Rediscovering Science in Religion and Society: A New Way to Talk About Science

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Abstract:

Recent attention in the media and among students has renewed the relevance of the question what should be considered scientific, and what place science has in contemporary society. To get an overview of the theoretical framework, selections from philosophers of science Karl Popper, Thomas Kuhn, and Bruno Latour are reviewed to see what they consider essential to science. The expectation was to find three conflicting definitions, but instead it is concluded that these philosophers do not necessarily disagree with one another. They describe different aspects of the same concept, but focus on either science as method, as a philosophy and set of scientific values, or as descriptive politics. None of them are truly wrong, because all of what they describe is crucial to knowledge production as a whole.

The third of the abovementioned views, that of science as description, can be considered the most controversial. This thesis elaborates on it in the form of Robin Horton, who writes about religious theory and makes a comparison to science. He argues that both science and religion are about explanation, prediction, and control, and about creating deeper meaning by imposing patterns on unobservable phenomena. In addition, both represent a reflection of society while providing the cognitive tools to engage in that society, and operate on a 'Theory Of'/'Theory For' dynamic, which is responsive to pre-existing beliefs and needs. This critical reflection is meant to show how constitutive all of the sciences are to human civilization, democracy, and society. Despite impersonal ideals of the laboratory and the ivory tower, science is very strongly linked to the experience of reality and society: to who we think we are, to what the world is, and where we think we should be going. The main argument is therefore that all three elements of science, and the different modes and topics of research, should be investigated equally and understood within this distributed context.

No single discipline is outside the politics of knowledge described in Horton and Latour: to deny certain disciplines their validity is equal to denying the corresponding parts in society. Inquiry into the nature of disciplines usually follow method, result or history. This standard needs to be revised by asking the right questions: a shift from only what a science is *for*, to also what it is *about*. This is important because, following Latour and Horton's line of reasoning, a discipline itself is largely the product of what it studies. Secondly, it is suggested that one way to showcase and promote this vision of science - and to reinvigorate the human sciences in the process - is to teach accessible concept-based courses, which seek application in people's lives and careers.

Contents

Introduction

In early 2015, an angry mob of students kicked in the door of the administrative building of the University of Amsterdam.[1] In their opinion they were taking back what was rightfully theirs: an institution hijacked by commercial interest and instrumental thinking should be there for the students and for knowledge. In the same month, the faculty of humanities in Utrecht organized an emergency meeting: the ministry of education has published a research vision for 2025, and the faculty realized they did not see clearly how they fit in. Unlike most disciplines, the humanities do not have an organized lobby, or the same kind of participation in policy creation as other sciences do. Often they have taken their position and societal relevance for granted. After their budget was cut, there was a sudden leap to action. In a separate instance, an action committee called 'Science in Action' with university staff from across the disciplines, 'Science in Action', campaigned to alert the press, the public, and the politicians of a changed academic landscape.[2] They pointed out that pressure to publish, quantified ranking systems, and perverse financial incentives are hurting research and education in all disciplines. In late 2013, The Economist published a special issue on the problems in the academic world, which laments the lack of incentives for replication, the publish-or-perish culture, and the low quality of a supposed cornerstone of scientific articles: unpaid peer reviews.[3]

These events show that now, more than ever, what science is, and what it should be, is on the public agenda. This thesis will explore these grand questions and suggest an alternative approach, which can be used to reframe debates on science in our society and economy. There are many facets to debating science, but this one will not argue in favor of any specific kind of study. The arguments and concepts developed here are meant to be used before the start of discussions on the value of particular studies. Personally, I am very open to reorganization and a possibly painful reform in academia, a most pressing matter in all sciences. This thesis however, will concern itself mostly with the questions: How do we describe what science is about? What role does science play in our lives and society? What does it do? Only when there is a common and accurate understanding of what scholars and researchers do can there be a proper debate about the money and support they deserve.

This quest for understanding science originally started in the office of coordinator of the History and Philosophy of Science master. It was a complaint that, after two years of study, science was even more confusing and elusive to me than at the start. With a hearty laugh, David Baneke exclaimed that it meant the program was a great success. Though accurate, it was unhelpful, and I was still looking for a generalized way of understanding science and what it is ultimately about. Using a historical and philosophical frame of reference, I will argue that the sciences are about providing cognitive tools and categories to engage with everyday life, with ourselves, and with others. At the same time, science creates the world around us when it defines the categories and concepts used in cognition and action. Science is about creating theories, which are used to engage the natural, social, and personal world around us. This is opposed to ideas which see science as solely concerned with the truth, science as a superior method, or science as a tool for profit, progress or power. This approach to science is more fruitful and comprehensive than referring to the method and results of natural sciences as a prototype, and more realistic than presenting science as the transcendental gospel of ultimate truth. The term

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[1] Hamer, Marc. "Amsterdamse Studenten Vallen Maagdenhuis Binnen." NOS 2015. Web. 19-5 2015.
[2] Science in Transition. "Position Paper." Science in Transition 2013. Web. 19-5 2015.
[3] One of the articles in the issue: "Trouble at the Lab: Unreliable Research." The Economist. October (2013). Print.

science is here used in its etymological sense: as knowledge that is acquired through rigorous study.[4] It is important to make clear that using the word science in this text will entail all established forms of knowledge production in an academic or other institutionalized research setting.[5] Natural science refers mostly to physics and associated sciences. Human science, in this text, refers to all of humanities and much of social science, including anthropology, sociology, communication, political science, law, economics, and some psychology.

The four main players who will feature in this argument are Karl Popper, Thomas Kuhn, Bruno Latour, and Robin Horton. The first three are Philosophers of Science with their own ideas about what science is and what is important in understanding it. The fourth, Horton, will be used to argue that religious theory has meaningful parallels with science. Every step from Popper to Horton takes the understanding of science farther away from the most commonly accepted ideals and clichés, which reign in most of the public and even scientific imagination, and exposes an increasingly wider definition of what science entails.

Popper argues that, while it is never possible to be completely sure if something is true, it is instead quite possible to know something is false. For him, science is creating falsifiable theories. While the development of a theory necessarily happens before a scientist has enough evidence, true science is about the process of critical evaluation and testing of those theories.

Kuhn argues that Popper overemphasizes falsification and focuses too much on the moments where truth is self-evident and all the difficult parts of science already in the past. Kuhn relocates science to earlier in the process, where truth is still uncertain and tough theory choices are made. Through philosophical interpretations of scientific criteria, scientists engage in a kind of puzzle solving, doing their best to make their assumptions and theories work. To Kuhn, proving theories wrong is only a small part of the sum of activities in scientific practice.

Latour takes an observational approach to defining what scientists do and what happens when science is made and succeeds. As an anthropologist, sociologist, and philosopher of science, he concludes that scientific practice is full of politics. He shows, quoting Pasteur, that the institution of science is more important that the people in it. He argues that we wrongfully think truth exists independently, waiting to be discovered. Facts and truth are created in a socially constructed environment and require translation and persuasion to be integrated into our lives and world views. What we think of as nature, or as fact, is created by us instead of revealed like some holy scripture. Latour stresses the hidden descriptive politics of science and the constitutive power it has over our experience.

Using the typology of science provided by Cunningham and Williams, the three philosophers are made distinct in relation to one another. Science as (1) superior method and producer of knowledge (Popper), as (2) representative of a certain set of values (arguably Kuhn), or (3) as a representative of human curiosity and achievement, and an expression of what modern civilization embodies (Latour). The three philosophers emphasize different parts of science: from method, to philosophy and puzzle solving, to politics of description and social construction. Their ideas on science are often opposed to each other, and other philosophers of science are categorized in one of the three by way of judging to

[4] Science and The Sciences will be used interchangeably. For the most part it will include all knowledge traditions in universities from the natural sciences, to the social sciences, and the human sciences. It may seem like examples and topics focus on natural sciences, but this is because this is the lowest common denominator.

[5] This makes a lot more in sense in my Dutch mothertongue, where the word science still literally means ‘the art of knowing’, or, ‘that which knowing entails’ (wetenschap).

which 'camp' they belong. In reality, they all describe equally important elements of what science is about, they merely stand at a different point in the spectrum which represents the whole scientific venture. There is no method without philosophy, no progress or crucial dissent without room for interpretation in scientific practice, and no description without concentrated authority and the politics of language. They are fighting about what the essence of a boat is, even though they all agree it should float.

Horton is used to support the argument that all three should be taken together, and to emphasize the valuable addition of Latour and his brand of anthropology and sociology of science. Horton's work on religious theory is strongly rationalist. He describes religion as a system arising from a need for explanation, prediction, and control. This system is a cognitive tool, which both reflects society and is used to engage society for change or conservation. Social configurations and phenomena are paralleled and complemented by religious tradition and myth. This happens on an individual, a group, and a community level. It consists of a 'Theory Of' and a 'Theory For', which on the one hand describe the world, and on the other prescribe the type of actions and categories possible and necessary to interact with it.

The same patterns can be observed in science. Science and religion both hypothesize underlying forces and patterns, which relate to our own experience, daily life, and actions. Since science is an outgrowth of religion, they share the fundamental explanation/prediction/control structure. There is a continuous effort to make science appear as distinct from religion as possible, because this perception is needed to guarantee its functioning as an independent authoritative force of knowledge. And yet, understanding this link between scientific and religious theory is useful, suggesting the need to look for social processes that run parallel to their respective theories.

Further Research: where it leads

Accepting the comparison with religion in chapter four reframes all sciences as 'Theory Of' different parts of society. With it, I hope to influence public and academic debates, which I think do not properly echo this understanding of science. Whether these parts of society, or the theories related to them, are relevant, is open to discussion. The frame does not judge the importance of certain sciences, but is able to put them in a new light, after which it is still possible to dismiss them – just on different grounds.

Every academic discipline, mode of study, and theory comes from somewhere, and finds application in providing points of engagement with the world around and inside the individual. In this picture of science, methodology and even results are secondary, no matter how crucial they are to the final product. Science is not for new smartphones, justifying policies, or the ultimate truth. It is not for obtaining results: it is concerned with the place knowledge takes in society. Not what science is *for*, but what it is *about*. Every type of science is about us as human beings, about some part of our civilization and society, and doubting science means to indirectly doubt the existence or relevance of a part of society. Therefore, before starting to speak what science is *for*, establishing *what* it is about should have priority. Often, when knowing what a certain discipline or study is *about*, we already know what it is *for*, as the subject is the result itself: a knowledge object exists the way it does because of how it is studied, so the study itself is already the product.

These points can be taken in multiple directions, such as philosophy of science, philosophy of education, disciplinary history, or discussions on academic reform. An important starting point is asking the right type of questions. I also propose the idea of concept-based courses, which put into practice the philosophy and analysis of this thesis.

Popper, Kuhn, and Latour

The first three chapters discuss the three philosophers of science. At the end of each section is a quick summary and some comments. The end of the chapter summarizes them in comparison to each other. The three philosophers were chosen mainly on the basis of their popularity in historical and current discourse. Many debates and disagreements in the 20th century were either started or heavily influenced by these three. The choice is based on the desire to show the interaction of some of the important arguments, and is not meant as an extensive review. Even when a philosopher may have addressed possible critiques elsewhere, the discussion is restricted to the chosen texts, a representative sample in engaging greater issues.

The intellectual starting point is the belief that science is describing real events, and has explanatory power that can make definitive predictions for the future. It is the belief that science can uncover absolute truth and law, truths which have lain dormant in eternity. Rising in popularity since the 17th century, this view is contested throughout philosophical history, and Popper too responds to the problems with this vision of science as empiricism and inductivism, and how to make it make sense anyway.

Popper's Science

> *"The cause and root of nearly all evils in the sciences is this – that while we falsely admire and extol the powers of the human mind we neglect to seek its true helps."*[6] Francis Bacon, Statesman, Philosopher of Science, and advocate for the development of a Scientific Method, 1620.

In a Cambridge lecture in 1957, Karl Popper related the result of his personal experiences and theoretical development up to the current point: his philosophy of science.[7] He addresses two issues: the problem of inductivism, and the exactitude of scientific demarcation. With demarcation he means to ask when a theory is scientific. The traditional answers are empiricism and inductivism.[8] In other words, if a theory is based on observations (empiricism) which predict relations between past and future events (inductivism), it is scientific. This definition also deems astrology scientific, but Popper is convinced that with a proper demarcation of science it will be exlcuded, and sets out to explain it.

On Science as Empiricism: The Problem of Verificationism

The problem with astrology, but also with Marxism and Psychoanalysis, is that it has too much explanatory power, and suffers from 'verificationism'. For instance, when Popper gave a description of a child to psychologist Alfred Adler, Adler was convinced he could diagnose and analyze the child from just that description.[9] Adler justified his analysis with previous analytical experience: he could be confident in his analysis because he had done it many times before, and because the case could be understood through his theories. This is a case of verificationism, which occurs when a phenomenon can be interpreted in such a way as to fit the theory, and is simultaneously seen as new information that lends support to the theory.[10] However, making an observation fit the theory, through interpretation, does not mean it must be true. This is because a statement, "in order to be ranked as scientific, must be capable of conflicting with possible or conceivable, observations".[11] The only thing proved by Adler in the abovementioned scenario is that the theory fits the observation.

Another example of this can be found in the Communist Manifesto: "The history of all hitherto existing society is the history of class struggles"[12]. Indeed it is possible to interpret all of human history as interactions between groups of a specific socio-economic status. This may give new perspectives on social change and the nature of society, but it does not prove that this is what society and history is about. It is another example of how a fit of theory proves a description is possible, partly by appealing to experience, but is still not much more than a description. So too both Freud and Adler can give different psychological explanations of a child's behavior, which seem to fit equally well, but do not prove

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[6] Bacon, Francis. "New Organon." Science in Europe, 1500-1800: A Primary Sources Reader. 1620. Ed. Oster, Malcolm. New York: Palgrave Macmillan, 2002. 145. Print.
[7] Popper, Karl R. "Philosophy of Science: A Personal Report." British Philosophy in Mid-Century. Ed. Mace, C. A. London: Allen and Unwin, 1957. 155-89. Print.
[8] Popper, 155-6
[9] Popper, 157-8
[10] Popper, 158
[11] Popper, 163
[12] Marx, Karl, and Friedrich Engels. "The Communist Manifesto." Karl Marx, 1848. Pamphlet.

anything. In addition, followers of these kind of theories often think the ensuing universal applicability is a strength instead of a weakness.[13] Popper, in contrast, deems this verificationism a weakness.

Testability through Falsification

An example of a theory that does not suffer from verificationism is Einstein's prediction about light's sensitivity to gravity.[14] This is a large claim, which could easily have been proven wrong simply by observing that what Einstein had predicted did not come true. Were this to be observed, Einstein's theory would be falsified and would require serious revisions, maybe even complete dismissal. Lucky for him, what he predicted was observed in 1919 when two expeditions made photographs of an eclipsed sun, showing the bent starlight around it. According to Popper, the power of a theory should therefore be equal to the relative ease with which it can be proven wrong.[15]

Astrological predictions, however, are so vague that they become untestable – and thus unfalsifiable. In fact, they can always be retroactively reinterpreted to escape falsification. Imagine, for example, that a prediction has been made that the day would bring lasting fortune. Then, when an accident happens, it can be interpreted that the accident is part of a chain of events that will bring fortune at a later stage, or the fact that a life was not lost is the fortune itself. Marxist predictions suffer from this weakness as well: Marx predicted the future impoverishment of the working classes, a socialist revolution in the most industrialized societies, revolution-free socialist societies, and no conflict between socialist countries. [16] Instead, history showed a rise in living standards, a socialist revolution in industrially undeveloped Russia, repeated civil unrest under communism, and war between socialist China and Russia. When Marxism was still making new predictions, it was science. Yet, over time, when the predictions proved wrong, Marxists reinterpreted theory and evidence, destroying the predictions' claim to scientific status.[17] Influential psychologists Freud and Adler, on the other hand, are non-testable by default, because no human behavior can contradict such a widely interpretable theory. Between these theories, it is falsifiable testability that makes the difference.

Oedipus Effect: Narratives versus Science

Popper stresses that what these psychologists and even Marxists say and think is not unimportant, but their untestability means that their theories suffer the same "daily confirmations which astrologers find in their practice."[18] They provide narratives to describe events, but cannot prove they describe the mechanisms underlying them. Instead, the events become the theory, confirmed by the theory itself. Popper introduced the term *Oedipus Effect* to describe the influence of a theory, or expectation, or prediction, upon the event which it predicts or describes."[19] Arguably, the Oracle in the classical Greek tragedy actually causes the chain of events in her description of them, more so than she predicted their occurrence.[20] The Oracle describes a prophetic story which itself sets in motion what is required to make

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[13] Popper, 158
[14] Popper, 159-60
[15] Popper, 160
[16] Taken from: Lakatos, Imre, John Worrall, and Gregory Currie. The Methodology of Scientific Research Programmes. Cambridge, England: Cambridge University Press, 1980. 5-6. Print.
[17] Popper, 161
[18] Popper, 161
[19] Popper, 161
[20] The parents of Oedipus send him away as a young child after hearing the Oracle's prediction that he will kill his father. Without the child present, the prediction should not be able to come true. Because of this, Oedipus later

her story come true: she provides a narrative which influences the events, but cannot be said to identify the underlying mechanisms that cause the events. The Oracle example is artificial, because it is taken from a play, but the point it makes is clear.

