Utrecht University

Bachelor's thesis philosophy

Why the no-miracles argument fails as an ultimate argument against scientific anti-realism

Date: June 19, 2020

Author: B. Van Hooijdonk

Student-number: 5633842

First reviewer: Dr. M. Lievers

Second reviewer: Dr. S. Werkhoven

Faculty: Religion and Philosophy

Bachelor programme: Philosophy

Word count: 6249

Abstract

The contemporary scientific practice is a hugely successful one. It is successful at predicting and explaining phenomena, its application to technology and its contribution to the physical health of humans. The success of science itself is in need of a scientific explanation. Hilary Putnam provides us with such an explanation. He explains the success of science by appealing to the notion of 'truth', in his famous no-miracles argument. Putnam regards his explanation as the *only* explanation for the success of science, while I do not regard his his explanation as the only possible one. I will demonstrate this, by providing an alternative explanation. This alternative explanation is inspired by the scientific anti-realist Bas van Fraassen. Van Fraassen is one of the most influential contemporary scientific anti-realists. He is almost solely responsible for reviving the realism anti-realism debate, which I will illustrate in this paper. Furthermore, I will argue that Putnam's explanation for the success of science is not a viable one. There are several hugely successful scientific theories, which are not regarded as true. I will use this fact as a counter-argument against Putnam's no-miracles argument.

Table of contents

Introduction

In this paper I will show that the no-miracles argument fails as an ultimate argument against scientific anti-realism. This argument claims that the succes of science can only be explained by appealing to the notion of objective truth. If this argument is accepted, anti-realism becomes untenable, since anti-realists do not think that scientific theories are true.

The no-miracles argument constitutes the defence of global scientific realism, because it protects the entire theory against arguments provided by anti-realists. Accepting realism logically follows the acceptance of the no-miracles argument. I do not accept the argument for a number of reasons. The no-miracles argument claims to provide us with a scientific explanation for the predictive, retrodictive and explanatory success of scientific theories, by appealing to the notion of objective truth. It succeeds at providing us with such an explanation, but the explanation fails at properly substantiating its claims. It is not the *only* explanation for the succes of science and I will use Van Fraassen's evolutionary argument to show this. By showing an alternative explanation the argument loses its strength as the only explanation and, in turn, as the global defence of scientific realism. It no longer is the *only* explanation for a phenomenon, but just a possible explanation. I do accept that scientific theories are hugely successful, but I do not think that truth is the only explanation for this success. Furthermore I will argue that truth is not a convincing explanation for this success, since there are a lot of theories that were and still are successful without being true. I will structure my argument by using several scientific theories which were once successful, but are now regarded as not true. I will also use theories that are still regarded as true, like the theory of relativity, as a contrast to the obsolete theories. But first I will start with an elaborate explanation of the contemporary debate between the realists and the anti-realists in which the 'no-miracles argument' is used. By providing a perspective it becomes clear how and why the 'no-miracles argument' is used and how the anti-realists, like Van Fraassen, have responded to this argument.

Did Mary Magdalene really appear to Bernadette Soubirous at Lourdes, or was there no miracle at all and can the phenomenon be explained in another, less miraculous, way?

1: Realism and contemporary anti-realism

1.1 Realism

‘Real' is a term that affirms existence, so being a realist entails believing that at least something is real. 'Real’ in the realist sense means that something is objectively real. For something to be objectively real it needs to be real, independently of the minds of individuals or of social constructs. The truth conditions for statements about the world exist outside the mind of the subject and are dependent on how things stand in the world.[1] The things we ascribe existence to exist independently of the the subject.

To be a realist about something entails ascribing objective reality to that something in a metaphysical sense. It is possible to be a realist about lots of things. One can be a realist about chairs and believe most of the chairs he sees, hears and reads about everyday have a reality in the mind-independent world. I hope everyone who reads this paper is such a realist. Less trivially, it is possible to be a mathematical realist like Kurt Gödel who believed in the objective reality of mathematical objects.[2] This is to say that things like numbers, sets and mathematical relations exist independently of our minds.

