington, DC.

ALLCHIN, Douglas. (2001). Error Types. *Perspectives on Science*(9), 38-59.

ALLCHIN, Douglas. (2004). Error and the Nature of Science. *ActionBioscience [online]*.

ALLCHIN, Douglas. (2012). Teaching the Nature of Science through Scientific Error. *Science Education, 96*, 22.

ALLCHIN, Douglas. (2015a). Context-Dependent Anomalies and Strategies for Resolving Disagreement. In *Empirical Philosophy of Science* (pp. 161-171): Springer.

ALLCHIN, Douglas. (2015b). Correcting the "self-correcting" mythos of science. *Filosofia e Historia da Biologia, 10*(1), 19-35.

ALLCHIN, Douglas. (2016). Is Science Self-Correcting? *The American Biology Teacher., 78*(8), 695-698. doi:https://doi.org/10.1525/abt.2016.78.8.695

ALLCHIN, Douglas. (2020). *Error Repertoires.* In print. Retrieved from Minnesota Center for the Philosophy of Science. http://douglasallchin.net/papers/err-rep.pdf

ALLCHIN, Douglas. (2021). [*Quotation of papers not published*. Message received by email in 13-07-2021].

ALLCHIN; Douglas, & WERTH, Alexander. (2017). The Naturalizing Error. *Journal of the General Philosophy of Science*.

BACHELARD, Gaston. (1996). *A Formação do Espírito Científico* (E. d. S. Abreu, Trans.). Rio de Janeiro: Contraponto.

BACON, Francis. ([1620]2003). *The New Organon* (L. Jardine & M. Silverthorne Eds. 3rd ed.). Cambridge, New York: Cambridge University Press.

BAKER, Monya. (2016). Reproducibility crisis. *Nature, 533*(26), 353-366.

CHANG, Hasok. (2012). *Is Water H2O? Evidence, Realism and Pluralism*. Dordrecht, The Netherlands; New York: Springer.

DARWIN, Charles. ([1859]2009). The Origin of Species - By means of Natural Selection, or the preservation of favoured races in the struggle for life (6th ed.). Cambridge, New York: Cambridge University Press.

DESCARTES, Rene. (1637 [2000]). Discourse on the method of rightly conducting the reason, and seeking truth in the sciences. In J. Veitch (Ed.).

FEYERABEND, Paul. (1978). Science in a Free Society. London: NLB.

FEYERABEND, Paul. (1993). *Against method* (3rd ed.). New York: Verso.

FEYERABEND, Paul. ([1970]1981). Classical empiricism. In *Philosophical papers - Problems of Empiricism* (Vol. 2, pp. 34-51). Cambridge ; New York: Cambridge University Press.

HULL, David. L. (1973). Darwin and his critics: The reception of Darwin's theory of evolution by the scientific community. Cambridge, Massachusetts: Harvard University Press.

KELLERT, Stephen. H., LONGINO, Helen. E., & WATERS, C. Kenneth. (2006). *Scientific pluralism*(pp. xxix, 248 p).

KUHN, Thomas. S. ([1962] 1996). *The structure of scientific revolutions* (3rd ed.). Chicago, IL: University of Chicago Press.

MAYO, Debora. G. (1996). Error and the growth of experimental knowledge. Chicago: University of Chicago Press.

MILL, John. S. (1874). *A System of Logic.*Definitive 8th edition. 1949 reprint. In: London: Longmans, Green and Company.

OKASHA, Samir. (2016). Philosophy of science: very short introduction: Oxford University Press.

OLIVEIRA, Deivide. G. d. S. (2021). The cosmological divergent proliferation in Feyerabend's pluralism. *Principia: an international journal of epistemology, Forthcoming*.

PFEIFER, Edward. J. (1965). The genesis of American neo-Lamarckism. *Isis, 56*(2), 156-167.

PLUTYNSKI, Anya. (2018). Explaining cancer: Finding order in disorder: Oxford University Press.

RESCHER, Nicholas. (2007). Error: on our predicament when things go wrong. Pittsburgh: University of Pittsburgh Press.

RICHARDS, Robert. J., & RUSE, Michael. (2016). *Debating Darwin*: University of Chicago Press.

RUPHY, Stéphanie. (2016). Scientific pluralism reconsidered: A new approach to the (dis) unity of science: University of Pittsburgh Press.

SKINNER, Michael. K. (2015). Environmental epigenetics and a unified theory of the molecular aspects of evolution: a neo-Lamarckian concept that facilitates neo-Darwinian evolution. *Genome biology and evolution, 7*(5), 1296-1302.