Similarly, Marxism has a narrative that provides a description of future events, but cannot be said to have actually predicted anything accurately. Yet, it is important to acknowledge that predictions are important because they do have power, sometimes even to make the events they describe happen. But as long as they are not testable, the predictions remain no more than a narrative. Non-scientific theories provide narratives in a manner of descriptive myth, which are unfalsifiable. Therefore, what sets Einstein's theory apart from verificationism and the aforementioned narratives is its testable falsifiability, making it a scientific theory.

Induction: on Science as Inductive Reasoning

Falsification is not supposed to be about meaningful versus meaningless, or important versus unimportant, but about demarcation.[21] Popper wants to clarify what science is, and his rejection of the traditional definition of empiricism and inductivism also leads him to criticize ideas about induction. While the problems of verification and falsifiability address empiricism, the next couple of paragraphs address the problem of induction.

The problem of induction refers to inductive reasoning - reasoning in which a number of instances or observations are used to make a larger generalization. It means that we derive an underlying pattern or even law from observations, which we believe certain situations will reproduce. Pavlovian conditioning shows inductive reasoning in dogs: when a bell rings and the dog is given food, the dog will reason that every time the bell sounds he will get food, and therefore will start to salivate before the food arrives. It shows that the dog has observed a pattern, and developed a theory as to predict future events. This conditioning can be achieved fairly quickly with both humans and animals in simple and complicated contexts, and is theorized to be essential to learning in general. Another more popular example: If we observe the sun coming up every day, we use inductive reasoning to predict that it will come up again tomorrow. Though the likelihood can be very strong, we can never be sure that the sun will rise tomorrow until it actually happens. And maybe even then, who says it is the same sun, and whether it is rising in the same way? Maybe the bell is just ringing because someone bumped into it! The way we justify the certainty that previous experience can predict the future is not water-tight, or even fully consistent.[22]

A traditional definition explains induction as a “habit of believing in laws that arise from frequent repetition."[23] The frequency of a repetition is argued to result in belief in a pattern, and the problem of induction is that this belief can never be fully logically justified. Popper has several things to say about belief in relation to habit and repetition, and where it comes from, which cast induction and science in a new light.

Beliefs before Observations

The habit of believing in laws, Popper says, makes us act on repetition we believe is there. This belief

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does not recognize his mother which allows an incestuous relationship. He also does not recognize the man he eventually kills as his father, which might otherwise have prevented Oedipus from murdering him.

[21] Popper, 163, 165

[22] Popper, 167

[23] Popper, 167. Popper refers to David Hume in making distinct his own ideas on induction.

becomes unnoticeable over time.[24] When first riding a bike much attention is paid to the repetitions involved, but at some point the preliminary belief is forgotten. In the same way as when not re-evaluate consciously whether the sun will rise tomorrow, the original belief is subconsciously turned into assumption or fact.

Learners also tend to establish belief in a pattern after only a single occurrence, which means that belief can come even before repetition, instead of after.[25] Popper's example is when a puppy is given a lighted cigarette to smell just once, it will afterwards be scared of even the sight of it and not investigate again.

Finally, when registering repetition, a qualification is required of what counts as a recurrence.[26] When observing two events, there has to be a moment when we judge the two events to be the same. This requires a formulation, a theory, of what the characteristics of the event are or should be. This amounts to interpretation and theorizing before the fact: a priori.[27] "Without waiting, passively, for repetitions to impress or impose regularities upon us, we actively try to impose regularities upon the world…"[28] We need a theory of what characterizes an event before we can register repetition.

To summarize, Popper explains that we forget our initial belief after enough repetitions, a belief often created after only a single occurrence, and not based on repeated observation but a creative inference – a theory. A belief is therefore not derived from multiple observations, but is a theory, which precedes observations. This undermines inductive reasoning, i.e. the belief in laws arising from repeated observations, indicating a considerable role for creativity and interpretation.

Inventing Theory: Problem and Subject before Observations

The consequence of saying that a theory comes first, when phrased strongly, is that scientific theories are inventions, even if they are later redesigned when their predictions clash with further observations. Popper therefore necessitates that scientists regularly jump to conclusions, a scientific trial and error, or, with the jargon of philosophy of science: conjectures and refutations.[29]

Calling scientific theories invention is an unpopular statement, but it should be realized that observation always requires a subject. Simply observing by itself is impossible, some need or interest needs to come first. "Observation is always selective. It needs a chosen subject, a definite task, an interest, a point of view, a problem. And its description presupposes a descriptive language, with property words; it presupposes similarity, and classification, which, again, presupposes interests, points of view, and problems."[30] The example is given of a hungry animal, which divides its immediate environment into edible and inedible things. A hypothesis will always need a frame of reference, a psychological a priori, expecting some repetition before encountering it.[31] The expectation of regularity is something innate, a combination of desire, hope, and imagination; it is a habit and it is psychological, an anticipation.[32] Any new hypothesis, any new theory or conceptualized pattern will always be preceded by a jump to conclusions, an imagined pattern, a pre-supposed subject.

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[24] Popper, 168
[25] Popper, 168
[26] Popper, 170
[27] Popper, 170
[28] Popper, 171
[29] Popper, 171
[30] Popper, 172
[31] Popper, 173
[32] Popper, 173-5

The problems of induction and scientific demarcation are related, because scientists still believe observations and experiments come first and that science is defined by inductive reasoning.[33] Induction, by its traditional definition, however, does not exist, considering Poppers arguments about belief. The murky essence of science lies in luck, ingenuity, intuition and especially in critical attitudes.[34] There simply is no formula for absolute truth or scientific success: there is no option other than to make theoretical jumps, because even if it is theoretically unjustifiable, it is practical.[35]

Dogmatic Thinking and Critical Thinking

To further elaborate on our problematic habit of believing in regularity, Popper makes a distinction between *dogmatic thinking* and *critical thinking*.[36] Dogmatism is used to describe a strong belief, that the holder feels needs no further confirmation to justify its existence. It is an important concept in understanding the invention of scientific theory and the setting up of trials, experiments, and hypotheses. Our dogmatic beliefs constitute our insistence that there is a pattern. In dogmatic thinking, regularities are expected even when there is weak or no evidence. This expectation is deeply entrenched in the psyche. Note that children show uncontrollable desire for repetition, which can be considered a primitive and pure example of dogmatic thinking. It can occur after a single or no observation. It should be noted, that dogmatic thinking is a necessary characteristic of perseverance, as success is not always evident from the start. When a scientist believes in regularity but cannot find proof, it can be disastrous he accepts defeat immediately. It should come as no surprise then that one of the possible sources of dogmatic thinking is intuition.

Critical thinking on the other hand can be defined as a weak belief: critical attitudes are more likely to be modified, corrected, and dismissed: they are open to falsification.[37] It may seem like dogmatic thinking refers to unscientific reasoning, yet it should be understood that critical attitudes operate on dogmatism.[38] As argued above, initial theory creation is a creative, intuitive process. This theory is then critically evaluated, and this critical evaluation is the inheritance called science. This evaluation happens after the creative period, and seeks to test it, but nonetheless operates on and requires this first moment of invention.

Critical Thinking and Trial and Error as Science

The idea that science consists only of inductivism and empiricism is nonsensical: Popper concludes that the accompanying demands for absolute proof are unreasonable.[39] Logic is to be used to criticize and analyze our theories, not to prove them. Usually the problem of inductivism is defined as a fundamental problem with all science, and a depressing reminder that absolute certainty is elusive.[40] There will never be enough evidence to create absolute natural laws.[41] So while some dismiss the belief in inductivism as irrational, Popper redefines belief as: critical acceptance of scientific theories. By this, he means that having faith in our critical faculties, in science, is a rational belief. Instead of focusing on determining universal laws, Popper's definition of belief is targeted at the scientific and critical attitude. So for him,

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[33] Popper, 180
[34] Popper, 181
[35] Popper, 186
[36] Popper, 175
[37] Popper, 176
[38] Popper, 177
[39] Popper, 178
[40] Popper, 178
[41] Also: Popper, 182

science is not about absolute certainty, but a superior critical attitude: a celebration of the brilliance of doubt and critical thinking. Some see the logical impossibility of finding absolute natural laws as the end of the argument, but Popper believes induction, used in the proper context of falsification, is sufficient. The consequence of Popper's view of inductivism is that science is trial and error, and all theory is hypothetical forever: innocent until proven guilty, true until proven false.[42] Progress in science is negative, in the sense that it is about proving things wrong instead of right. The scientist strives to error, and though it may be in the name of truth, it is not truth that is found. Instead it is the inability to err while having the largest potential to be wrong. That potential is the height of scientific achievement.

Reflecting on Popper

For a theory to be scientific, it needs to be testable so it can be proven wrong. Because although proving something as 100% true is impossible, proving something false *is*. Therefore, a theory that can be falsified is scientific, and will lead to growth and improved certainty in knowledge. Theories that do not allow falsifiability are no more than narratives, mythological descriptions and stories, which provide interpretations but no proof or reliability. Inductivism is important in science, but it is flawed, because repetitions cannot be observed without setting up an interpretational framework first. This entails that theory comes before observation, which means jumping to conclusions: the scientific process is one of trial and error. Dogmatic thinking may seem unscientific, but it is what sustains us when going through the process of jumping to conclusions and trial and error. Critical thinking organizes and evaluates dogmatic beliefs – beliefs, which originate from creative, intuitive processes. Critical thinking is the inheritance called science: what has developed over the centuries. Despite the challenges posed, science is ultimately based on faith in these critical faculties. Hence, Popper summarizes science as a process of trial and error, critically evaluated dogmatic belief, with its hallmark being the falsifiability of theories. This is how Popper thinks science makes sense, how it works, and how it should work.

Demarcating What?

Popper's falsification and definitions of belief and inductivism, he says, is "neither a problem of meaningfulness or significance, nor a problem of truth and acceptability," instead it is an issue of demarcation between science and non-science.[43] It is at no point explained what the difference exactly entails, or what it means. Following this logic, to name a few, the study of law, psychology, cultural studies, social sciences, political science, string theory[44], and philosophy of science are all not science. This is because all of them tolerate exceptions, which should falsify the theory, or because crucial parts of their theory cannot be falsified. Therefore, scientific knowledge about them is impossible in Popper's philosophy of science.

Popper emphasizes falsification, which if taken literally means that only those disciplines which correctly apply falsification are scientific. A large part of this correct application is the primary role of critical thinking. The result is that the term science becomes useless, because we already have the term physics. No other discipline would seem to come as close to fulfilling the demands of this philosophy of science. And even in the case of physics, and all the others by implication, if Popper admits that the theories are invented initially, and rely on interpretations at early stages, how come that this crucial process is not included in the definition of what science is?

For the fields not fitting the criteria, the only other label Popper provides is that of a 'narrative'

[42] Popper, 179
[43] Popper, 162

or 'myth'. However, Popper also deems it important to point out that myth or narrative have a significant role in science, because the myth may become testable over time. See, for instance, Newton's theory of gravity and the idea that the moon influences the tides. These are not unfamiliar ideas in astrological theory, which addresses the influence of heavenly bodies on the earth.[45] Myth can anticipate scientific theory, Popper says, and may be significant in other ways. What is unclear is exactly how the importance or relevance of a myth is to be recognized, and what is to be done with it. There is a duality in Popper, as his theory admits to the initial stages of science being influenced by 'unscientific' factors, but at the same time treats this stage as temporary and to be overcome. Does that mean that all the disciplines mentioned above are myths, waiting to evolve into properly falsifiable scientific knowledge? That seems a little strange. And even if this is the case, what is supposed to be done with that knowledge in the meantime? Surely, the non-scientific disciplines also conduct research, also make theories, and try to prove them correct. Calling them creators of myth and unscientific would be possible in Popper's theory, but what exact conclusion should be derived from it is unclear.

The physicists would probably eagerly forbid everyone else from using the word science, but it should be realized that science is a loaded word. Arguing that someone's work is not scientific is a severe accusation: Demarcations have consequences. While acknowledging some role for 'unscientific' processes, Popper does not fill in the blanks. Thomas Kuhn, whose theories will be discussed in the following section, attempts to fill in the blanks for him, but not before showing that Popper's demarcation makes no sense at all. He turns it around and argues that dogmatic thinking has much more influence on critical thinking than Popper describes, even in the later stages of science where critical evaluation should reign supreme. Even worse, science not only operates on dogmatic thinking, but it is full of dogmatic thinking itself, with critical thinking being more of an exception than the rule. As Kuhn is discussed, Popper's demarcation of science will crumble, leaving even more room for the role of interpretation in science than Popper already admitted.

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[44] At the moment, but the Large Hadron Collider might change that in the coming months.
[45] Popper, 162

Kuhn's Science

> *"Scientists sometimes deceive themselves into thinking that philosophical ideas are only, at best, decorations or parasitic commentaries on the hard, objective triumphs of science, and that they themselves are immune to the confusions that philosophers devote their lives to dissolving. But there is no such thing as philosophy-free science; there is only science whose philosophical baggage is taken on board without examination."*[46] - Daniel Dennett, Philosopher of Science, 1995.

Introducing Kuhn

Thomas Kuhn proposed a controversial theory, which claims that science moves through scientific revolutions going from one paradigm to the next, in the process of which the previous paradigm is abandoned. A paradigm is not merely a theory; it is a collection of scientific values and cognitive aspects related to a scientific collection of statements.[47] The revolutions by which paradigms are overthrown show parallels to political turmoil, when regular discourse fails, and persuasion and matters of interpretation become the most important tool.[48] Paradigms tend to use their own language in their defense, the very same language that conflicting paradigms do not recognize.[49] While Popper expects falsification to provide progress, Kuhn observes that scientists often refuse to let their old paradigms go despite conflicting evidence.[50] There is much to say about this very broad idea, but the following discussion of Kuhn will restrict itself to two texts which address subservient arguments related to Popper's theory. The first text is '*Logic of Discovery or Psychology of Research*'[51], a response to Popper, in which Kuhn tries to delineate the exact differences between his own theory and that of his predecessor. The second text, '*Objectivity, Value Judgment, and Theory Choice*'[52], contains clarifications and responses to criticism of Kuhn's ideas on scientific theory choice and progress. The texts are a good sample to expose some fundamental differences between Kuhn and Popper, and to show how the two see science differently.

It should be noted, as Kuhn does, that the two philosophers actually have much in common. They both doubt logical positivism and complete certainty in science. It is exactly because they share so much, that highlighting their differences is fruitful to the larger discussion. Basically, Kuhn rejects Popper's theory because he believes that it does not correspond to scientific reality. The disagreement with Popper in *Logic of Discovery or Psychology of Research* consists of four arguments: 1. Popper unfairly focuses on extraordinary science, which is very rare. Most of what science is, happens during long periods of normal science. 2. Popper says that mistakes are when theories are proven wrong, but

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[46] Dennett, D. C. Darwin's Dangerous Idea: Evolution and the Meanings of Life. New York: Simon & Schuster, 1995. 21. Print.
[47] Curd, Martin, and J. A. Cover. Philosophy of Science: The Central Issues. New York: W.W. Norton & Co., 1998. Print. 99-100
[48] Curd & Cover, 87
[49] Curd & Cover, 88
[50] Curd & Cover, 101
[51] Kuhn, Thomas S. "Logic of Discovery or Psychology of Research." The Essential Tension: Selected Studies in Scientific Tradition and Change. Chicago: University of Chicago Press, 1977. 266-92. Print.
[52] Kuhn, Thomas S. "Objectivity, Value Judgment, and Theory Choice." The Essential Tension: Selected Studies in Scientific Tradition and Change. Chicago: University of Chicago Press, 1977. 320-39. Print.

the moments of supposed falsification cannot properly be called mistakes. Mistakes, instead, occur in normal science, and change little. 3. Normal science is about puzzle solving, not about critical thinking as suggested by Popper. 4. Popper acknowledges that no absolute evidence can be given in falsification, and still hold on to his theory, which makes him a naïve falsificationist, turning falsificationism into an ideology rather than a theory. The review of the second text will go deeper into the scientific values and the role of subjectivity in science, which is a discussion that follows from the first.