Extending the realists conception to scientific realism, this form of realism entails the view that the entities which our best scientific theories describe have an objective reality in a world that is independent of the subjects. The reality of these entities must be manifest in this world, since most of the sciences try to describe this world. If one applies scientific realism to accepting modern cell theory, for example, one believes in the reality of the cells that make up the human body, that there is something that is a cell and that this cell exists roughly like the object described in cell theory. More concretely the cells found in modern cell theory actually are like the cells as they are described in theory and really do make up the human body, contrary to what the instrumentalists believe. Scientific instrumentalists determine the value of a scientific theory on practical criteria like the usefulness of such a theory. Regarding the objects in a scientific theory as having an objective reality is a typical realist’s claim and constitutes the metaphysical commitment of the scientific realist.

---

[1] Ladyman, 2002, p. 158

[2] Wang, 1988

Scientific realism also entails a semantic commitment. It entails the commitment to interpreting a scientific theory as literally true. The truth of a theory has to be determined by investigating the facts in the actual world. If the theory corresponds to the facts the theory is true, if not, the theory is false. This interpretation of 'truth' constitutes the correspondence theory of truth.[3] Such an account of truth implies that the words for entities, which appear in a scientific theory, are genuinely referring to something in the world. If this would not be the case, it would be impossible to determine the correspondence between these entities and the actual world. Boyle's aether theory entails the claim that light moves through an intermediary substance called 'aether'.[4] So, accepting Boyle's aether theory implies believing that the term 'aether' actually refers to this intermediary substance. In some sense 'referring' itself is to be seen as some semantic intermediary act by means of which the theory and the actual world are connected or disconnected.

The scientific realist must add one last commitment to the metaphysical and the semantic commitment. He has to accept the claim that humans are capable of determining the truth or falsity of the statements found in scientific theories. According to the scientific realist, we do in fact know some of the true and false statements of science.[5] If we were not be capable of knowing some of the true scientific statements, then how could we carry a genuine believe in the truth of these statements? We would be condemned to be sceptics or at best agnostics about scientific theories.

To conclude, the realist's position can be summarised by the following claims:

(a) A mind-independent world exists. (The metaphysical commitment)

(b) Scientific theories are to be interpreted as literally true. In the previous sentence 'True' has to be interpreted as corresponding to the facts and 'literally' has to be interpreted as literally referring to these facts. (The semantic commitment)

(c) Humans are capable of knowing that at least some of the scientific theories are true. (The epistemological commitment)

---

[3] Ladyman, 2020, p. 157

[4] Burtt, 1924, p. 37

[5] Ladyman, 2002, p. 159

To conclude this chapter, the position, as advocated by the realist, is the view that humans are capable of knowing whether the entities in our best scientific theories genuinely and truly refer to the facts. These facts exist in a world that exists independently of the mind of individuals. Accepting a scientific theory implies a belief in the truth of such a theory. I added the clause ‘’best scientific theories’’ to prevent scientific realism from becoming too much of an Aunt Sally for the critics of the pseudo-sciences. The pseudo-sciences are not regarded as properly scientific for different reasons. Some versions of creationism are compatible with both all the evidence that is currently available and all the evidence that will possibly become available in the future. Such a theory is not regarded as a proper scientific theory because the theory is unfalsifiable.[6] This paper provides a critique of Putnam’s explanation for the success of our better, or more broadly accepted, scientific theories. For example, the theory of general relativity and modern cell theory. By using genuine scientific theories the critique will be focused on Putnam’s explanation of the success of science and not on the quality of the examples of scientific theories which will be used throughout this paper.

1.2 Contemporary Anti-Realism

The anti-realist about science rejects at least one of the realist’s claims. For example, if one rejects claim (a), concerning the world as existing independently of the mind, by claiming that the mental world is all that exists, one becomes an idealist instead of a realist.[7] Alternatively, one can be a pragmatist and reject claim (b). For the pragmatist the truth-value of a statement is not determined by correspondence between the words in a theory and the facts but by practical considerations. According to the pragmatist William James the truth of scientific theories depends on the interpretation of the word ‘true’. Some philosophers interpret ‘true’ as corresponding literally to the facts, while other philosophers interpret ‘true’ as being of instrumental value.
James would look at the practical consequences of each interpretation and if these consequences matched, both interpretations would mean the same. The meaning of the word ‘true’ can be determined by comparing the practical outcomes of each interpretation.[8]

Most of the arguments that were used to defend scientific anti-realism were not convincing enough to persuade philosophers to actually become Anti-Realists. During the last century the debate

[6] Mahner, 2007, p. 518

[7] Ladyman, 2002, p. 144

[8] James, 1907, p. 45-46

seemed to have been decided in favour of the realists. It is likely that this would still be the case, were it not for the efforts of the Dutch-Canadian philosopher Bas van Fraassen.[9] He managed to create a wholly new version of Anti-realism, called 'Constructive Empiricism'. This new version has gained support throughout the years and still poses a significant threat to realism.