Epistemologically progressivist and traditionalist analyses of scientific error in Rescher's Allchin's and Feyerabend's philosophies

In the modern period, Bacon and Descartes dedicated some time to talk about errors. However, by the end of the last century, and the beginning of the 21st century, the topic did not receive enough attention. Thus, we debate three different authors on error, representing two epistemic views that we are calling progressivist and traditionalist. The first author is Rescher (2007), who we take as a supporter of a more traditionalist approach, with a great contribution to the researches on the topic. The second author, a progressivist, is Allchin. He stresses the need to build a catalog of errors, so we can gradually avoid them. Our third author, Feyerabend, sees errors from this categories: small and comprehensive. Different from Allchin, Feyerabend puts more weight on issues like pluralism and the relation between error and all the theoretical structures of which it is part. Our aim, beyond exploring the views of these authors, is to see how in the 21st century they present different but contributive research on errors, although we hope to convince the reader that some of these views, as how Feyerabend contributes to this subject matter, seems to be in better harmony with science as we see nowadays.

Keywords: Theoretical inconsistency · Coherence · Reliability · Repertoire of errors · Scientific Pluralism.

Análisis epistemológicamente progresista y tradicionalista del error científico en las filosofías de Allchin y Feyerabend de Rescher

En la época moderna, Bacon y Descartes dedicaron algún tiempo a hablar de errores. Sin embargo, a fines del siglo pasado y principios del siglo XXI, el tema no recibió suficiente atención. Así, debatimos sobre tres autores diferentes acerca del error, representando dos categorias epistémicas que llamamos progresistas y tradicionalistas. El primer autor es Rescher (2007), a quien tomamos como partidario de un enfoque más tradicionalista, con un gran aporte a las investigaciones sobre el tema. El segundo autor, progresista, es Allchin, quienes destaca la necesidad de construir un catálogo de errores, para que podamos evitarlos gradualmente. Nuestro tercer autor, Feyerabend, ve errores en estas categorías: pequeños y completos. A diferencia de Allchin, Feyerabend pone más peso en cuestiones como el pluralismo y la relación entre el error y todas las estructuras teóricas de las que forma parte. Nuestro objetivo, más allá de explorar las opiniones de estos autores, es ver cómo en el siglo XXI presentan investigaciones diferentes pero contributivas sobre errores, aunque esperamos convencer al lector de que algunas de estas opiniones, como cómo Feyerabend contribuye a esta temática, parece estar en mejor armonía con la ciencia como vemos hoy en día.

Palabras Clave: Inconsistencia teórica · Coherencia · Fiabilidad · Repertorio de errores · Pluralismo científico.

DEIVIDE GARCIA DA SILVA OLIVEIRA is Professor of history and philosophy of science, and philosophy of education at the Federal University of Recôncavo da Bahia, Brazil. His PhD was completed at the Federal University of Bahia, Brazil. His research interest rovers around general philosophy of science, philosophy of biology, Feyerabend's philosophy, and science teaching. More recently, he edited the book *Filosofia da Ciência*,

vol. 3 (Ufpel). Among his latest papers there is: "The cosmological divergent proliferation in Feyerabend's pluralism". *Principia: an international journal of epistemology*.

INFORMACIÓN DE CONTACTO | CONTACT INFORMATION: Centro de Ciencias Agrarias Ambientais e Biologicas - CCAAB, Universidade Federal do Recôncavo da Bahia. Rua Rui Barbosa, Centro, 44380000 – Cruz das Almas, BA, Brasil. e–mail (✉): deividegso@gmail.com · iD: http://orcid.org/0000-0002-5004-1949.

LÍLIA FERREIRA SOUZA QUEIROZ es is PhD student in Teaching, Philosophy and History of Sciences at the Federal University of Bahia (UFBA). CAPES Scholarship. She has as advisor Prof. Dr. Gustavo Rodrigues Rocha and co-supervisor Dr. Deivide Garcia da Silva Oliveira. She has research interest in Philosophy and History of Sciences, and is researcher member of the Research Group on Philosophy, Science and Scientific Education (G-EFFICIENTIA) coordinated by Deivide Garcia.

INFORMACIÓN DE CONTACTO | CONTACT INFORMATION: Programa de Pós-Graduação em Ensino, Filosofia e História das Ciências (PPGEFHC), Faculdade de Educação, Universidade Federal da Bahia. Avenida Reitor Miguel Calmon, s/n, Campus Canela, 40110-100, BA, Brasil. e–mail (✉): lsouzaqueiroz@gmail.com · iD: http://orcid.org/0000-0002-7129-4881.

HISTORIA DEL ARTÍCULO | ARTICLE HISTORY
Received: *10–April–2021*; Accepted: *29–June–2021*; Published Online: *30–June–2021*

COMO CITAR ESTE ARTÍCULO | HOW TO CITE THIS ARTICLE
Oliveira, Deivide Garcia da Silva and Queiroz, Lilia Ferreira Souza (2021). « Epistemologically progressivist and traditionalist analyses of scientific error in Rescher's Allchin's and Feyerabend's philosophies». *Disputatio. Philosophical Research Bulletin* 10, no. 17: pp. 77–106.