Misguiding Emphasis: Normal versus Extraordinary Science

Standard examples to indicate how science works, like the eclipse observation in 1919 discussed above, are actually very rare in the history of science.[53] These events do indeed showcase scientific characteristics, but distract from the fact that crisis precedes instead of causes it, as will become clear in the following paragraphs.[54] The context of this crisis, from which this extraordinary science eventually arises, is that of *normal science*, which Popper seems to ignore. Instead he focuses on those few moments where all scientific ideals are perfectly aligned. Yet, all scientific training and education is geared towards normal science, which determines testing procedures and theory directions. Students are not trained to be revolutionary theory-debunking-machines, but to expand and refine scientific theory. "It is normal science, in which Sir Karl's sort of testing does not occur, rather than extraordinary science, which most nearly distinguishes science from other enterprises."[55] True falsification, where a theory is definitively rejected, is extremely rare, and instead the essence of what science is should be sought in normal science. It is like trying to understand the whole culture and history of France merely by studying the French revolution. It is understanding 1500 years of French history from 15 extraordinary years.

If science progresses according to falsification and testing, then the 16th century controversy concerning Ptolemy proves Popper wrong. The controversy did not occur because of some falsification, but because of inconsistency in a theory.[56] The theory ended up being replaced before it even existed, and it was never falsified before it was replaced. In this case it was assumed that the theory needed to be adapted, not that it was wrong. This approach, too, shows the scientific intent to make a theory work, supporting the idea that science – normal science – is about puzzle solving rather than testing and falsification.[57]

On Mistakes and Puzzle Solving

Popper generalizes his own work as "the thesis that we can learn from our mistakes."[58] A mistake is when: "The individual has failed to obey some established rule of logic, or of language, or of the relations between one of these and experience."[59] There are two aspects of mistakes that are important to understand: firstly, a mistake usually occurs conjoined with a failure to recognize an alternative, and

[53] Kuhn, *Logic of Discovery,* 271
[54] Kuhn, *Logic of Discovery,* 272
[55] Kuhn, *Logic of Discovery,* 272. comma added
[56] Kuhn, *Logic of Discovery,* 277. Concerning the use of the equant in the astronomical model, which disrupts the idea that the heavenly spheres are perfectly circular. It modelled the movements in a way that planets would have two separate circular movements to predict their positions. Only one circle is not only aesthetically more pleasing, but also suggests the heavens are not, well, heavenly.
[57] Kuhn, *Logic of Discovery,* 277
[58] Popper, Karl R. Conjectures and Refutations; the Growth of Scientific Knowledge. New York: Basic Books, 1962. p. vii. Print. In Kuhn *Logic of* Discovery, 278. Emphasis removed.
[59] Kuhn, *Logic of Discovery,* 278

secondly, the mistake can only be uncovered by isolating it in application. It means that a mistake occurs when you make the wrong choice, and when you discover and admit that a bad result is linked to this choice. These mistakes can therefore only occur in an activity with pre-established rules, where choices are lined up, and where consequences are correctly identified as relating to this framework of choices and results.

Kuhn says this happens in normal puzzle-solving science, and Popper locates it in extraordinary science.[60] For Popper, mistakes are outdated theories like Ptolemaic astronomy, Phlogiston theory, or Newtonian dynamics.[61] The moment they are falsified, they are identified as mistakes. It is unfair, says Kuhn, and teleological to suggest Ptolemy was making a mistake. What he was doing was puzzle solving, trying to make his system work, and he was not breaking some rule of logic or failing to choose an alternative when he was developing his astronomy. Both Popper and Kuhn view science as initially invented and accepted before serious confrontations occur. This makes Popper's emphasis on learning from our mistakes problematic: the work of Ptolemy was perfectly scientific at the time.[62] This may go against common sense, which is inductivist and teleological by nature, but Ptolemy did not make a mistake. He was working on a puzzle to capture nature in a structured framework. He is just as scientific as we are today, and the way he organized the available data should not be characterized as a mistake, but as an amazing piece of puzzle solving.

Mistakes take place within systems, and are ironed out without harming the theory.[63] This is *normal science*, meaning that it consists of most of the scientific work performed, and should therefore be more characteristic of science. Popper suggests that mistakes require whole systems to be replaced, which glosses over the fact that for long periods of time the theory was sound knowledge. To illustrate: for Popper, Ptolemaic theory was only science when it was created – when it was made testable, exact and detailed. Following the ideal of falsification, it was also science when it was disproven. This guides the vision of science away from the impressive 1300 years that the theory flourished as science, as if to say science was not practiced during those years. In those centuries, mistakes were when Ptolemy was wrongfully applied or understood, when it warranted small adaptions or tweaks, not complete revisions. Kuhn thinks it is problematic to judge whole theories based on the criteria used in its individual application, which shows a point of friction between the two philosophers: Popper locates mistakes in the application of falsification, and Kuhn locates mistakes in daily normal science when theories are not disproven but maintained. For Kuhn testing and mistakes are about puzzle-solving, about making theories work and improving them, and should not be used to understand large pervasive scientific change. As per the example of Ptolemy, it is strange to say astronomers were making continuous mistakes for 1300 years.

Normal Science as Puzzle Solving, as Opposed to Critical Thinking

Puzzle solving refers to the elaborate efforts to expand on existing theories, to follow their rules of testing, to make them work and to extend their reach and rehearse their predictive and descriptive powers.[64] The role of theory for Kuhn is that of the provider of the puzzles to be solved. Popper refers to Thales and Plato in ancient Greece as the forbearers of the kind of thinking done in science: critical thinking. This critical discourse he connects to the very nature of science and his theory of falsification.

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[60] Kuhn, *Logic of Discovery,* 278-9
[61] Kuhn, *Logic of Discovery,* 279
[62] Kuhn, *Logic of Discovery,* 278
[63] Kuhn, *Logic of Discovery,* 280
[64] Kuhn, *Logic of Discovery,* 271-2

However, Kuhn asserts, when the work of knowledge moves from critical discourse to puzzle solving, is when science really emerges.[65] This is the practice of *normal science*. While doing normal science, a scientist works with an established set of rules and assumptions and extends them into his research and work.

To explain this argument, it can be made analogous with Socrates' trial: imagine a scientist walking around the lab continuously questioning every concept, term and formula, like a type of Socrates, a master of critical thinking and dialogue. For this, Socrates would eventually be convicted to death by poisoning, and the scientist would also find vocational death: he would be fired or shunned as an annoyance, or even worse, as a philosopher. Those who upset the order with their deep and pervasive critical evaluations are not popular.

In the process of scientific puzzle solving, the terms for solutions and failures are predetermined.[66] In terms of the Socrates example, those who convicted him were trying to quench his idealism, his critical thinking and his questioning of the scientific and social order. Governing is also a kind of puzzle solving: trying to make things work with the existing power distribution. The official charge against Socrates was: "Socrates is guilty of being a busybody, in that he inquires into what is beneath the earth and in the sky, turns the weaker argument into the stronger, and teaches others to do the same."[67] Socrates was blamed for not being helpful to the established order. Similarly, when a scientist fails to make a theory work, the practitioner is blamed first instead of the theory.[68] Only when a personal failure becomes a failure of theory does a crisis emerge.[69] But as the Socrates' trial shows, before this happens it is an issue of politics, where the scientist is reprimanded for not conforming. Luckily, these days, we do not execute scientists if they have new ideas, but we set out to destroy their research and ideas instead. The same process is still in place though, since critical thinking is the mark of deviance, while dogmatic thinking is actually much closer to the overwhelming majority of scientific activity. The question arises of whether science should be characterized by the rare occurrence of truly critical thinking, or by the business-as-usual science that dominates regular scientific life.

Another example concerning puzzle solving: Newton famously announced “I feign no hypothesis”, which meant he refused to explain why gravity worked. It was his way of holding on to experimental philosophy and to avoid explaining God's role in his theory of gravity. This is often seen as a defining moment in modern science: the moment that Newton literally took religion out of the equation. Essentially, he rejects critical discourse in favor of puzzle solving, because he assumes a strong new dogmatic position by ignoring God in his explanation - and rightly so. Indeed, this type of reductivism, where larger subject matters are reduced to smaller representatives, can be interpreted as promoting puzzle solving. It is excluding certain questions and criticisms for the sake of scientific progress and efficiency, preventing them from being posed. This is good for science, but can be controversial when it ends up excluding God or morals.

The last example in making the point for puzzle solving is one of Popper’s and Kuhn’s own making: both think that astrology is a pseudo-science, but for different reasons. Popper says that astrology is a pseudo-science because it avoids falsification. This is a historical perversion, says Kuhn,

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[65] Kuhn, *Logic of Discovery,* 273
[66] Kuhn, *Logic of Discovery,* 273
[67] Plato. "Apology: Defense of Socrates." Introduction to Philosophy: Classical and Contemporary Readings. Eds. Perry, John, Michael Bratman and John Martin Fischer. New York: Oxford University Press, 2007. 29. Print.
[68] Kuhn, *Logic of Discovery,* 273
[69] Kuhn, *Logic of Discovery,* 273

because records show the practitioners were very aware of their continuous failure.[70] Falsification was not avoided, it was just thought that astrology was incredibly hard to do right. Therefore, the inaptitude lay with the practitioner, not the theory.[71] So even when evidence against their theory was presented, the practitioners were blamed first instead of the theory. Popper notes this is very similar to what happens in contemporary medicine and meteorology.[72] When a doctor fails to heal, we tend to blame the doctor, not the theory he is using. Falsification is widely known to occur in astrology, but much like traditional medicine, there was at the time simply no known alternative to explaining the relation between the heavens and what happened on earth.[73] This relation clearly exists, though maybe not in the way they had imagined it. Because astrologers did make testable predictions, Popper's exclusion of them on the basis of a lack of falsification is wrong.[74] Falsifications happened all the time, and people were fully aware of them. Yet, it was not accepted that these falsifications disproved the theory, but though that it disproved the skill of the practitioner. Consider that the legendary Kepler, Brahe, and Ptolemy - all formidable scientist-philosophers - practiced astronomy and astrology together.[75] It would take some time for the art of astrology to be fundamentally questioned, and this questioning certainly did not happen on the basis of falsification, but a change in scientific values discussed later.

Naïve Falsification and Ideology

Popper does not seem like a naïve falsificationist, and he also says that he is not one. *Naïve falsificationism* refers to the idea that science is no more than the pure application of falsificationism, something closely related to a type of radical experimentalism or empiricism. Yet Popper's theory leaves no other choice than to be designated as such, revealing another perspective on Popper's philosophy.

Kuhn and Popper agree that there is an asymmetry between generalization and negation. A generalization or a theory can never be proven to be successful in all its possible instances, but it can more definitely be shown to fail in certain crucial applications.[76] Kuhn gives the example that it is extremely unrealistic to prove that all swans are white, even though it is a reasonable generalization, and at the same time much easier to disprove it by finding only one black swan.[77] Considering the relation of refutation and falsification to proof, Popper's theory is suggestive that any one black swan will immediately destroy the generalization.[78] However, in reality, science is not a dramatic cyclical annihilation of theories.[79] In normal science, theories are continuously challenged and adjusted, often in ad-hoc fashion. Ad-hoc in the sense that the scope of the original theory's explanatory reach is expanded to catch an anomaly or deviation within its boundaries. The agreement on this is voiced by Popper: "In point of fact, no conclusive disproof of a theory can ever be produced; for it is always possible to say that the experimental results are not reliable, or that the discrepancies which are asserted to exist between the experimental results and the theory are only apparent, and that they will

[70] Kuhn, *Logic of Discovery,* 274
[71] Kuhn, *Logic of Discovery,* 274
[72] Kuhn, *Logic of Discovery,* 275
[73] Kuhn, *Logic of Discovery,* 275
[74] Kuhn, *Logic of Discovery,* 275-7
[75] Kuhn, *Logic of Discovery,* 277
[76] Kuhn, *Logic of Discovery,* 280-1
[77] Kuhn, *Logic of Discovery,* 284-7
[78] Kuhn, *Logic of Discovery,* 281
[79] Kuhn, *Logic of Discovery,* 281

disappear with the advance of our understanding."[80] For Kuhn this statement is central to his entire argument, but Popper deals with it as a threat to his theory. Yet, he insists that critical thinking will triumph, and holds on to his falsificationism. Therefore, if certainty in providing disqualifying evidence is impossible, and Popper insists that logical falsification is the way to go, he positions himself as a naïve falsificationist.[81]

Popper's enterprise is to construct a logic of knowledge: helping us decide what knowledge is worthy holding on to.[82] Exactly how this is supposed to work, however, is a mystery because absolute conclusive disproof is impossible in Popper's framework. When can a theory be abandoned, and when should it be fixed? "Rather than a logic, Sir Karl has provided an ideology; rather than methodological rules, he has supplied procedural maxims."[83] This crucial issue is unspecified, and instead ignored by suggesting that there is a logic, a road, a clear method. But this clear method of choosing, this scientific method, is not clear at all. A theory comes with a list of imagined states, in which it either fits or is falsified. This list consists of cases that the theory expects, cases for which it was designed.[84] New cases and states will occur, but "no exclusively logical criteria can entirely dictate the conclusion" that it is falsified.[85]

This analysis reveals that Popper is talking about a 'should', about ideology. A very good one indeed, many aspects of which are crucial to the scientific enterprise, but merely an ideal nonetheless. As Popper wrote:

> "Assume that we have deliberately made it our task to live in this unknown world of ours; to adjust ourselves to it as well as we can; …and to explain it, *if* possible (we need not assume that it is) and as far as possible, with help of laws and explanatory theories. *If we have made this our task, then there is no more rational procedure than the method of … conjecture and refutation:* of boldly proposing theories; of trying our best to show that these are erroneous; and of accepting them tentatively if our critical efforts are unsuccessful."[86]

This indeed sounds like something we should be doing, but it is not what we are actually doing. It does not describe science, but prescribes it as if it were an imperative. It is actually the values in the quote above, the character of the maxim, the declaration, which explains theory choice and scientific progress better than mere logic or experimentation. It can be identified as an ideal of experimentalism, testability, falsification, and a bias towards science that operates on universal laws. In the following paragraphs the role of values in science will further explain how this works.

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[80] Popper, Karl R. The Logic of Scientific Discovery. 1959. p. 50. Print. quoted in Kuhn *Logic of Discovery*, 281-2. Punctuation added.
[81] Kuhn, *Logic of Discovery,* 282
[82] Kuhn. *Logic of Discovery,* 283, This is derived from another text by Popper which is not the one discussed earlier. The text by Popper used above does not mention the logic of knowledge, but concerns itself with demarcation, which I interpret to be first step in establishing a logic of scientific knowledge, so basically the same thing.
[83] Kuhn, *Logic of Discovery,* 283
[84] Kuhn, *Logic of Discovery,* 288
[85] Kuhn, *Logic of Discovery,* 288
[86] Popper, *Conjectures and Refutations*, 51. Quoted in Kuhn, *Logic of Discovery,* 292

Theory Choice and Scientific Values

And hence Popper turns into a scientific idealist who describes the way science should be instead of the way it is. Though he describes many essential features, he misses specific points on practice. After accusing Popper of lacking a theory, Kuhn defends his own ideas, which even though he admits do not provide wholesome answers, are still more realistic than Popper's, or others like it.[87] The theme of *Objectivity; Value Judgment, and Theory Choice* is a polemic against criticism of Kuhn's earlier work and a rejection of the idea that scientific progress and theory choice proceed along definable rules. These definable rules of logic can be crudely summarized under a header like *objectivity*. The three main arguments of Kuhn's second text under discussion are: 1. The examples used as role models by Popper are not representative of what normal science is. 2. The role of subjectivity is misunderstood, scientific values are fundamental to objectivity. 3. It is more realistic to see the rules of science as values, whose interpretation entails philosophy of science, and influence what is done in the name of objectivity.

Deceptively perfect examples

Kuhn accuses Popper of transferring "selected characteristics of everyday research to the occasional revolutionary episodes in which scientific advance is most obvious and […] ignoring the everyday enterprise entirely."[88] Theory choice in revolutionary episodes, according to Popper, follows a logic, but this logic is only possible if the opposing theories are fully formulated already.