The debate between Constructive Empiricism and Scientific Realism revolves around the question, what the aim of science is. Scientific realism considers the aim of science to be providing us with theories that tell a literally true story about what the world is like. Accepting a theory involves a genuine belief in the truth of the theory.[10] Van Fraassen does not believe that interpreting a theory literally, automatically implies a belief in the truth of such a theory. It is possible that an atheist and a protestant have both read the story about Noah's Ark and both interpret the story literally. Both the atheist and the Protestant interpret the story roughly similarly, but the atheist probably does not believe the Ark exists, while the Protestant probably does. Believing in the truth of such a story is not logically followed by interpreting the story literally. This example helps to illustrates the fact that the literal interpretation of a scientific theory does not imply a belief in the truth of such a theory. Van Fraassen describes the aim of science differently. According to him science is aimed at providing us with empirically adequate theories. I will elaborate on the meaning of 'empirically adequate' in the next paragraph. Believing a theory involves a belief in the empirical adequacy of the theory.[11] Van Fraassen evades the problems arising from realist's notion of 'truth', by describing the aim of science as aimed at empirical adequacy. He calls his new theory Constructive Empiricism.

This new conception of science leaves us with a few questions, which need to be answered. The most prominent question is: what does Van Fraassen mean by 'empirical adequacy'? According to Van Fraassen a theory is empirically adequate, if what it says about the observable things and events in this world is true, which means that the subject and predicate in the description are literally referring. Furthermore the theory must save the observable phenomena.[12] Now we are left with the question of observability. 'Observable' is an ambiguous term, so it requires some further explanation. 'Observable' does not imply that the thing, which is supposed to be observable, is

[9] Monton; Mohler, 2017

[10] Van Fraassen, 1980, p. 8

[11] Van Fraassen, 1980, p. 12

[12] Van Fraassen, 1980, p. 12

observable under all conditions. 'Observable' should be interpreted hypothetically. Van Fraassen uses the following criterion to determine whether some object X counts as 'observable':

> ''*X is observable if there are circumstances which are such that, if X is present to us under those circumstances, then we observe it*.''[13]

From this description we can infer that 'observability' is dependent on our physical constitution.[14] For example, if I were to be standing in a laboratory and a scientist showed me a transparent box, containing only one atom, this atom would count as 'unobservable'. The atom is simply too small for me to see. When the scientist shows me the box the atom is present, but I am unable to observe it. The human eye is not devised to detect atomic particles. In contrast, if I saw a trail of fresh footprints on the beach, without seeing the man responsible for making these footprints, then this man would count as 'observable'. The man would then count as 'observable', because I would have observed him if I had been there five minutes earlier. To infer the observability of some object, you must conceive some hypothetical situation, without altering your physical constitution, to decide whether the object counts as 'observable'. According to Van Fraassen, an inquirer is allowed to use tools, like binoculars or a microscope.[15] This possibility has received a fair bit of criticism from other philosophers. I will return briefly to these criticisms in the next paragraph.

---

[13] Van Fraassen, 1980, p. 16

[14] Ladyman, 2002, p. 212

[15] Van Fraassen, 1980, p. 15

2. The no-miracles argument

The debate between the realists and the anti-realists, concerning the aim of science and the belief in scientific theories, was the topic of the previous chapter. The debate remains undecided to this this day, but some serious attempts have been made to kick Constructive Empiricism out the door. Especially the criterion for 'observability' seems an Aunt Sally and some fair points have been made against the tenability of this criterion. However, these criticisms seem to miss the core of Van Fraassen's argument. These criticisms are focused on borderline cases, in which it is not clear whether something counts as 'observable' or 'unobservable'. Van Fraassen's criterion seems somewhat vague and arbitrarily drawn, but there certainly are clear-cut cases in which a scientific theory contains entities which clearly count as 'observable' or clearly as 'unobservable'. The birds, which are used to support the theory of evolution, clearly are 'observable'. The quarks, which are used in quantum theory, clearly are not. The critique focusses on the criterion for observability, which might be considered flawed, but the critique is not focused on the distinction itself. It seems that these criticisms miss Van Fraassen's the central point, namely that there are entities that are observable and that there are entities that are not observable.