Similar to the distinction made earlier between extraordinary science and normal science, Kuhn again makes a point of differently situating science. The science in our standard textbooks is misleading, because it selectively gives us perfect examples.[89] Famous examples, which are given to exhibit the scientific method and success are: Foucault's pendulum, which demonstrates motion of the earth; Cavendish's demonstration of gravitational attraction; and Fizeau's demonstration of relative speed of sound in water and air. These experiments are supposed to show science in action, providing irrefutable proof of scientific theories and swaying the community towards a new truth. What is not explained is that these experiments were proving theories which the majority of scholars already believed, and hence were not as crucial as they are portrayed to be.[90] The theory choices made in these examples are deliberately made to seem unproblematic, as if the scientific procedure was clear all along, is definite, and unstoppable. It is in normal science wherein puzzles are defined and solved, up to a point where another theory can be dethroned and falsified. The moment it actually happens, for example the moment the curvature of light was shown in 1919, is actually after the fact: the theory has already been developed. The honestly difficult choices which scientists face, which precede these experiments, are ignored.[91]

When a theory necessary for an experiment is still being developed, competing theories have significant claims to the truth. When they are falsified, these other theories are often retroactively pictured as faulty to the point of the self-evident, almost as if those not adhering to the correct theory were simply stupid. However, difficult decisions are made when scientists are at a stage of discovery and invention. It is generally agreed that subjectivity, which itself is sometimes described using the terms creativity or intuition, is a relevant factor at the stage of invention and discovery. Seeking an algorithmic

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[87] Kuhn, *The Essential Tension,* 389-92

[88] Kuhn, *Logic of Discovery*, 288

[89] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 327. A retrospective verificationist fallacy, if you will.

[90] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 327. Parallels with Popper when he mentions theory before observation in induction.

[91] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 328

description, seeking specified rules and definitions of theory choice, contradicts this.[92] It is strange to believe that later justification of the theory in the form of, for instance, the aforementioned experiments, is done on exclusively objective terms, since the theory has such subjective origins. Indeed, Popper admits that his critical thinking operates on dogmatic thinking, but places emphasis on critical thinking as science while underplaying the larger role dogmatic thinking plays in many crucial decisions.

Scientific Criteria and Subjectivity in Science

Kuhn believes that great changes in science take place in the form of paradigm shifts.[93] These are situations in which techniques of argumentation and persuasion have to function without definitive proof to support them. In this situation this is the only way to achieve a fundamental change in theory. A testament to the large role of argumentation and persuasion in science is the fact that widely recognized scientific role model Albert Einstein never accepted Quantum Theory, more or less because he did not like it. Kuhn addresses these kind of phenomena by stressing the underestimated role of subjectivity in science.

Critics of Kuhn accuse him of not providing a factual method of theory choice, which is not inaccurate.[94] Despite possible interpretations of his work, Kuhn most definitely believes in scientific progress, which he attributes to improved research training. He also believes that good scientific theories follow some general guidelines, which are very recognizable to any researcher:[95]

- Accuracy: The consequences deducible from the theory should be in demonstrable agreement with results of experiments and observations.
- Consistency: A theory should be internally consistent and consistent with other related theories.
- Scope: A theory should extend beyond itself, beyond its core observations.
- Simplicity: A theory should bring order to what would otherwise be more confusing.
- Fruitfulness: A theory should expose new relations and phenomena.

These are quite general, and there are surely more, but these principles are chosen as an example and as most important in the eyes of Kuhn. Ideally, if all research were to follow these rules, science would be rather straightforward and simply a matter of good practice. It is regrettably the different interpretations of these criteria, and that they can compete with one another, which causes problems.[96]

Consider the following: Copernicus' heliocentric mathematical model was not more accurate than Ptolemy's model.[97] On account of accuracy, the choice could not have been made. Mathematically, the theories were equally complicated. The only thing Copernicus had over Ptolemy was that his theory made away with the hated equant, which was a mathematical trick to make predictions accurate in a model where the earth is at the center, and to retain perfect circular movements for the planets. In terms of modelling and math, consistency and simplicity do not clearly break the tie. Both Ptolemy and Copernicus were internally consistent, but Copernicus disagreed with the entire scientific canon on the earth and sky. According to the above criteria then, geocentrism should win, and it did. At least, until Galileo's underdog mentality would pick up on the theory, and Kepler would simplify the calculations

[92] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 328
[93] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 320
[94] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 321
[95] Criteria loosely adapted from: Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 321-2
[96] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 322
[97] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 323-4

sixty years after him. Today too, scientists supposedly wielding the same scientific criteria can come to different conclusions with lasting consequences.

The difference in interpretation of the criteria can prove a crucial subjectivity. Personal scientific views matter as to the emphasis and hierarchy of the criteria. So too, general philosophical context explains much of the local diffusion and popularization of specific scientific theories and concepts and the consequent geography of their criticism and development. German Romantic philosophy predisposed to energy conservation theory, while English social thought in the 19th century was susceptible to the concept of struggle in evolutionary theory.[98] So both philosophy and the interpretation of the criteria, which itself can be considered philosophy of science, are subjective influences to be accounted for. Subjectivity is often categorized as "an index of human weakness, not at all the nature of scientific knowledge."[99] Yet, both Kuhn and Popper acknowledge that subjectivity and intuition play a role in discovery and invention. Scrutinizing these subjective and intuitive ideas, testing and justifying them, happens in the realm of objectivity. When doing this, it should be sensible to take the subjective origins into consideration.[100] This ideal of a clear distinction between subjectivity and objectivity does not translate into scientific practice, in which the line between discovery and justification is doubtful.[101] The critical does not simply operate on the dogmatic. Subjectivity is an inherent part of science and does not stop affecting it no matter what part of the process is looked at.

Not Rules but Values: Science Does Not Operate on Static Guidelines

The role of values and their function in science should not be underestimated. When 'an eye for an eye' is invoked in a discussion, the discourse is altered. The person stating it associates the discussed topic with a certain value, a certain structure, which is not unlike adding a variable to the equation. It suggests certain outcomes and modifies the values implicitly held within the debate. For instance, in a situation of conflict, the person saying 'eye for an eye' is suggesting that an action of equal worth or injury must be taken, but not defining what that action is or its appropriate value. A person who quotes the maxim 'turn the other cheek' is counseling an inverse non-aggressive conflict resolution, without defining what it entails or what the consequences would be. These values are debatable interpretations of biblical passages, much like scientific values.

Popper and others insist that initial choices are subjective, but that through method and scientific attitude the subjective can be surgically removed and will eventually disappear completely. Kuhn designates this as a non sequitur: it does not follow logically.[102] When Kuhn imagines a world, which strictly keeps to perfectly defined scientific criteria, it is horrible.[103] After a theory is accepted it would never be doubted because it exists in a state of complete objectivity, and every dissenting new voice will be assumed to originate from personal, that is subjective, misinterpretation. It would be as bad for science as insisting that the descriptions of the world in the Bible are not open to interpretation

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[98] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 325. Energy conservation is appealing in resisting the unpopular suggestion that the universe will decay into inert equilibrium, which stems from interpreting the 2nd law of thermodynamics. The receptiveness to Struggle in evolution comes from ongoing debates in England concerning 'the poor question', relief and social welfare, as represented by the works of Malthus. Questions like: Were the poor meant to suffer/die in service of natural selection, punishment by God, or English racial purity?

[99] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 326

[100] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 326. See also Popper 186 on making jumps.

[101] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 327

[102] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 329

[103] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 330

or revision. It is not only sensible, but also necessary to see the scientific criteria suggested by Kuhn as values.[104] New theories and fundamental criticisms require room to develop, they require time and opportunity to mature into a theory that is capable of challenging and persuading. "What from one viewpoint may seem the looseness and imperfection of choice criteria conceived as rules may, when the same criteria are seen as values, appear an indispensable means of spreading the risk which the introduction or support of novelty entails."[105] If the rules were too clear, there would be no room for disagreement.

The hierarchy of scientific values can vary according to the purpose of the person adhering to it and the type of work that person is seeking to engage in. Isolated in his own context, for example, Copernicus can be considered an anomaly. He worked on a theory that initially, according to rigid criteria, should not have developed in the first place, as discussed above.[106] Though Copernicus' ideas were circulating in limited scholarly circles, Galileo brought them further into the limelight. The best reason for Galileo to choose to look at Copernicus, from the viewpoint of scientific criteria, was the value of simplicity.[107] If Galileo would have prioritized consistency and accuracy, he would have picked Ptolemy, and the acceptance of Copernicus might have been delayed even more. General observations, which were not to the purpose of proving Heliocentrism, still hinted in that direction, and with a rise in his reputation Galileo increasingly announced his rare belief.[108] Galileo was a bit of a rebel[109], which is not a bad trait for a scientist either. His personal disposition and character might have contributed to his entertaining of alternative theories. Maybe a scientific value such as competition, individualism or originality is in order? In any case, the variety in how scientists interpret the scientific criteria is congruent with anomalies and irrationalities in scientific history, and helps us to understand them.[110]

Subjective Rules of Objectivism

Thus, the scientific criteria laid out by Kuhn, which are supposed to ensure objectivity are themselves subjective. It is therefore odd to make a sharp distinction between subjectivity and objectivity. Every time a difficult scientific choice is made, the rules on which it is based are re-evaluated, implicitly or explicitly.[111] When a theory or research direction is chosen, it needs to be evaluated against other choices, which are put in context by the scientific criteria. This means interpretation, subjectivity. Nonetheless, this championing of subjectivity by no means implies that we should give up in striving for objectivity. It just means that subjectivity plays an important role in practicing science. At the moment, subjectivity is restricted to the realm of discovery, and rejected outside of it.[112] This is naïve and should be changed according to Kuhn.

Subjectivity is thought to be opposed to fact, and characterized with words like 'taste' or

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[104] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 330
[105] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 332
[106] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 332
[107] Recall that Copernicus described planetary motions in a single epicycle, while Ptolemy used two.
[108] Westman, Robert S. "The Copernicans and the Churches." The Scientific Revolution: The Essential Readings. Ed. Hellyer, Marcus. Malden, MA: Blackwell Publishing, 2003. 46-71. Print.
[109] See Gregory, Frederick. "Galileo Galilei: Heliocentrism Gains a Champion." Natural Science in Western History. Boston, Massachussetts: Houghton Mifflin, 2008. 113-33. Print. & Oster, Malcolm. Science in Europe, 1500-1800: A Primary Sources Reader. New York: Palgrave Macmillan, 2002. p. 66-77. Print.
[110] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 331
[111] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 333
[112] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 334

'feeling'.[113] But consider again the example of Einstein and his dislike for quantum theory. This example is known in its popular form as the quote: "God does not play dice." The very use of the word dislike is actually typical, and shows that Einstein's action is categorized as completely subjective . Because this dichotomy is what Kuhn resists, it is important to understand that Einstein disagrees based on his interpretation of scientific criteria: he does not think science should make predictions and descriptions in the form of percentages. Now Einstein's choice is shown to us in a different light. Quantum theory does not fit his idea about what science should be, and he was convinced that a more accurate and discrete theory would, and should, appear. Opposing subjectivity and objectivity to each other obstructs this more subtle understanding of why Einstein took this position. Objectivity is incomplete; facts will always require some interpretation.[114] Einstein, in this case, disagrees on the interpretation of simplicity and accuracy, as he thinks quantum theory is making things more confusing, complicated, and less accurate.

Reflecting on Kuhn

The emphasis and examples given by Popper are extraordinary and misleading; they avoid a large part of the activities that are also part of science. The moments when falsification is enacted occur at the end of a much longer process of accumulation and development, which Kuhn calls ‘normal science’. At the moment an experiment is set up, or a prediction is made, a theory has already been developed. The idea that science progresses through mistakes, which are brought to light by falsification, is also inaccurate. Theories that later prove inaccurate are not mistakes, they are respectable scientific endeavors, which describe and understand nature to the best of their abilities. Change in these theories is preceded by long periods of normal science, in which the chief effort is to improve and elaborate on the accepted theories. This process can be understood as one of puzzle solving. Mistakes are experienced in this context, in failure to apply or understand the existing theory, and are usually blamed first on the scientist, not the theory. Most scientific work happens in the process of trying to improve or supplement theories, not disprove them, even if that may sometimes be the result.

Aside from to the inaccuracy of reducing science to falsification, there is the problem of defining the moment when a theory is truly falsified. Even Popper himself admits that it is hard to say when precisely falsification occurs. Popper’s combination of jumping to conclusions with critical thinking ends up understanding his theory as saying something vague such as: ‘we cannot justify where our ideas come from, but if we try really hard to criticize them afterwards it counts as science and we will be okay’.

Not only is it unclear when a theory is truly falsified, but the process of 'jumping to conclusions' is entirely unexplained. It refers to what happens before theories are fully developed. It is much earlier, often before proof is provided, that difficult choices already have to be made. There are indeed scientific criteria of good practice, but they are interpretable and subjective. So the very rules that should guide objectivity and critical research are in themselves subjective. If the criteria were to be adhered to literally, many innovations and discoveries would actually not be possible or greatly delayed, such as Copernicus' heliocentrism. Therefore they should be treated as scientific values, and their interpretation, which is at the basis of science and theory choice, taken more seriously.

Comment

The earlier definition of science has been one of experimentalism, where the core of scientific work was

[113] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 336-7
[114] Kuhn, *Objectivity, Value Judgment, and Theory Choice,* 337

the critical evaluation of theories. Kuhn has emphasized that theories develop long before they are tested, and that they are initially developed not because of their truth, but because they fit the specific configuration of scientific values. This development should not be designated as non-scientific. Popper already admitted that dogmatic thinking (belief which resists change/evidence) is important for science and its progress, but Kuhn takes this idea further: if it is so important to science, why is dogmatism not included in the definition? He is applying the characteristic thinking of a historian by widening the context. While Popper had been saying: in order to be scientific, we have to be critical of everything and test all of our beliefs, Kuhn expands the scope of understanding and testing to a much larger context. He says that it is equally important to understand where our beliefs come from, and why we decide to test one belief over the other. In this way, Kuhn exposes the role that philosophy of science plays in scientific choices. For Kuhn, science is a list of assumptions and interpretations upon which we act in our studies until they break down. The breakdown could possible even be through some form of falsification, but that would still only be a small part of the whole of scientific practice.

What is more, by moving the spotlight away from experiments, Kuhn shows science as a living and changing belief system, with many commonly accepted features in which interpretation is a variable. This variable is a defining influence on groundbreaking theories in the form of an inclination towards a certain kind of result, or about what is judged most important or interesting. When faced with two candidate theories, the scientist turns philosopher, as evidence is not enough. The scientist is forced to consider which of the two aligns most with the chosen scientific values. It can be argued that even when facing only one theory, which aspects to emphasize or which direction is chosen, can be a matter of what scientific values someone identifies with most. These are values that can move a young student of economics to choose to become an economic historian, economic anthropologist, behavioral economist, micro-economist, economic philosopher, choice theorist, macro-economist, marketing analyst, and so on. Because the moments of falsification are moments where these choices have already been made, Kuhn wants to make clear that these decisions should be included in what is defined as science. These moments, when theory is being developed, happen when the scientist is sitting behind the computer nine to five, trying to make the literature correspond to the findings, trying to make the formulas work, or proving that the theory has identified a gap in the canon. These are activities where nothing is being falsified yet, but it is still science, and can take excruciatingly long. This work is when the scientist tries to develop the chosen understanding of the world, with scientific values acting as a catalyst, into a collection of scientific statements. Science is already taking place the moment puzzles are being defined.

Latour's Science

> *"To the Greeks mathematics meant: things learnt. People mistakenly consider scientific knowledge different from ordinary knowledge."*[115] - Herbert Spencer, Sociologist, 1854.

Popper and Kuhn debated what characterizes scientific practice and what its essence is. Popper defines it, and Kuhn in turn deconstructs it. Popper provides an ideal, something to strive for. Kuhn doubts this ideology, no matter how effective or necessary. His alternative, which involves acknowledging that science includes significant interpretive and subjective elements, is harder to grasp or even accept – yet, according to him, more realistic. For Kuhn it is more realistic to acknowledge the large role subjectivity plays in more than a few initial aspects of science. Popper provides clear rules to work with, which is his effort of demarcation, i.e. arguing that science is a very specific kind of activity. Kuhn doubts this definition, and widens the definition of what is included in the process of knowledge production in science. Latour jumps in the tear made by Kuhn and with strong rhetoric rips it open even further. While Kuhn is still in the mode of describing how science is affected by interpretive influences, Latour turns this into re-defining science itself as the main interpretive force.

Some remarks on Latour and his Work

Latour, and French philosophers in general, are notoriously hard to read and digest. In the coming section, some liberties have been taken to ensure the highest possible readability. Selectivity is practiced to assure that only those arguments and ideas are used, which are relevant to the current venture. Some important arguments from the original text are left out, or translated into the current framework. The effect of this is that some of the rhetorical edge is taken off.

Latour works with constructivist ideas, such as that the fate of a statement, whether it becomes solidified into fact or fiction, depends on debate more than on its inherent truth value.[116] One example to think of is Georg Mendel, who had studied heritability in pea plants under the label of botanical studies. He had essentially invented genetics, but it would take 50 years for someone to figure out that this could be combined with evolutionary theory, of which no one had comprehensively understood how it worked yet.[117] Truth and facts do not simply arise like messiahs of science, they require a lot of work to be propelled into the world, and this work is highly political and sociological. Latour made himself a controversial reputation with statements such as: It is worse to be ignored than to be criticized, because "fact construction is so much a collective process that … one of the main problems to solve is to interest someone enough to be read at all; compared to this problem, that of being believed is, so to speak, a minor task."[118] In other words, he is suggesting that finding an audience is more important than writing good work, just like a politician has a higher priority to collect votes than to be a good politician. Therefore, much of his study is one of the sociogenesis of science, i.e. the study of how science and facts are socially generated. Convincing people, firstly, that an idea is worthy of attention, and secondly that it affects their lives, is entirely different than convincing them it is true.