There is at least one argument that is aimed at the core of constructive empiricism. This is the no-miracles argument, which constitutes the global defence of scientific realism. The argument was put forward by Hilary Putnam in 1975. He used the argument to support some form of mathematical realism. The attack on anti-realism was at best a secondary purpose of the argument, nonetheless it is regarded as a powerful argument in the defence of scientific realism. The argument is as simple as it is elegant:

> ''*The positive argument for realism is that it is the only philosophy that doesn't make the success of science a miracle*."[16]

Putnam provides us with a scientific explanation for the relation between science and its objects. According to him adopting scientific realism is the only way to explain the success of scientific theories. Putnam's explanation entails that the terms used in scientific theories genuinely refer to something in the actual world.[17] Even when the same term is used in different theories the referents exist. The protons, as described by modern atomic theory, refer to the same particles as the protons

---

[16] Putnam, 1975, p. 73

[17] Putnam, 1975, p. 73

which are described by quantum field theory. The similarity between the referents in different theories can only be successfully explained by scientific realism, otherwise the similarity between the referents would be a major coincidence. Putnam call this coincidence a miracle. The acceptance of a scientific theory implies a belief in the truth of such a theory.

Putnam's argument is intuitively powerful. Is it not wondrous that our scientific theories are capable of predicting new phenomena? Is it not a miracle that the first prototypes of quantum computers, which rest on different theories in the field of quantum mechanics, have already been built? Not according to Putnam, since our scientific theories are approximately true. It is no miracle that it is possible to predict new phenomena and use our scientific theories to invent new technology. Van Fraassen owes an explanation for the success of science to Putnam and scientific realism in general. How Van Fraassen and some other philosophers provide such an explanation is the topic of the next chapter.

3: Why the No-Miracles Argument fails

3.1: A possible alternative: Van Fraassen's evolutionary argument

Remember that Putnam provided us with a scientific explanation for the success of science and that he regarded his explanation as the only one possible. If there is only one viable explanation for a phenomenon you are bound to accept it, at least according to Putnam. Van Fraassen is not convinced by Putnam's explanation and offers an alternative scientific explanation for the success of science. To construct his argument, Van Fraassen uses the theory of evolution to serve as an analogy.

Van Fraassen agrees with Putnam that the success of science is in need of a scientific explanation. His explanation focusses on the apparent regularity between scientific predictions and the accuracy of these predictions. Scientific realism explains this regularity by considering scientific theories as a sort of mirror of the actual world. What happens in the actual world, is mirrored by our scientific theories and is accurately represented in these theories. Van Fraassen uses this explanation to serve as a contrast to his own explanation. He regards science as a biological phenomenon, which helps us in adapting to our environment.[18] The critical reader can detect a hint at instrumentalism here. He continues his explanation by sketching an analogy between the theory of evolution and the behaviour of scientific theories. According to Van Fraassen scientific theories behave in the same way as natural species which have been subjected to evolutionary changes. The bird that was not well adapted to its environment, gradually went extinct in favour of the bird that was adapted to its environment. The same goes for scientific theories; only the well adapted survive. Van Fraassen explains it as follows:

> *''In just the same way, I claim that the success of current scientific theories is no miracle. It is not even surprising to the scientific (Darwinist) mind. For any scientific theory is born into a life of fierce competition, a jungle red in tooth and claw. Only the successful theories survive—the ones which in fact latched on to the actual regularities in nature."*[19]

[18] Van Fraassen, 1980 p. 39

[19] Van Fraassen, 1980, p. 40

Success is not dependent on the truth of scientific theories, but on its adaptation to actual regularities in the natural world. The debate between Van Fraassen and the realists is essentially a debate on different explanations for these regularities. Putnam appeals to truth for his explanation, while Van Fraassen appeals to the theoretical adaptation to these regularities and to the evolutionary process scientific theories went through. The theories that were not latched onto the regularities went extinct while the theories that were latched onto them thrived. Truth is not to be seen as the underlying reason for the regularity. Theories that are not well adapted, will lose against their adapted competitors. Only the adapted, or successful, theories remain. Van Fraassen's explanation does not require the notion of truth, nevertheless it certainly is a possible explanation. Remember that Putnam regarded scientific realism as providing us with the only explanation for the regularities. By providing a viable alternative, Van Fraassen degrades Putnam's explanation from the *only* explanation to a *possible* explanation.

Much is to be said in favour of Van Fraassen's position. It seems at least plausible that scientific theories adapt to regularities due to competition. By not appealing to truth but rather to adaptation to regularities, Van Fraassen evades the problem concerning truth as meaning corresponding to the facts. The mechanical laws which govern the universe probably did not change radically during the last 3000 years, but our understanding of these laws did. Newton's and Einstein's interpretations of the universe are mutually exclusive, nevertheless they were both regarded as true. I will provide a more elaborate explanation of the theories later on. Newton's theory was regarded as true for some time, until the theory was replaced by another one. This seems to imply that truth is relative to a point in time, but this cannot be reconciled with the meaning of 'truth' as corresponding to the facts. Both theories refer to facts that did not change during the transition between the theories. Van Fraassen is able to offer us an explanation for this transition. Observability is dependent on technological advances, so the criterion for observability is elastic and eligible to change over time. For example, the Hubble Space Telescope helped broadening the scope of objects which are considered as observable. What was not observable then, can be observable now. The regularities in scientific theories adapt to change over time. This explains, at least partly, why theories that were once successful and were once regarded as being true, are not regarded as being true anymore.

It is beyond question that the contemporary scientific practice is characterised by competition between scientists, universities and countries. Scientific theories face a hard time being accepted by the scientific practice, due to this competition. If I were to apply for a job and if I were to be invited for the subsequent job-interview, the chances of me getting the job would be higher if there were less competitors. Furthermore the chances of me getting the job will rise, if I fit the company's and the function's requirements. If I do not fit these requirements, the likelihood of me getting the job will be low, but it is still not impossible that I would still be hired after all. Likewise, consider a scientific theory which does not match our observations, so that it does not save the phenomena. It would be difficult, but not impossible, to make such a theory gain support within the scientific community and be subsequently accepted by that scientific community. Theories that do not save the phenomena face difficulties in winning against their competitors that do in fact save the phenomena. When a theory does not match our observation, for example, the theory owes an adequate explanation for this inconsistency. It is no miracle that our best contemporary scientific theories save the phenomena, the odds of these theories surviving are simply much better than the odds of the theories that do not save the phenomena.

Our best scientific theories are also adapted to their environment in another way. These theories seem to be able to adapt to the possibilities of our measuring devices, to the insights in other scientific disciplines and to our scientific perspective. Consider the shift from Newtonian mechanics to Einstein's theory of general relativity again. Einstein interpreted the constitution of space and time as being relative, instead of absolute, hence relativity. Furthermore, he described the nature of gravity form a revolutionary new perspective.[20] Einstein changed our scientific understanding of the universe radically. In a way he was influenced by the insights of James Clerk Maxwell in the field of electromagnetism. Maxwell researched the speed of particles, in particular the speed of light. Einstein stated the following about Maxwell in his first paper on general relativity:

> *''It is known that Maxwell's electrodynamics—as usually understood at the present time—when applied to moving bodies, leads to asymmetries which do not appear to be inherent in the phenomena."*[21]

Einstein would later on build his theory of general relativity upon Maxwell's findings. So, in some way general relativity is adapted to Maxwell's findings. In turn, Maxwell's theory is adapted to the earlier insights of other scientists like Gauss and Faraday.[22] Maxwell converged their insights into a unifying theory of electromagnetic fields.