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[115] Spencer, Herbert. "The Genesis of Science." Seven Essays, Selected from the Works of Herbert Spencer. 1854. London: Watts & Co., 1907. 38. Print.

[116] Latour, *Science in Action*, 27

[117] Gregory, Frederick. Natural Science in Western History. Boston, Massachussetts: Houghton Mifflin, 2008. 456-476. Print.

[118] Latour, *Science in Action,* 40-41

Another observation by Latour states that writing in the popular science genre is difficult, because science is designed to force people out of the scientific discourse, creating a subversive monopoly on knowledge;[119] a monopoly not unlike the priests of old had when only they were able to read the bible. This particular remark of Latour's may overstep a boundary, because the use of the word 'designed' suggests that science is made inaccessible intentionally. He is right to point out science has become so complex that it has become accessible to only a small segment of the population. He is also right to point out that the consequence is a type of monopoly on knowledge. Nevertheless, to say that the intent to specialize and facilitate advanced study is the same as the intent to exclude people, is maybe going too far. One of my professors, Bert Theunissen, once said that only very few are really a Latourian, but that everyone who comes in touch with his work walks away with at least some alterations to their vision of science. Even Bruno Latour himself is not a Latourian (as defined by his critics), because he does not think all of science is a social construct, even though his book treats it so. He later expressed worry, when he noticed that politically or religiously motivated skeptics of climate change and evolution were using his own rhetoric and critiques to attack science.

> "Dangerous extremists are using the very same argument of social construction to destroy hard-won evidence that could save our lives. Was I wrong to participate in the invention of this field known as science studies? Is it enough to say that we did not really mean what we meant?"[120]

Latour is actually a realist, believing there is a reality out there, and that our theories correspond to it with varying success. His work is a traditional academic polemic, pushing theories to their limit in the name of furthering discussion. His work is a purposely single-sided and restricted study to highlight certain features, something he is self-conscious about.[121] Despite this warning, many people still take him literally, which is why these words seek to pre-empt this type of response.

Latour provides a radical new perspective on science and focuses on elements usually ignored, denied, or victimized by ignorance. "Defending science and reason against pseudo-sciences, against fraud, against irrationality, keeps most [scientists] too busy to study it;" too busy to study science itself as an outsider.[122] Scientists are so busy with what science should and should not be, that they neglect to try an empirical outsider view. Consider the following comparison: The Italian Baldasar Castiglione wrote *The Book of the Courtier* (1528), on proper behavior in court and in high society in general.[123] It describes the virtues of a 16th century distinguished citizen and politician, necessary for success and respect. This can be compared to what Popper sought to do, as he too was describing how proper science should work. Then the more famous book *The Prince* (1531/2) by Niccolo Machiavelli, praises the use of fear, betrayal, and violence as effective and necessary tools for a ruler or politician, with benevolence and other virtues to be used when effective, but not as imperatives.[124] He makes extensive use of contemporary examples. These elements of politics are often publically dismissed, denied, or ignored, because they do not fit the ideology or desired image of that same system. Machiavelli advocates pragmatist tactics - a deviation from the usual focus on moral and good behavior in the contemporary

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[119] Latour, *Science in Action*, 52, 82-83

[120] Latour, Bruno. "Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern." Critical inquiry 30.2 (2004): 230. Print.

[121] Latour *Give me a laboratory and I will raise the world*, 142-3

[122] Latour, *Science in Action*, 15

[123] Castiglione, Baldassarre. The Book of the Courtier. Trans. Bull, George. Garden City, N.Y.: Doubleday, 1976. Print.

[124] Machiavelli, Niccolò. The Prince. Trans. Bull, George. London: Penguin Group, 1999. Print.

canon of political education. This would be Latour's *Science in Action*.[125]

In the following review of two of Bruno Latour's texts, science is radically defined as a social and political force. While Kuhn and Popper were still searching to define science as a more or less independent practice, Latour made the whole of society a context of science. Society as a context of science means that science is not practiced outside of regular life, it is not practiced isolated in labs or in autonomous objective spaces. Science directly and actively shapes the world and our understanding of it. It is therefore that Latour defines science as a force of meaning and reality. The two texts discussed here are his essay *'Give Me a Laboratory and I Will Raise the World'* and excerpts from the book *'Science in Action: How to Follow Scientists and Engineers through Society.'*[126] They complement each other well, because the *Science in Action* book is generally an elaboration of the paper. The chief arguments of both texts combined are: 1. What we think of as 'nature' is the result of the scientific process, and not its cause. 2. The diffusion model versus the translation model of science: independent truth and facts are an illusion, and obscure the essential social constitution and maintenance behind knowledge production. 3. To make a theory work, the world needs to be re-defined and re-described, and then made to fit this description. This is different to ideas of discovery, which purport that a theory works because it is true. 4. A scientist is like a politician or a bureaucrat, but given an advantage by operating in a depoliticized space. Much of what the scientist does is institutionally defined, and not the product of some mythological genius.

The Place of Nature in Science

Despite all the complications arising from the sociological and political aspects of science, aspects which are not denied by practicing scientists, the prevalent belief is still that nature will overrule these irregularities.[127] This belief is not unlike the expectation of the return of the messiah: Nature will eventually reveal herself to the believers in science and bring with her complete understanding. This is, for the most part, a belief in the scientific method, and that if followed closely, will lead to 'the truth'. It is also a belief about what nature is, nature like a referee deciding who wins in a scientific debate.[128]

Compare it to two Christian nations in medieval Europe engaging each other on the battlefield. Both ride with God, and they are convinced that God will prove their own side correct. In the end, the victor will claim that victory has proven God's favor. Yet empirically, the result of the battle produces God's favor, not the other way around, and there is no way to prove otherwise. This is no argument against religious narratives, but an empirical observation: the favor is a direct result of the battle instead of the cause of its result.

In the same way, nature plays a role in science: when a theory becomes established, it describes a state of nature or the world. Statements about nature only appear after a controversy is settled, and if nature only reveals itself after research, then it is the result instead of a cause of scientific discovery.[129] During a scientific controversy, invoking nature as being on your side does not work[130]: it would be tantamount to claiming that God is on your side, and quite unscientific. This observation makes the past

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[125] Latour, *Science in Action*, 37, 40, 124. The comparison is quickly drawn, and confirmed by Latour himself.
[126] Latour, Bruno. "Give Me a Laboratory and I Will Raise the World." Science Observed. Eds. Knorr, K. and M. Mulkay: Sage, 1983. 141-70. Print. & Latour, Bruno. Science in Action: How to Follow Scientists and Engineers through Society. Cambridge, Mass.: Harvard University Press, 1988. Print.
[127] Latour, *Science in Action*, 94
[128] Latour, *Science in Action*, 95
[129] Latour, *Science in Action*, 97
[130] Latour, *Science in Action*, 98

very hard to study, because of the temptation of teleology: of interpreting history on the basis of the knowledge we have gained of its outcomes. When watching a football match knowing the outcome is 1-0, every shot on goal for the winning team will be a near hit, while every shot for the losing team will be a futile attempt. You wait for the goal to be made, during which every chance by the losing team is merely a cumbersome delay of the inevitable. Some feelings of sympathy and ridicule might come up, as the losing team is foolishly unaware of their impending defeat, and all their work is nothing but obstructing the opposing team's inevitable victory hanging over them. This, too, is how history of science is often read: already knowing the outcome, nature is perceived to be on someone's side.

This causal inversion is important in understanding science. It is usually believed that science uncovers nature, that it discovers existing truths, just like the battle uncovers God's favor. Yet in reality, it is science that shapes the truth of nature, not the other way around: nature is a result of science.[131] This gives a descriptive or even prescriptive character to science, and makes it a whole different venture from the one described by Popper and Kuhn.

Diffusion versus Translation: Finding or Creating Facts

In settling scientific controversy, nature is wrongly conceived of as an actor, wrongly used in describing what happens before facts are established. Because nature is wrongly designated as a determinant, those who hold teleological perspectives will seek to understand how nature is prevented from revealing itself. After all, how can we fail to recognize nature when she is right there for us to see? This faulty understanding will blame social factors for obstructing facts and theories after their conception.

Latour calls the belief that facts lead an independent life, to the point that they could exist without people, the *Diffusion Model of Science*.[132] Followers of this model believe that the truth is out there in nature, and once unlocked it will automatically displace falsehood. Diffusionists see facts as eternal, almost Platonic. Part of this belief is an affinity for technological and scientific determinism. Diffusionists would argue that the computer changed the world, but Latour would argue that it was not the computer, it was us. Diffusionists would argue that, in truth, bacteria existed all along and were merely waiting for humanity to become aware of them. This determinism signifies the inevitable spread and adoption of science, but Latour wants to remind us we are the ones who shaped the computer and its science, we who shaped bacteria, and we who are still shaping science today, not the other way around.

In actuality, facts and innovations like the computer are constantly changing.[133] Much of our history contains fairy tales about geniuses who made spectacular breakthroughs: the myth of the genius.[134] Yet, their contribution is only a small part of the scientific progress associated with their names. Similarly, our terms 'Dark Ages', 'Renaissance', 'Industrial Revolution', or 'Science' for that matter, are categories of convenience that refer to an unwieldy range of events and ideas. Karl Marx drew much of his inspiration from the likes of David Ricardo, Adam Smith, Friedrich Hegel, and other French and German philosophers. He also wrote in a time where the topic of political economy and the rise of the proletariat was very popular in scholarly work and popular debate. Similarly, Darwin felt forced to publish on evolution because otherwise Wallace, who was developing very similar ideas in the Pacific, might have 'stolen his thunder' and become the paragon of the evolution debate instead. Alan Turing's

[131] Note that this means Latour is arguing that Popper's concept of the Oedipus effect is actually applicable to all science, and there is no escape.
[132] Latour, *Science in Action*, 133
[133] Latour, *Science in Action*, 134
[134] Latour, *Science in Action*, 134

work on the enigma code was enabled and preceded by great advancements made by Polish cryptographers. Alexander Bell stole the telephone design from Antonio Meucci; Leibniz developed calculus in parallel with Newton; Newton is known to use a lot of data from others, to the point of being on the verge of plagiarism; and heliocentrism was an idea that had existed since Ancient Greece. Yet it is in our nature to categorize and summarize, to take collections of facts and events and attribute them to one person or one focal point. If facts could emerge merely by discovery, then the first time heliocentrism was pondered, it should have become permanent. The truth is that facts are given shape in society by large groups of people functioning within great social and institutional contexts.

The aforementioned examples are to show that scientific progress surely means, as it is often phrased, to stand on the shoulders of giants. Progress is accumulation and constant development. In fact, 'standing on the shoulders of giants' is itself a Diffusionist statement, because it reinforces the myth of the genius. Instead, it may be phrased as standing on the shoulders and failures of everyone before and even around you. Diffusionists paint discoveries and ideas as magical instances of revelation, and everything that follows as static development.[135] 'Ideas' are thought to originate from one person alone (e.g. Newton or Copernicus), and often as only having been able to come from that person (Einstein). After this mythical revelation, the fact or idea is perceived as set loose, and its afterlife as a process of obstruction.

Society as Obstruction or Conduit of the New Truths

A Diffusionist reader might therefore read with frustration how long it took for people to accept Pasteur's work on microbes as true at first, and secondly as relevant to their own life or scientific practice. The educational and intellectual infrastructure supplied by organized religion is not generally thanked for its contribution; the church and religion are stereotypically often depicted as obstructing science. The fact that many exemplary philosophers and scientists displayed religious motives and inspiration is inconvenient for this view of science. Regrettably, the Diffusionist would view anything in the past that disagrees with today's truths as an obstruction, or even an enemy, of science. They would see fact and scientific truth as enduring martyrdom in society like a prophet of nature, unrecognized and persecuted by the authorities. This is part of the view that whatever happens in scientific history that does not fit presupposed development trajectories is designated unscientific or working against progress.[136] According to Diffusionists, society is a medium ideas travel through, while deviations of their projected journey indicate irrationality.[137] Human beings themselves are the greatest obstruction to truth, and social factors by definition are irrational.[138] It is as if decisions and discoveries were meant to be made all along, 'the truth was always there'. Irrationality becomes a go-to for whatever we do not expect or agree with. Tracing a truth or fact backwards from today, the Diffusionist wonders how people in history did not immediately understand it as it is done now, and conclude that it must have been due to social factors that prevented the truth from flowering. Note that sentiments involving 'the truth was always there' posit a truth usually wielded by those who utter it, and that it therefore becomes a tool for empowering the speaker. Rarely does someone who is proven wrong utter such a sentence.

Social factors should not be emphasized as blocking progress, they should be understood as the glue of science. Latour's own model of science is called the *Translational Model*.[139] His own definition of

[135] Latour, *Science in Action*, 135
[136] Latour, *Science in Action*, 135
[137] Latour, *Science in Action*, 136
[138] Latour, *Science in Action*, 136
[139] Latour, *Science in Action*, 141

translation is: "the interpretation given by the fact-builders of their interests and that of the people they enroll."[140] To put it more mildly, those that are creating new descriptions of the world translate it to connect it with the life experience and needs of others. No one is going to care about gravity until you explain or show that you can use it for ballistics and construction, or make possessing the knowledge otherwise worthwhile to the individual. For Latour, the term 'hard fact' refers to a piece of information with very strong social bonds. The associations made with it are so strong, that it is rewarded the designation of fact.[141] The translational model of science is thus a view that sees science as the engineering of associations, of relations, and connecting different descriptions of the world with each other.

The importance of this realization lies in understanding that objects and facts are moved onwards by people.[142] A smartphone is nothing by itself, all the elements required to make it work put it in a vast web of requirements and precedents, which need continuous maintenance. From the worldwide industry supplying materials and assembly, to the education required for the software development and use, to the maintenance and the level of scientific knowledge which was required to attain this technological marvel, to our own bodies which we use as reverse interfaces to interact with the device, and the fact that all major technical components the smartphone depends on are the result of separate government funded research projects. It almost sounds like Samsung or Apple should be involved in the freight sector, our school curriculums, university programming, medical and psychological research and awareness, and paying the government royalties, just to ensure the sale of its phones. These companies do not do any of these things, of course, but despite the fact that our society is not configured to reflect this, they are most definitely dependent on it.[143] It is a confusing and vast mix of aligning of interests and resources, but what is most certain is that a smartphone did not suddenly appear as a magical feat of mythical scientific genius. Vast groups of people are involved in making science happen, and making it successful. This goes for machines and invention, but also for theories and research.

Latour makes a subtle distinction in changing what is usually perceived as the interruption of the spread of science, is actually the encountering of new interests.[144] It is a process of translation, in which new ideas need to be accommodated to different interests. It is this change in perceiving science that makes Latour suggests that to understand facts is to understand people, because facts are mediated by people, and can only be mediated when their interests correspond with those constructed facts. It is not we who are guided by the facts, it is the facts that are guided by us. The adoption of Pasteur's work on microbes did not take so long because it was obstructed, but because it took a lot of people a lot of time to translate the theory into the larger network of medical practice already in place.[145]

Latour's theories emphasize the role of our own agency, of humans, and not nature or some predestined truth. Recall that this is a constructivist argument, which resists the notion that truth is independently present for us to discover. Constructivist views observe how interpretations of the world around us become facts or laws, with their epistemology anchored in humans, not nature. Latour

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[140] Latour, *Science in Action*, 108
[141] Indeed, it may be said that it is a little like a glass-is-half-full or half-empty argument, but not insignificant.
[142] Latour, *Science in Action*, 137-8
[143] Though corporate lobbying can be considered a form of doing this.
[144] Latour, *Science in Action*, 140
[145] Latour, *Science in Action*, 136 (check reference!)

focuses on this part of the process, the role humans play in turning a piece of information from a suggestion into a fact or truth.

The Lab and World-Changing Descriptions

Crucial to understanding Latour's theory is keeping in mind that his venture is to be understood from sociological and anthropological perspectives. He observes and registers, and does not seek essential or ideal, but empirical characteristics of science. His case is illustrated in *Science in Action* with many historical examples such as the Diesel engine, Marie Curie's Polonium, DNA, and growth hormones. His original historical case study five years earlier was that of Pasteur and his pioneering work on Microbes, which is the subject of his *Give Me a Laboratory and I Will Move the Earth*.

The chief aim is to show how Pasteur captures a piece of the world, changes its relations, and newly describes and controls the world with himself at the center. An important rhetorical claim is that Pasteur needs to 'turn the world into his laboratory' for his science to work. This has further consequences for how science is perceived, as it entails that scientists need to alter experienced reality before their work can be true, and not that science immediately works because it is true.