---

[20] Fleury, 2019, p. 85

[21] Einstein, 1905, p. 1

[22]Fleisch, 2008, p. 29 and p.58

Einstein also adapted his theory of general relativity to a shifting perspective. In the late seventeenth and the early eighteenth century, the scientific perspective was focused on our own planet and the workings of our own solar system. It is not a miracle that Newtonian mechanics succeeded very well at predicting the motion of objects on earth and within our solar system, but failed when applied to regions outside our solar system. The more universal[23] perspective in the late nineteenth century required that fundamental theories about space, time and gravity could be applied to a wider range of phenomena. These phenomena included the motion of objects within and between distant galaxies. Newtonian mechanics failed in adequately predicting these phenomena. Due to this failure, Einstein adapted astrophysics to the new scientific perspective. I am aware that I am not giving an adequate account of the notion of 'scientific adaptability', but that is not necessary to explain the main point. The main point is that it is hard to properly understand the theory of general relativity and Maxwell's theory of electromagnetism, without understanding of the theories upon which they were built. In a way they are adapted to them, because without them general relativity and Maxwell's theory of electromagnetism would have looked different or would not have existed at all. So, the central point is that most scientific theories are not created *ex nihilo,* but rather are influenced by and are rather adapted to their predecessors.

It therefor seems that the success of theories like modern cell theory, general relativity and Maxwell's theory of electromagnetism can, at least partly, be explained by appealing to the adaptability of these theories. They are adapted to relevant factors like their ability to save the phenomena and the demands of the scientific community. It is not 'truth' as meaning corresponding to the facts that seems responsible for the success of scientific theories, but rather the ability of these theories to fit the shoe of the scientific practice at some point in time, which can explain the success of scientific theories.

In this chapter I have offered an alternative explanation for the success of science. Putnam's explanation for this success is no longer the only explanation, but rather one of more explanations. In the next chapter I will explain why Putnam's explanation is flawed, by showing that his interpretation of 'truth' is not an adequate explanation for the success of science.

---

[23] Universal in this sense does not mean some form of necessity, but rather the space and time around our planet in a broad sense.

3.2 Truth and success, a dubious relation

Putnam sees truth as the underlying reason for the success of science. Success has to be interpreted as the ability to make significantly more correct predictions by using scientific theories than without using these theories.[24] The technological applicability of scientific theories also amounts to the success of science. For example, most of the drugs which are prescribed by doctors, actually have the predicted effect. This effect can be predicted by using the theories of the biomedical sciences. Returning to Putnam, he does not think that the truth of a theory necessarily implies that it is successful, but rather thinks that the success of a scientific theory can be explained by appealing to the truth of that theory. We can infer this from the phrase 'only explanation' which can be found in the no-miracles argument. He sees the truth of scientific theories as the only explanation for the success of these theories. He uses a method of abduction, in this case inference to the best explanation. In Putnam's mind, he even infers the only explanation. The only way the success of science can be explained, is if the scientific theories are in fact true. From (a) the metaphysical commitment and (b) the semantic commitment of the first chapter, we can infer that 'truth' entails that the words for the entities in scientific theories genuinely refer to the objects they pick-out in the real world.

Two objections can be made against Putnam's view that truth is the only explanation for the success of scientific theories. The first objection has been made in the previous chapter, by offering an alternative explanation. By offering this alternative explanation, Putnam's explanation is relegated from being the *only* explanation to being a *possible* explanation. We can now inquire into the strength of Putnam's explanation. Is it really likely that truth is solely responsible for the success of scientific theories?

As aforementioned, the genuine reference of the words for entities within a theory, are a necessary condition for the truth of a theory, according to the realist. If there were no actual cell's in the human body or wherever, then the realist would not regard cell theory as true, since its central terms would not refer to anything in the actual world. In contrast, non-referring words for entities are less of a problem for the instrumentalist who can consider cell theory to be true to attain certain (medical) ends. The instrumentalist is not interested in the actual existence of the entities within scientific theories.[25] The instrumentalist does not apply a metaphysical notion of truth; he rather he

---

[24] Kukla, 1996, p. 298

[25] Lockard, 2013, p. 1701

uses truth to reach certain goals, without involving metaphysics. ''If it works, it's is true'', would roughly summarise the instrumentalist's position.

To return to the main topic of this chapter, I believe it's highly doubtful that the words for entities in successful scientific theories always genuinely refer. Remember that Putnam tried to provide us with a scientific explanation for a phenomenon, in this case the success of science. We can quite easily criticise his explanation by providing a number of counterexamples of scientific theories that are or were successful, but nevertheless not true. That is to say, the central terms or the words for entities in these successful theories do not genuinely refer. If we can find a few of these examples, it would become hard to maintain that the success of science can adequately be explained by appealing to the notion of truth. To this list of examples, we can add theories that were once successful and were once regarded as true, but saw their axioms or equations updated, changed or replaced. The old axioms or equations were replaced for a reason and the axioms or equations are not regarded as true anymore, so the realist, in contrary to the pragmatist, cannot invoke truth to explain their previous success.

In the first chapter aether theory was briefly discussed to illustrate scientific realism. The term 'aether' finds its origins in the philosophy of Aristotle. He thought of aether as the heavenly substance which composed the celestial bodies.[26] Partially due to the work of Rene Descartes and Christiaan Huygens, the term 'aether' found its revival in the age of enlightenment and was seen as the substance through which light moved. The theory was held in high regard until Albert Michelson and Edward Morley refuted the existence of such a substance in 1887.[27] They proved that the aether did not exist or, at least, that it was not the substance trough which light moved. The term 'aether' did not genuinely refer to the theoretical substance. Nonetheless, aether theory was highly successful in explaining how light moved through space and enabled scientists to make accurate predictions about the trajectory of light.

The same goes for the caloric theory of heat, which contained the hypothesis that heat consisted of a fluid called 'caloric', which was capable of penetrating all space and was able to flow in and out of all substances.[28] The theory was quite successful in predicting and explaining natural phenomena like the expansion of bodies when matter is heated. Caloric theory explained this expansion as

---

[26] Hahm, 1982, p. 1

[27] Michelson; Morley, 1887

[28] Brown, 1950, p. 367

additional matter flowing into heated matter, so the expansion was explained. This theory was also was refuted and the term 'caloric' has been considered to be non-referring ever since. Larry Laudan offers us a long and not at all exhaustive list of scientific theories that were once successful, but whose terms and words for entities are now regarded as non-referring in his paper '*A Confutation of Convergent Realism*'.[29]

Now let's look at the shift from Newtonian mechanics to the theory of general relativity one last time. At the beginning of the twentieth century Newtonian mechanics was regarded as being true, that is to say, the theory provided a unified description of gravity and the movement of objects and this description mirrored the actual world. The equations used in Newtonian mechanics provide us with a model of a mechanism for the relation between objects, which is accurate and tells us true things about the behaviour of the objects involved in the theory. For example, an object with a certain mass is attracted to another object with a certain mass. Both the masses of these objects are responsible for the attraction of the one object to the other or the other way around, this is called 'gravity'. Newtonian mechanics was highly successful at explaining the behaviour of objects on our planet and the behaviour of objects within our own solar system, but began to show anomalies, which it could not account for, when the theory was applied to the universe outside our own solar system. To successfully predict the phenomena in a broader astrophysical perspective, a new theory with new equations was required and it was Einstein who devised this new theory. A part of his theory is the reinterpretation of gravity not as a force, but as the name we give to the effect of the curvature of space and time on the motion of objects.[30] Newton, therefore, was wrong in describing gravity as a fundamental force, rather than as an effect. Nevertheless, Newtonian mechanics was and still is regarded as highly successful. Newton's theory was capable of explaining a large number of phenomena. Until the theory of general relativity replaced Newtonian mechanics, it was expected that Newtonian mechanics could truly explain the phenomena. It is beyond doubt that Newton's theory was a successful scientific theory, but the theory failed at truly explaining the phenomena. To this day Newtonian Mechanics is being taught in schools and at universities; even scientists use Newtons equations to predict phenomena. Scientist still use the equations, because they are simple and easy to use. These scientists undoubtedly know that these equations have been replaced by ones found in the theory of general relativity. Again, we see an incredibly successful theory, which is not regarded as true. How can Putnam hold truth responsible for the success of science when one of its most successful theories is now regarded as not being true? The so called 'facts' the words in

---

[29] Laudan, 1981, p. 33

[30] Ladyman, 2002, p.173

Newton's theory of gravity referred to, were disproved by Einstein. By interpreting gravity as an effect and not as a force, Einstein contradicted Newton's theory.

In this chapter I have argued that the supposed connection between truth and success is a dubious one. Putnam holds truth responsible for the success of science. By providing a number of examples of theories, which are or were successful but not true, I have showed that the supposed connection between truth and success is a doubtful one.