Where was the vaccine invented? Where is science?

Pasteur first went from his lab to the farm to learn, where he capture the disease and took it back into the lab.[146] Through his work in the lab, Pasteur together with his lab workers manage to isolate the microbe, grow it at will, infect organisms with it at will, simulate variation, and inoculate animals.[147] There was interest for the work, but it was considered to merely take place in a lab, not in the world at large.[148] Labs were, in those days, not as effective and reputable as they are now. The 1881 field experiment at Pouilly le Fort was a breakthrough: a heavily orchestrated public experiment to show off Pasteur's achievements in the lab.[149] Great media attention was organized, and given, to the experiment in which Pasteur predicted which animals would die from the infection and which would not. It was a great success.

A standard account of Pasteur's story will say that the vaccine was invented in his lab.[150] If Latour were forced to point to any specific moment where it was invented, his choice would, however, be Pouilly le Fort. The novelty of the argument is the stress on the step from the lab to the public. This step is usually ignored in history of science. According to the diffusion theory mentioned above, the vaccine is invented in the lab, and its spread taken for granted. Latour disagrees: the field experiment is a crucial aspect of science, and one in a long series of events that are inimical to it. Diffusionists would say that it had taken physicians 13 years until, finally, in 1894, they agreed that Pasteur's work was relevant to their own.[151] Thirteen years of irrationality, of obstructed science. In reality Pasteur's work was seen as concerning prevention, not curing disease. These 13 years were years of translation, re-interpretation and incorporation into existing frameworks, and of convincing learned people to change their ways. The Diffusionist would interpret the 13 years as wasted, as his teleological view does not understand why the fact of vaccination does not travel freely, and is obstructed by people. Latour sees the 13 years as necessary time, an attitude more neutral in judging history. If established tradition and

[146] Latour, *Give me a Laboratory*, 145-7
[147] Latour, *Give me a Laboratory*, 148-9
[148] Latour, *Give me a Laboratory*, 150
[149] Latour, *Give me a Laboratory*, 151-2
[150] Latour, *Give me a Laboratory*, 150
[151] Latour, *Science in Action*, 136

wisdom could be overthrown with the flick of a switch, it would mean chaos. In these 13 years, many scientists, forgotten in time, worked tirelessly to develop and spread microbiology, like missionaries. Microbiology did not start, nor end, with Pasteur, but it is still alive and still being created and transformed this very minute.

Pasteur did not unleash a truth that simply flies out of the lab and colonizes the world all by itself.[152] People needed to be convinced, and even more, the world itself needed to be coerced. This is a crucial part of the larger argument: the world outside needs to be made to fit the world of the laboratory. Microbes do not exist until you convince people that they do. It is much more sensible than it sounds: the experiment in Pouilly le Fort needed to follow the rules of the lab exactly, otherwise it would not have worked. Pasteur and his team created a new language, a new power, a new agent: that of microbes and microbiology. For the experiment to work, they describe the world, and in doing so, they reconfigured it. Only after their strict instructions were followed, did their experiment work. Only when accepting the claims about microbes and how they work did they become real and did they extend to our life and world. The crucial part is that description of the world, and its adaptation into our own experience, comes first. Scientific theory and its application will be inert, gathering dust like Mendel's genetics, unless it is advertised and translated, unless it is aligned with interests, made relevant or otherwise justified. Pasteur's theory and the facts it contains will not survive without this action, which is why social context and the science should not be studied separately.[153] To understand science is to understand knowledge creation, and to understand knowledge creation is to understand people and society.

The Pope wields the power of the Catholics and of God. A force created by Saint Paul in Rome. Marx, too, created the force of the proletariat.[154] It enabled socialist politicians to employ a language and a view of the world in which they represented and wielded the power of the laboring masses. Using their description of the world, they then position themselves as authorities of a new power, which can modify society and which cannot be absorbed or explained in the existing system. Pasteur too wielded the power of microbes, a fresh new power with him as its spokesperson, its master.[155] He gained the ability to redefine, describe, and even dictate the world. It is a recurring pattern, just as today, in the early months of 2015, Thomas Piketty has suddenly become an authority on the economy and contemporary capitalism. For the time being, his name will be synonymous with income inequality. His research team and all the people that have helped him and delivered data are forgotten. As a byproduct and necessity, science invests theories and facts with concentrated authority to describe the world.

A Depoliticized Space with Political Power

The laboratory is a place where fresh new politics are created.[156] Note that the laboratory is institutionally similar in social constructivist architecture to the Ivory Tower: this institutional structure exists for all the disciplines. Denying that these places produce new politics is like denying children have anything to do with sex.[157] The same reason makes intellectually vulnerable nations heavily regulate university curriculums. A side effect of the way this works is that the application of new politics, extending the conditions inside the lab to beyond, causes prediction to only work if the outside of the

[152] Latour, *Give me a Laboratory*, 155
[153] Latour, *Give me a Laboratory*, 159
[154] Latour, *Give me a Laboratory*, 158
[155] Latour, *Give me a Laboratory*, 157
[156] Latour, *Give me a Laboratory*, 157, 160
[157] Latour, *Give me a Laboratory*, 153

laboratory is made to conform exactly to the inside.[158] This poses the interesting problem that predictions only come true when the exact prescriptions of the scientist are followed, which does not make it prediction, but engineering. Society needs to be engineered to fit certain facts, instead of the other way around. If this fails, the fact will be lost.

Part of this engineering is creating new categories and descriptions, which facilitate the new facts and ideas. Once a world is convinced of these new ideas, the new science can be put into practice. The rivals of Pasteur, the hygienicists, were studying whole cities, nations, soil, wind, wealth, climate, diet, and crowding – in combination or all together at the same time.[159] They too were looking to find where disease comes from, how it spreads, and how to prevent it. The Hygienicists would never find what they were looking for though, as long as they did not take microbes into account. Remaining within Latour's framework however, the mistake is trying to understand the world with the existing descriptions and variables, seeking relations between existing categories. This situation is in favor of the disease, which cannot be caught in this perspective. Pasteur catches the microbe and creates a situation in his lab in which he determines how the microbe behaves. In the process, he describes a new world, one in which he has the power over the microbe and those who it affects. Anyone willing to participate in that power will have to accept Pasteur's description first, his authority, and then act on it.

In a nutshell, the process of producing science in Latour is: first, create a vision or description. Then convince others to share this with you by describing the potential action in the context of this vision. That is how knowledge is created, how new visions emerge, new powers are unlocked, and the world understood and changed: always acting on our own descriptions, our own definitions of nature and social. This then, is his experiment. Kuhn had already stressed persuasion and subjectivity, but Latour goes so far as to say this is the main element of science. To Kuhn, persuasion is key in theory controversy, while to Latour it is even present in all theory creation and propogation. Kuhn argued that most of science was puzzle solving and theory elaboration, but Latour attributes the creation of new politics to science too.

The Scientist, the Politician and the Bureaucrat.

Latour describes a stereotype of a politician: self-interested, greedy, short-sighted, fuzzy, compromising, shaky, active in full scale, having single chances, and being constantly monitored.[160] Now consider this stereotypical description of a scientist: disinterested, far-sighted, honest, rigorous, clear, looking for certainty, working on scale models, being allowed many mistakes, and hidden from scrutiny. The only real difference between the two, Latour concludes, is that the scientist has a lab. As soon as the scientist steps out of the lab, the scientists turns politician, arguing uncertainties receiving immediate feedback or pushback on mistakes.[161] To stay correct, the scientist must extend the lab to wherever he travels. A simple example is that of standard weights: only if the scientist can convince the people where he travels to use standard weights, will his research make sense.[162] The politician too will only be believed where his world-view is shared: he will paint pictures of the world and suggest actions based on it. When a voter shares the world-view, or is persuaded by the description, then a vote can be secured, or even a supporting action. The scientist can try to describe the world as many times as he likes within the

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[158] Latour, *Give me a Laboratory*, 166
[159] Latour, *Give me a Laboratory*, 149
[160] Latour, *Give me a Laboratory*, 165
[161] Latour, *Give me a Laboratory*, 166. Compare to Kuhn when he says that as soon as a scientist leaves the theoretical comfort zone, he becomes a philosopher.
[162] Latour, *Give me a Laboratory*, 166-7

laboratory, is allowed many mistakes, and is even praised for making them and trying again. Very few will praise an experimental politician, and praise his mistakes, while the ivory tower protects the scholar from this.

Consider this job description: dealing with many papers and forms, handling a lot of files, knowing little of the (real) social world, imposing forms on other forms to try and make them fit, and preferring to believe a piece of paper over any other source of information. This description could easily fit a scientist. It could also be a bureaucrat. Interestingly, the bureaucrat is despised for the very same reasons the scientist is admired.[163] Not only is it that the scientist has a lab, but what he creates or dreams up is not usually directly applied to our personal experience. The difference to the bureaucrat is that it seems like the forms and papers the scientist deals with have nothing to do with us, while the bureaucrat has our name on those papers, and their fate is directly determining ours.

Thus, the laboratory can be seen as a secular political space, which gives scientists incredible power to change and describe society without the immediate backlash a politician or bureaucrat would endure. Yet all of them describe society, seek to develop a new language, and positively associate themselves with this language. Some say that the magic of science lies in special methods, special minds, or special culture, but the material reality is that it is the laboratory, which enables the magic of science.[164] Pasteur himself has confessed that his success is not thanks to the scientist, but thanks to the lab.[165] A laboratory can be characterized as a space in which you are allowed to make as many mistakes as you want.[166] This plurality of mistakes is then archived, recorded, organized, and readable. Pasteur, in his lab, was able to try out new descriptions of the world cheaply and repetitively, harnessing the power of the sum of mistakes. It makes him more powerful than anyone, who is allowed fewer mistakes.[167] Anyone outside the lab has to work in a chaotic world where mistakes are fatal. Admittedly, these mistakes can be understood as the scientific method, or as experimentation, or even an ivory tower, which protects the academic world from outside influence while the scientists figure things out. It is an immense privilege, a unique institution, and greatly underestimated and misunderstood source of power in shaping our world.

Reflecting on Latour

Usually, science is perceived as revealing nature, but to Latour it is science that creates nature. What nature is, is a result of science. So too are facts and truth, which are often seen as existing independently from our inquiry. Even when they do, their representation is still interpreted and created by us. Facts and innovation are living processes, and change all the time. What nature or society is now, is very different from what it was 30 years ago. While society is often seen as an obstruction to the diffusion of knowledge, it is actually society that is the necessary conduit giving shape to it. Facts are meaningless without humans, without our human framework to relate them to our own interests and experience.

For Latour, science is the creation of new language, new descriptions, which are then successfully related to our world experience and interests. Every scientific innovation includes not just a conclusion by a scientist, but also the process by which it is expanded beyond the ivory tower and

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[163] Latour, *Science in Action*, 255
[164] Latour, *Give me a Laboratory*, 160
[165] Latour, *Give me a Laboratory*, 161
[166] Latour, *Give me a Laboratory*, 164
[167] Latour, *Give me a Laboratory*, 165

beyond the laboratory. Science only works if you convince the world, and this stage is a greatly underestimated part of it, because it shapes what the knowledge means and even what it contains. The Latourian view focuses on the power of description, the social forces necessary in science, and reveals the lab as a de-politicized space for producing new politics. A scientist does many of the things the politician and bureaucrat does, but is privileged in that he is made more or less immune, because of the isolated position science is given institutionally. Once the work is done, the scientist goes outside to try and integrate his new descriptions into our lives and decision processes. In this sense, scientists truly (re)create the world.

Latour's argument that a lab is a depoliticized space where politics are created seems like it is revealing some nefarious scientists and scholars manipulating society from their covert and privileged position. The lesson is exactly the opposite: exactly because the university is ideally de-politicized, the laboratory gives room to free speech and democracy. Democratic ideals need new politics all the time: it needs eloquent, innovative and up-to-date interpretations of the society and its needs to act on. The use of the word politics is scary to many scientists, but an important aspect of politics is creating the potential for action. Politics is also about creating actors, creating concentrated power for getting things done, finding consensus and agreement so decisions can be shared and acted upon: it is reaping the benefits of shared understanding of the world and what needs to be done.

Comment

Is this fair, or is it just rhetorical? Is the scientist winning an argument because he is right, or just the most persuasive? Did he do the right type of falsification, was he lucky, or did he redefine the world to fit his results? These are possible responses to Latour's theory, but the most important thing is the realization that nature and our world are defined by the descriptions of scientists. Nature is not verified, but literally defined by what they do.[168] Truth is not important in understanding this aspect. Incontrovertible facts and science do not conquer society, it is ideas of nature and the world heavily entrenched as facts, which find their way out.

People outside the world of science are telling other people what to do and what to think all the time, which is resisted or accepted in varying measures. It is strange to consider that scientists are also describing the world, providing theories for what to think and do, while operating in isolated autonomous spaces like the lab or the ivory tower. That is not what happens, a scientist will never say: this is the truth, but it does not apply to you because science is an autonomous space, separate from society. The scientist will even argue that it *does* apply to you *because* science is an autonomous space, which is exactly how science betrays that it is a producer and coercive actor of descriptive politics.[169] Just like the politician derives authority from the people and the political system, and the priest derives power from the church and its constitutional documents, so, too, the scientist claims the authority of knowledge traditions generated from within its protective boundaries. In a sense, science is the most sneaky and coercive of them all, because its truth is derived from exclusive access to texts and information, much like the priest. But at least the politician derives authority from a physical source in which outsiders can participate, just like the bureaucrat can be sued, and the religious man disagreed with through religious freedom. Such a thing as scientific freedom does not exist in the same way.

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[168] For a more moderate version of this argument see: Kitcher, Philip. "The World as We Make It." Science, Truth, and Democracy. Oxford; New York: Oxford University Press, 2001. 43-53. Print. Kitcher, 52: "For our classifications, the ways in which we draw boundaries around pieces of nature to suit our capacities and interests sometimes lead us to modify the world as we find it."

[169] See also Kitcher, 201

Popper quotes Kant: "Our intellect does not draw its laws from nature but imposes its laws upon nature."[170] He proceeds to argue that it is a logical a priori, but not a valid one. He means that it is logical to expect laws and regularities to exist in nature, and from this expectation to invent laws and patterns to see if they fit. It is nonetheless invalid to expect our laws to be imposed successfully, he says, because nature resists our impositions. If theorizing gravity pulls objects up, nature will resist the attempt to impose this regularity on it. It shows Popper's description of nature as an actor, the type of actor Latour argued not to exist. Nature will never tell us how we should understand or describe it, this is up to us. Nature is not preventing us from arguing that gravity is upwards. Something like this: Perhaps this world is burdened with sin, which keeps us away from the heavens as our bad Karma is pulling us down. This because our natural inclination is being united in the heavens, which is where the source and core of being and existence is found. This kind of ad-hoc reasoning is possible on any level of science and in any discipline. That this is possible with real power and effect is evidenced by the many cults, sects, and new religious movements still active in scientifically advanced societies, groups that successfully recruit intelligent people capable of critical thought. It is naïve to think that a certain group of people is completely impervious to this reasoning. Invoking nature in an argument is invoking the authority of truth – and a fallacy. What we end up saying is that something is correct because it is the truth. What this all comes down to is that the truth will never speak for itself, someone will always speak for it.

Coase Theorem: An Example from Economics

The power of description inherent in science is not to be underestimated. As recent economic turmoil has shown, descriptions from the economic sciences can have great consequences for the choices made by politicians and policy makers. An infamous example is the Coase Theorem, which, much like Adam Smith's invisible hand, was an influential thought experiment/metaphor.[171] It has received great academic, judiciary and policy attention, including both attempts of expanding on it, as well as debunking it. At its core, the Coase Theorem argues that, with sufficiently low transaction costs, bargaining will lead to a satisfactory outcome for all. The theorem addresses conflict resolution theory involving externalities, such as environmental damage and pollution. Its application has been broad, but one use has been to support the argument that government does not have to regulate corporate or individual pollution, because the rational parties involved will bargain their way to a solution. Ronald Coase himself, and many scholars after him, has emphasized that this situation almost never occurs in reality: the transaction costs are always too high for at least one of the parties for the theorem to take effect. Yet, the theory was taken up and has received much attention, because it aligned with world-views. This is not a story about political or business interests, or problematic characteristics of the study of economics, but about the role basic interest plays in promoting or developing descriptions. It shows the interaction of how politics are created in the sciences, simply through the act of description.

For Popper, the Coase Theorem would represent a dogmatic belief, which is attempted to be made testable and applied in order to heighten its scientific status. Popper believes that with sufficient critical attitudes it can be proved wrong or right. For Kuhn, who viewed absolute falsification as unlikely, the choice for the Coase Theorem is philosophically motivated. All discussions on whether it is true or not are part of the puzzle-solving phase, which means it has already been established as normal science.

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[170] Kant in Popper, 174

[171] From a seminar on the history of Experimental Economics in Utrecht School of Economics 30-1-2015. See: Medema, Steven G. The Legacy of Ronald Coase in Economic Analysis. Aldershot, England; Brookfield, Vt.: E. Elgar, 1995. Print.

What Latour adds to this is the insight that, first of all, the Coase Theorem has created a new description of the world, a new agent, carried by its describers. Like Latour said, it is more important to be read than to be right. Now that the Coase Theorem has entered standard debates in Economics, it has achieved the status of a knowledge object. It has been established as something that exists and worthy of study, both by its opponents and proponents. Proponents seek to draw power from it, while opponents seek to undermine it in favor of some alternative.

The Problem of Science

These knowledge politics, descriptive elements, and philosophical modifiers are more obvious in the human than the natural sciences, possibly because more people and interested parties from outside their disciplines participate in them. They are generally denied in the Natural Sciences, which is something all three philosophers seek to correct in their own way. Popper marginalizes intuition and creativity as the initial frame for a theory, purporting that what is science comes afterwards. For him, the problem of science is that of filtering truth from subjectivity, despite lasting uncertainty. For Kuhn, scientific values determine theory choices, which is his way of saying philosophy of science sets the stage. Scientific values are choices, which last for the duration of the study of the theory, and therefore form a subjectivity with an enduring presence in the realm of objectivity. For him, the problem of understanding science is determining and evaluating our scientific values, and understanding the link of the resulting practice to them. For Latour, knowledge politics are equal to science, instead of just being a part of it. For him, the problem of science is that of establishing knowledge objects, of generating meaning and relating it to our interests, tying it to potential actions, and consequently concentrating control and power in the hand of those who wield this knowledge.

Which one of them is right?

The boring answer - and the correct one - is all three of them are right. As an example, take the role that the three give to 'the human element' in science. The term is used here to indicate the effect of human subjectivity on the search for knowledge. For Popper it is necessary, but to be overcome. Kuhn thinks the human element is unjustly thought of as a weakness, and crucial in understanding scientific practice. Latour writes that though the human element is a construction, it is actually the constituent of science, and only through our own subjectivity can we engage with knowledge. As it turns out, any debate about which one of the three characterizes science best is actually proving Kuhn right, because whichever you prefer is matter of your scientific values. To reiterate: Popper says we must work to transcend the human element in search for certainty, Kuhn says we should not neglect it, and Latour says science itself operates on and is hopelessly dependent on it. So take your pick: are the scientific method and ideology, the scientific philosophy and values, or the social infrastructure and institutions most characteristic of science?

Another point of comparison: mistakes. All three mention them in different contexts. For Popper, mistakes occur when theories prove wrong through the method of falsification. In Kuhn, mistakes are observed when theories are wrongly applied, deviating from status quo and from standardized scientific values. For Latour, mistakes are a privilege of the knowledge worker, as the scientist is allowed a space for describing the world without immediate backlash. Interestingly, all three agree that mistakes lead to progress. Again, the axes of their perspectives are method, philosophy, and the social. Kuhn and Latour take it upon themselves to expose the relevance of these other factors, but clearly science cannot do without any of them. It is silly, therefore, to characterize science by just any

one of these, because science is not exclusively a theory, a world-view, or a tool for directing social and economic power.

Popper Wins Anyway

Yet, in today's society and politics, Popper wins anyway. Admittedly, on the surface and in the textbooks, Popper's view of science is the most sensible. It aligns itself best with how natural scientists view what they are doing, and with how they present themselves to others. It is natural science that tends to be used as a standard for measuring the scientificity of other disciplines. Science is seen as being predominantly about method, experiments, and proving things. It is not considered scientific to focus on understanding, describing, and analyzing, the things that the role model disciplines do not primarily address. This is why some social sciences and the human sciences are on the defense, as they are charged with explaining themselves in Popper's frame of reference. It is part of an instrumentalist view, often accompanied with a focus on objectively measurable output, or economic returns. It ranks results above purpose and intent, with results defined in a way that the only way to do it right is doing no human sciences at all. What matters in this thesis is that, underneath it all, is a denial of how integrated and important philosophy and sociology of science is to all sciences. The sciences are all part of shaping philosophy and society. In judging the sciences, their function as a carrier of philosophy and descriptions is greatly underestimated.

The Chair, the Moon, and Philosophy of Science

The problem of defining science is comparable to the question: Where is the origin and the essence of a chair? It may be the moment it was created, the final product presented, or its usage and effectiveness, which can be directly experienced. Or maybe it is the work done to harvest the wood, to select the materials, and to choose and create the tools necessary to make a chair. Without this process and choices made in it, no product would exist. Or maybe it is the original notion, the moment someone thought wood could be reconfigured into a shape, and a composition of parts, to become a device for sitting on. This person had to convince himself and others that this was a good and useful idea. Admittedly, the first one is easier to grasp, and the third seems somewhat silly. Yet, it cannot be denied that without any of the three stages, the chair would not exist. Some fundamental description and philosophy is required for setting up the criteria and parameters of the work on a chair, the form of which determines the end product, and the lack of which prevent completion.

When arguing that the final product is the only thing that matters, constitutional and early stages of development are ignored. Would it be decided that only this late stage matters, all chairs would be exactly the same in the end, even if we needed different chairs. Just focusing on the final goal state is not enough. Consider also the first moon landing: Was the most important moment when it was decided that a moon landing was possible and necessary, was it the puzzles and challenges of making it possible that were most crucial, or was the most important moment when it actually happened? What is most representative? What is most essential? The conception, the creation, or the result?

These metaphors are to showcase our tendency to pick one of these three to represent all of them. We need to have some kind of goal or product, and faith in it, much like Popper's faith in critical thinking and demand for testability. We need to think about the process, how this is achieved and how it affects the different purposes and results we envision, much like Kuhn's emphasis on interpretation of the values involved in the project. And we need to think about where the terms and concepts came from, which we use to determine our goals and mental and physical tools, much like Latour's explanation of our constructed environments for producing and imposing new knowledge. These

maxims should not be a surprise to anyone at all. Yet on many occasions, science is thought and talked about almost exclusively in methodological and instrumental terms, reluctant to acknowledge the role of those other factors.

Cunningham and Williams: The Philosophy of the Philosophy of Science

'The disagreement on what science is', is an interesting way to describe what philosophy of science entails. Cunningham and Williams, in their discussion on the history of the concept of the scientific revolution, describe three major categories of philosophy of science: philosophical, moral, and as universal human enterprise.[172] All ideas on what science is, and its position in society and history, can be located in or between these terms.

Their Philosophical perspective is explained as being about method of inquiry. This perspective is explained to finds its home in 19th century positivism, and sees science as being about the superior way of producing true knowledge, usually taking the physical sciences as a prototype. For this perspective, science is about laws, prediction and explanation only. Science is seen as originating in the Scientific Revolution, which is described as the period in which mechanical philosophy started to take hold, and general mathematical causal laws become more commonly applied. The historical category of Scientific Revolution was invented by people with this view in the 1940s.[173]

The Moral conception[174] takes science as the embodiment of the values of freedom, rationality, truth, goodness, and as a cause for social and material progress. It is often accompanied by utopian ideals that science will bring widespread peace, welfare, happiness, and the end of manipulative politics. The moral view also uses the Scientific Revolution, but more in the context of the resistance to Church dogma, and the independence of science from tradition and authority. In short, it is taken as the representative of the advancement of free thought. This view is prone to politicization, and can be found in populist rationalist contexts inside and outside of academic circles. It is the most common positive view of science in the public perception.

The third view, science as universal human enterprise, more or less sees science as equivalent to civilization. Science represents the eternal quest for understanding, coming from an inborn curiosity and desire to understand. Historian Norbert Elias broadly refers to Civilization as a concept expressing "the self-consciousness of the West."[175] All respectable and institutionalized forms of knowledge count as science, because they are part of this continuing process. In this view the Scientific Revolution is no more than a development within science as a whole, a new approach to existing problems. It also means the ancient Greeks practiced science in their own way. They approached many of the same questions as were addressed in the 17th century scientific revolution, but regrettably without arriving at the same answers.

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[172] Cunningham, Andrew, and Perry Williams. "Decentring the "Big Picture": The Origins of Modern Science and the Modern Origins of Science." The Scientific Revolution: The Essential Readings. Ed. Hellyer, Marcus. Malden, MA: Blackwell Publishing, 2003. 221-4. Print.

[173] Cunningham & Williams, 221

[174] I hope it is not too confusing that C&W use 'Moral' for what I had earlier described as 'Philosophical'. For them philosophy refers to method, while in my use it refers to the Kuhnian interpretation of values. It can be argued that they are both philosophical in the sense that they are about epistemology and ontology, but I draw the line at fundamental interpretation which plays a lesser role in Popper. Going into this farther would mean defining philosophy, which would make this thesis even more complicated than it already is.

[175] Elias, Norbert. The Civilizing Process: Sociogenetic and Psychogenetic Investigations. Trans. Jephcott, Edmund. Oxford; Malden, Mass.: Blackwell Publishers, 2000. p.5. Print.

Popper, despite his criticisms, clearly falls in their philosophical category. His notion of critical thinking as the essence of science can be interpreted as meaning that, as long as the correct critical thinking is applied, something is considered science. In combination with his ideas on falsification and testing, he places himself clearly within an empirical and experimental tradition, which is usually argued to originate during the scientific revolution.

Kuhn is tricky, because he does not say exactly that science is about progress or freedom. He does, however, describe science as operating on a set of scientific values. These values are constitutive of what is eventually produced, and also become representative of that produced knowledge. In other words, when a science or theory is successful, the ideas and philosophy behind it become more popular too. Even though Kuhn tends to describe science as inherently conservative, he certainly understands it as a carrier of ideals and philosophy, which profoundly influence its functioning and results.

Latour can best be understood in the third category of universal human enterprise. Latour's translation model of science is not unlike the spread of civilization: the effort to implement institutions and knowledge traditions can be understood in the same way that scientific facts and concepts like the microbe are implemented through integration. The way he speaks of how scholars create the world around them with language fits the idea that science is civilization. Science, in response to society, and as a tool to engage with society, has defined what nature is, and what society is and should be. Especially when accepting that scholars think about and define what society is, it becomes evident that they are giving meaning and definition to what civilization is.

The next chapter of this thesis will address the virtues of this last comparison. It is not done to disprove anything, but as a supplement to achieve greater and broader comprehension on the position of science in society. Robin Horton describes how society interacts with religion, and what religious theory entails, enables and contains. The structural and functional features of which fit very well with Latour's philosophy of science, and will help show that science is also a representative of who we are as humans, instead of some independent structure developed merely in service of us.

Horton on Religion, Theory, and Science

> "*The truly scientific mind has… been long familiar with the truth that a so-called law of nature is simply a convenient formula for the coordination of a certain range of phenomena.*"[176] Nature Magazine book reviewer, physicist & mathematician, Cargill G. Knott, whom observes that science as description is rather obvious, *1892.*

Introduction

Robin Horton has studied religion in African societies for over four decades and to this day resides in Nigeria, teaching and working at the University of Port Harcourt. He is an expert in the field of religious theory and cultural analysis. He defines his approach as intellectual-pragmatic, referring to his view that religion is a cognitive tool, adaptive and acting on the needs presented by social and intellectual environments. Within religious studies, Horton's theory is classified under the label cognitive or intellectualist theories of religion. Guthrie summarizes this label succinctly:

> "Cognitive, or intellectualist, theorists assert that the leading motivation for religious thought and action is to interpret or explain the world on one hand and to influence or control it on the other. In this view, religious thought may be mistaken, but it is neither irrational nor, in context, even implausible. Nor does religion differ fundamentally from other kinds of thought and action."[177]

This is opposed to other ideas, like those of Freud, which emphasize the individual and unconscious, and see religion as a tool for embodying wish fulfillment and dealing with anxiety;[178] Durkheim, who sees religion chiefly as a social mechanism for a shared social identity and action;[179] and Arnold van Gennep, who focuses on religious ritual as an instance used to deal with and relate to nature and social phenomena. [180] Gennep has many parallels with Horton, but while he focuses on action, Horton chooses a more theoretical approach, treating religion as a method of explanation, prediction, and control. Beyond some of the basics of Durkheim, Horton stresses both how theory reflects society and how it is used to engage with it. The idea that religion does not differ in its fundamentals from other kinds of thought and action leads Horton to promote the *Similarity Thesis*, which directly compares religion to science. In the following paragraphs, Horton's theory will be reviewed, illustrated with examples from his own book and some extra ones added for flavor. The main sources used are the introduction, first chapter, and post script of *Patterns of Thought in Africa and the West: Essays on Magic, Religion, and Science*.[181] The book is a collection of essays, which review in depth the evidence, observations, and examples on which Horton bases his theory. It is in many ways the zenith of his academic quest to get his theories established. From the tone in the post-script, it can be understood that Horton has grown tired of his critics, but is hopeful that his ideas would be widely accepted, or even self-evident, in about

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[176] Knott, C. G. "The Grammar of Science." Nature 46 (1892): 97-99. Print.
[177] Guthrie, Stewart Elliott. "Religion: What Is It?" Journal for the Scientific Study of Religion (1996): 413. Print.
[178] Partridge, Christopher H. The World's Religions: The New Lion Handbook. Oxford: Lion, 2010. 26-8. Print.
[179] Partridge, 19-22
[180] Partridge, 32-34
[181] Horton, Robin W. G. Patterns of Thought in Africa and the West: Essays on Magic, Religion, and Science. Cambridge: Cambridge University Press, 1993. 1-49, 347-387. Print.

20 years.[182] It is 23 years later now: let us indulge and see if his hope has come true.

A quick note on the definition of religion: in this chapter, religion is treated as a theory in its own right. The general analysis and eventual comparison to science only works if religion is compared on a structural and functional basis. When defining religion based on content, the comparison is rendered meaningless. In addition, comparing religion and science based on content would always mean that a prototype is created, which would pose the problem of one religion ending up as more properly 'religion' than another. Secondly, the analysis focuses on what religion and science do, not on their results. At no point is the result of any science questioned. The question of superiority in achieving a certain type of result is also unimportant. Neither will the truth of religion be of any relevance to the greater argument. This chapter will emphasize processes above results. It will show that there is more to understand about the role of science in human society, and how this can be done. Doing so will prove the importance of asking what science is *about*, as an important antithesis to what it is *for*.

In short, this chapter will discuss: 1. The problematic definition of religious objects, and Horton's definition of theory. 2. The interaction between theory and experienced reality: theory and daily practice. This is understood by the interaction of *Theory Of*, and *Theory For*. 3. The correspondence of social structure with theory, and of needs with theory. Both discussed in a context of engaging with social and individual reality through theory as a cognitive tool. 4. The *Similarity Thesis*: the ways in which religion and science overlap. Both are used for explanation, prediction and control in everyday life and beyond, and depend on accessibility and engagement through their descriptions. 5. The comparison is further supported by observing that science itself has grown out of religion, instead of alongside it. 6. With their comparability established, the descriptions of religion used earlier in this chapter can also be applied to science. They show science as crucial in describing our world and life experience. There is much more to learn about disciplines and science by asking the question what it is about, than what it is for.

On Theory: Blurring the Secular and Sacred

The Western African societies studied by Horton consider using gods as equivalent to using charms, magic spells, or potions.[183] Equivalent here means that both engage certain hypothesized powers in the world with a particular goal: if the god will not listen, maybe a potion works instead. If the purpose of a potion and petitioning the gods is the same, then a functional distinction is tricky. Some might hold that both are equally superstitious, but then it can also be said that both are equally religious. Though the subjects - gods and potions - are very different, their functionality and purpose is the same.

It is comparable to having lucky socks, or praying (petitioning) to a god for a sports victory. Praying is considered religious, and lucky socks adorable. Yet it is hard to deny that in some way, lucky socks function as a religious object. Some kind of higher power is associated with them, a power beyond just being socks, making them fall into the category of religious object. These actions and objects "utilize the principle that the symbolization of a desired end brings about its fulfilment".[184] They represent an attempt to give needs a structure; they provide imagined control, relieve anxiety over helplessness, and provide potential for action.[185] The lucky socks are a symbol of luck, in which is invested and to which is

[182] Horton, 354
[183] Horton, 30
[184] Horton, 41
[185] Also in the same train of thought, but using the concept of magic and myth: Malinowski, Bronislaw, and Michael W. Young. The Ethnography of Malinowski: The Trobriand Islands 1915-18. London; Boston and Henley: Routledge & Kegan Paul, 1979. Print. (e.g. 212-3).

attached some kind of hope or invisible force that will affect performance. Meanwhile, praying is a plea, a request, asking god to help us. Both externalize the fulfillment of some need, and by associating with the externalization attempt to achieve control over the uncertainty that caused the original need. But for Horton, an understanding of religion by its subject content is not sought. Instead, its functionality and application is made central to the analysis. In this mode of thought, Horton spends several pages reviewing different definitions of religious theory and religious objects, but finds there is no way to define a religious object without including some secular object in it.[186] Even though praying is clearly very different from putting on socks, the purpose and logic behind the two are the same.