Conclusion

The purpose of this paper was to show that the no-miracles argument has failed as an ultimate argument against scientific anti-realism. To attain this goal I started with sketching the contemporary debate between realism and anti-realism, in which the no-miracles argument is used to defend scientific realism. The sketch of the argument allowed us to consider the argument in the relevant context and identify the assumptions made by the scientific realist.

The no-miracles argument explains the success of science by appealing to the notion of 'truth' as the only explanation for this success. I have argued that Putnam's explanation is not the *only* explanation, by using Van Fraassen's evolutionary analogy. This alternative explanation explains the success of science, not by appealing to 'truth', but rather by arguing that scientific theories have an evolutionary nature. Like the natural species, scientific theories adapt to their environment. The theories that were not latched on to regularities went extinct in favour of the ones that did latch on to regularities. This provides a different explanation than the one that Putnam provided us with, in turn relegating his explanation from the *only* explanation to another *possible* explanation.

In the last paragraph the strength of Putnam's explanation was reviewed. The connection between truth and success was considered and was found to be dubious. Some incredibly successful theories are now regarded as not true, since it was found that the words for the entities in these theories were unsuccessful at referring to entities in the actual world. Furthermore, the use of Newtonian mechanics showed us that theories, which are not regarded as true can still be used to successfully predict and explain phenomena.

To conclude this paper, 'truth' cannot properly account for the success of science. I cast no doubt on the success of science itself and I agree with Putnam that this success is in need of an explanation, but I do not think that an appeal to 'truth' helps us in explaining this success. I have sketched Van Fraassen's evolutionary analogy as an explanation for the success of science and I regard this explanation as a viable starting point to inquire further into the success of science. It is up to the sociologists to inquire into the evolutionary behaviour of scientific theories and up to philosophers and physicists to inquire into what the implications of a new view on the scientific practice, as an evolutionary process, are.

Bibliography

Books

Burtt, Edwin Arthur, 1924, '*The Metaphysical Foundations of Modern Science',* 2nd. rev. ed. 1954, (Doubleday Anchor Books: New York)

Fleisch, Daniel, 2008, '*A Student's Guide to Maxwell's Equations', (*Cambridge: Cambridge University Press)

Fleury, Pierre, 2019, '*Gravitation : From Newton to Einstein',* (Geneve: Springer)

James, William, 1907, *Pragmatism: 'A New Name for Some Old Ways of Thinking',* (Cambridge: Cambridge University Press)

Ladyman, James, 2002. '*Understanding philosophy of science*'. (London: Routledge)

Mahner, Martin, 2007. '*Demarcating Science from Non-Science*', In: *Handbook of the Philosophy of Science vol 1: General Philosophy of Science – Focal Issues*, ed. T. Kuipers, p. 515 - 575, (Amsterdam: Elsevier)

Putnam, Hilary, 1975, '*Mathematics, Matter and Method'*, (Cambridge: Cambridge University Press)

Van Fraassen, Bas Cornelis, 1980. '*The scientific image*'. (Oxford: Oxford University Press)

Wang, Hao, 1987, '*Reflections on Kurt Gödel',* (Cambridge, Mass: Bradford Books)

Articles

Brown, Sanborn, 1950, '*The caloric theory of heat',* In: *American Journal of Physics,* Vol. 18, p. 367-373

Einstein, Albert, 1905, *'On the Electrodynamics of Moving Bodies'*, in: *Annallen der physik,* vol. 17

Monton, Bradley and Mohler, Chad, 2017, *"Constructive Empiricism*", The Stanford Encyclopedia of Philosophy

Hahm, David, 1982, '*The fifth element in Aristotle's De Philosophia: A Critical Re-Examination',*
In: *The Journal of Hellenic Studies*. vol. 102, p. 60 - 74

Kukla, Andre, 1996, '*Antirealist Explanations of the Success of Science*', In: P*hilosophy of Science* vol. 63 p. 298 - 305

Laudan, Larry, 1981, *'A confutation of convergent realism'*, In: *Philosophy of Science,* Vol: 48. p. 19 - 48

Lockard, Matthew, 2013, "*Epistemic Instrumentalism*." In: *Synthese*, vol. 190, p. 1701–1718

Michelson, Albert; Morley, Edward, 1887, '*On the Relative Motion of the Earth and the Luminiferous Ether',* In: *American Journal of Science*, vol. 34, p. 333 - 345