Take, for instance, a definition of a religious object as 'something which cannot be touched or observed directly, and of which the existence can only be verified by other observable phenomena, which are assumed as symptoms of underlying unobservables'. Among such unobservables can be counted atoms, alpha particles, string theory, genes, the Social in sociology, the Renaissance in History, justice and power in political theory, incentives and rationality in economics, gender, identity in anthropology, intertextuality in literary theory, and even just plain mathematics. No person has ever directly observed any of these. As Horton describes it: far away "from the sphere of the ordinary, solid material things, we find the religious side by side with the secular." Some more attempts: 'Religion is Society worshipping itself', a definition which also includes football culture. 'Religion is a set of beliefs about the meaning of life and the nature of the universe'; a definition which can be made to conform to (astro-)physics and biology. 'Religion is about what happens after death'; which could also include the broad study of history and psychology of memories. 'Religion is about the belief in higher powers'; which includes gravity, and all of the unobservables previously mentioned.[187] 'Religion is about creating communities who follow authoritative leaders who provide and follow virtues and values beneficial to all its members and society'; this can include nationalism, Leninism, Chinese Communism and different forms of fundamentalism, which puts extreme Constitutionalism in the same category as the self-proclaimed Caliphate in Iraq. For some, religion may include 'the use of sacred relics that represent certain events, and magical items that bestow enhanced abilities on the wearer'; which would arguably include photographs, The White House, and mobile phones. Any definition, which tries to capture all of religion, if considered long enough, will always include other secular aspects of life. The only way to save religion from this problem is by defining it by its content, which would force a prototype, surely a problem to any religion that is not picked as the prototype.

That which is termed religion contains and serves many functions integral to our life experience. While differences in content and method stand out, the functional and structural aspects transcend any attempt at definition. In the ensuing confusion, Horton starts inspecting what a religious theory does at its very core, looking for an explanation of religion's place.

Theory Adds Meaning and Relations

Religious theory, treated as a general theory, consists of a collection of statements which describe the world or parts of it, and are in a real sense, a theory of the world. Theory itself is never a passive mirror of the world of everyday discourse.[188] Theory never merely describes everyday life, but imbues it with

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[186] Horton, 25

[187] One that could be added is Foucault's infamous micro-physics. With micro-physics he refers to emergent pressures and influences which steer our individual behavior, and reproduce through disciplinary institutions like prisons and hospitals: a transcendent societal power. Foucault, M. Discipline and Punish: The Birth of the Prison. Trans. Sheridan, Allan. London: Penguin Books, 1991. 23-30. Print.

[188] Horton, 356

extra meaning and advanced descriptions. As such, the Nuer people believe there is a Spirit (Kwoth), which is entirely indeterminate, and contrast it to creation (Cak).[189] The Spirit itself can never be understood, but its effects and existence can be perceived in creation, and engaged in the form of symbols and metaphors. Trying to understand Spirit is useless and arrogant, but the Nuer do know Spirit can be influenced by prayer and sacrifice. As this example shows, as any other will, theory inherently denies the validity of everyday discourse.[190] In the case of the Nuer, they see creation, which is the world they live in, as subsidiary or part of a larger reality. A theory adds layers to what direct experience delivers, always denies that creation is just creation, and imposes additional relations on observations, going beyond initial common sense.[191] The desire to explain familiar and puzzling features of everyday life will always lead to deeper and broader perspectives, to the creation of theory.[192] This process makes new sense of a situation and at the same time provides material for possible responses to that situation.

Horton describes religion as providing and inviting Theories Of and Theories For. They are used for affecting social order, bringing about social change and innovation, and maintaining a status quo.[193] It does this while operating on a fundamental need for explanation, prediction, and control. Religion is often described as passively reflecting the society in which it functions, but it should be understood as a tool with its own agency, a cognitive tool, which can be harnessed by its subjects.[194]

'Theory Of' and 'Theory For'

A religious theory gives descriptions of the world, which are to be understood as Theory Of, and from it can be derived directions for possible action, which constitute the Theory For. Horton gives the example of the West-African Earth-Spirit as a guardian of the community.[195] The spirit's existence and character were originally inferred by noticing that groups with peaceful influx of unrelated peoples seemed to maintain higher cohesion. The ancestral forces, spirits representing lineage, could not account for this, so they inferred a separate earth spirit with no filial affinity. Even though the spirit protected everyone in its domain, it would have made sense that those who settled the territory first, the oldest lineage, had the strongest link to it. At this point, the description is still a Theory Of. Further inference led to the argument that the oldest lineage present should lead the community, and hence the theory is used to support a status quo.[196] When an alien lineage conquers the territory, it is confronted with the earth spirit, who is linked to the existing community and not its conquerors. Asserting dominance in a territory might anger the spirit. The leading lineage and locals could be expected to be best at communicating and appeasing the local earth spirit, which would motivate the conquerors to use the leading lineages as administrative intermediaries. The fact that the spirit was thought of as pertaining to the earth may even lead them to grant increased administrative autonomy to areas where resources (like gold) were to be found, seeking to appease the residing earth spirit even more. The Theory Of the earth spirit, has a direct link to a Theory For dealing with political reality.

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[189] Horton, 24. Referencing Evans-Pritchard, E. E. Nuer Religion. Oxford: Clarendon Press, 1956.p. 315-6. Print.
[190] Horton, 356
[191] Horton, 72. The definition is a little glossed over here, but it refers to our primary senses. Our initial input or experience, what is right in front of us without qualification.
[192] Horton, 356
[193] Horton, Robin. Patterns of Thought in Africa and the West: Essays on Magic, Religion, and Science. Cambridge: Cambridge University Press, 1993. Print. 354.
[194] Horton, 355
[195] Horton, 356
[196] Horton, 357

Another example is the West African Asante state of the 18th century.[197] Its bureaucratic offices were handed down from father to son, which seems like nothing extraordinary. However, the Asante had a matrilineal system of lineage. Their family lines and associated inheritance structure followed the mother. Family names, land, and wealth were passed on following female bloodlines. Based on lineage, any one of the children of the mother should be able to inherit the office. The exception of the bureaucratic offices occurred, because the Asante religious beliefs stated that children are given an identity through their mother, but skills and character through their father. It therefore made more sense to have the father's sons inherit the office, because they would possess the required skills. The example shows how a Theory Of becomes a Theory For, in this case for the bureaucratic pseudo-meritocratic system.

Shadow Recipes of Religious Theory: Theory as a Cognitive Tool

A Theory Of can be expected to always turn into a Theory For, even when going against itself. Just as religious theory can explain and prescribe a status quo, it also has what Horton calls a *Shadow Recipe*.[198] Every theory has a recipe for a status quo, as well as a revolution, following the logic: if not A, then not B. When the earth spirit described above is weak, so is the community, so strengthening the earth spirit will lead to a better community. If anyone were to purposely weaken the spirit, this would logically damage and threaten to disintegrate the community. There are recorded instances of exactly this happening as saboteurs sneaked in and sabotaged enemy shrines, desecrating them. It was reasoned that the damage of the spirit would ensure victory against the weakened community in the coming physical confrontation. Horton equates this to a spiritual version of a preliminary bombardment, an action usually with no real strategic value, but done so as to damage morale.[199]

A second example of a shadow recipe is a prevalent religious belief in West Africa, which states that individuals and groups are part of a single larger world and single humanity. The existence of a supreme being as the world's guardian spirit is thus present in several pantheons, with the local spirits being subservient to it. This Supreme Being was thought to not relate to individual groups, but instead was conceived as relating to every individual separately. The religious reality was that communities had an inward orientation, putting priority on their local spirits, sometimes out of humility. While at first merely a Theory Of, integrating all phenomena into the larger narrative of guardian spirits, it was actually a great opening for Islam. When Islam arrived, it could destroy local cults, disintegrate local communities, and re-unite them under the guise of the pre-figured supreme spirit. This did indeed happen, relying on native religious ideas to realign indigenous inhabitants with Islam. Similar processes are seen in Christianity, as Plato and Aristotle are retroactively turned into Christians. The Abrahamic religions in general also record similar events, attacking local religious artifacts to assert dominance and superiority of an overarching spirit.

Ambitious leaders from within (rival peoples) and outside (Islam) attacked or destroyed local cults while invoking the authority of an overarching spiritual being. The guardian spirit, which enabled and approved conquest or annexation, was referred to in arguing the people to be assimilated as part of its sphere of influence. Without the pre-existing theory, and its shadow, creating wider socio-political order would have been different and likely harder. From Theory Of (distant irrelevant Supreme Being), to Theory For (destroy local spirit in the name of greater spirit), to again Theory Of (Supreme Being

[197] Horton, 358
[198] Horton, 359
[199] Horton, 360

reigns over all): the new status quo established also had its shadow recipe, possibly in a claim that a Supreme Being knows all and its revelations are eternal, which science can challenge. A polytheistic religion would be able to avoid attacks based on knowledge supremacy, as they never claimed their spirits are omniscient, or as providers of knowledge as a primary attribute. This might explain why polytheism seems to not clash with science as much as monotheistic religions can do.

The point is that religious theories are descriptive, but can be used as a manual to creating, maintaining, and changing the status quo. They provide cognitive tools for engaging with society and the world in all its mysteries. It is a description and explanation of society, a prescription of society, and in a way a prediction of society. These short examples show that what things are limit or enable what can be done with them.

From Society to Religion and Back: Divine and Social Relations

Religious Theory and Power: Theory Comes First

If religion is established as a Theory For and Theory Of, it seems like a very practical entity, and indeed it is. It is the reason some consider religious theory as an instrument of power, a way to organize authority, hierarchy, superiority, and other people's servitude or obedience. Theory, and its institutionalization and application in the form of a Church or a canon of rituals, is often thought to be a tool for people to use in asserting dominance. Horton refers to Michel Foucault, and Marxist and feminist religious criticism, which pose that religion is a platform for patriarchy, surveillance, repression and pacification.[200]

Take, for instance, the spread of Christianity. Christian leaders worked to assimilate the 'pagan science' held by much of the Mediterranean urban elites into their own theoretical framework.[201] Pagan science was deemed compatible with, and Plato and Aristotle were designated forerunners of, Christianity. It was, in a Kuhnian sense, a puzzle-solving venture from a Christian paradigm. This could be interpreted as a means of manipulating new converts into accepting Christianity: of building bridges with a nefarious purpose. This view is, however, unfair to those who in their practice and religious philosophy sincerely believe in their explanation of the world. It also gives a type of agency to religion, which it simply does not have. Religion does not repress on its own, but can be used by those with repressive agendas.

Horton thinks that the relation with power should be seen differently: politics act in a parasitic manner upon beliefs.[202] Those seeking to exercise power do not, and cannot, create religious theory to serve their purposes. Beliefs need to already exist and correspond to daily life. They need to already be established and valued, only then can a political agent base his manipulation on those beliefs. Horton refers to a study that shows how guerilla leaders in colonial Rhodesia tried to rally the rural masses using Marxist-Leninist narratives.[203] They failed to do so because the Marxist narrative had, for the rural denizens, no cognitive reference to the established (religious) theories. The categories, concepts, and powers described in Marxist theories did not connect with their conception of the world, and their life in it. When the guerilla leaders changed their ideological strategy to manipulating age-old beliefs on the chief ancestors, the response was a resounding success. The implication is that a negotiation takes place,

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[200] Horton, 363

[201] Horton, 375. Refers to: Brown, Peter Robert Lamont. The World of Late Antiquity: Ad 150-750. London: Thames and Hudson, 1989. 82-3. Print. And others.

[202] Horton, 364

[203] Lan, David. Guns & Rain: Guerrillas & Spirit Mediums in Zimbabwe. London: James Currey, 1985. Print.

which seeks to find a balance between the promoter and the recipient. The result will have to remain cognitively plausible within the existing framework. And as such, the same framework can be used to challenge the guerilla leaders, when it is felt their actions no longer concern the ancestral spirits. Just as, theoretically, a priest can question a bishop's actions based on Christian virtues, despite it being his superior.

It is undoubtedly true that religious theory is used for power, but it is a process of negotiation, and not necessarily a conspiracy theory. A cognitive appeal and connection to local values and traditions is necessary. Horton's perception of religious theory does not address religion as power, but as Theories Of the world. They provide action potential and a way to achieve cognitive compatibility between peoples, individuals, and the world. The guerilla example supports that ultimately what religion provides is a cognitive tool. The tool is used to understand and to organize the environment physically and socially, to give a sense of our place in it, what it is, and how to interact with it. This tool is not necessarily rational or consciously applied, but a part of our natural inclination of sense making.

Religion should not be seen as a tool for power, just as it should not be understood as a tool exclusive to our conscious mind. It is a tool for creating rationality. Action and change will always have to occur within existing rationalities, within existing frameworks of understanding: within existing theories. Therefore, religion should not be considered some coercive method for disciplining people, but rather as a field of reference, which provides context for executing politics of various purposes.

From Society to Religion: Religion as an Extension and Expression of Our Own Life Experience

In short, it was just argued that power does not produce religion, but religion - or something like it - can be used to mobilize or exercise power. Instead of originating from power, Horton believes it more likely that theory runs parallel to social structures: "In every situation commonly labeled religious we are dealing with action directed towards objects which are believed to respond in terms of certain categories… which are also the distinctive categories for the description of human action."[204] This quote describes Horton's idea to describe the relations with religious entities (man-to-god relations) in terms of relations with ourselves and others (man-to-man relations).[205] The relation an individual or group has to a religious object can be understood in terms of the relations present within that group: social situations and relations have strong parallels to religious relations.

Take the exemplary Kalabari village community.[206] The social and religious organization of the Kalabari peoples has three levels: village, descent-group, and individual. Every level has its own cult and spirit guardians. Founding heroes are worshipped and addressed for village welfare, and when necessary, to help in competition with other villages. Descent-groups, which are the extended families lines, have their own ancestors, to whom they turn for their descent-level needs. Individuals might turn to the Water-People, an autonomous set of spirits who are not affiliated with any group. These can be persuaded to aid in individual success or wealth, which the other spirits would refuse because they watch over groups, not individuals. The Kalabari perfectly showcase how religious engagement unfolds along the social categories of daily life, and the needs, which they present.

Horton is not aware of any work showing it, but he expects different family configurations to affect religious theory and practice too, even sex-dependently. An example he missed, proving his

[204] Horton, 31
[205] Horton, 32
[206] Horton, 35-6

assertion, is the variety and form of ancestor worship in Korea.[207] Two main categories of worship are practiced: Confucian and Shamanistic. The Confucian ritual presents the ancestors as benevolent, deserving, and good.[208] The ritual is characterized by strict procedure with little communication between the ancestor and the living, almost all formality and no interactive content.[209] These rites are dominated by the sons of a family, addressing their biological parents in the context of their life-long debt as entrenched in Confucian religious theory. The Shamanistic ancestor ritual sees ancestors as disgruntled, selfish and malevolent, and tends to target the unhappy ones.[210] This ritual is flexible and can be noisy and lively, and may include quarrels, strong emotions, and accusations from both the ancestors and the participating descendants.[211] The living ask for forgiveness, for alleviation of some evil, or for good fortune. The Shamanistic ancestor rituals are dominated by women, whose position in the family is of low rank. Following tradition, wives are imported from outside the family, and forced to worship ancestors and adopt parents who are not biologically theirs. Parents who, in addition, heavily favor their own son. As the wife bears children, her position of power grows, and rivalry with the parents and especially the mother of her husband emerges almost to a point of social determinism.[212] Unsurprisingly, it is they who see their ancestors as selfish and malevolent. “The duality of ritual forms allows each gender to express its own relationships with the family members, who later become the objects of the two rites.”[213]

Structural Parallels and Interaction of Social Life, Needs, and Religion

In practicing their religion “…religious people participate in a social field containing non-human fathers, mothers, husbands, wives, friends and enemies”, as exhibited above.[214] "In short, religion can be looked upon as an extension of the field of people's social relationships beyond the confines of purely human society."[215] The Catholic religion, for example, includes non-human fathers (God/Jesus), mothers (Virgin Mary), husbands, wives and friends (saints), and enemies (demons/heretics/heathens).

As with the Kalabari, any member of a society has a list of goals concerning health, wealth, and general welfare functioning on different social levels, such as personal, family or village/community groups.[216] The chosen goal, and the category in which it is effective, will determine what kind of theory that person will be looking for to act upon. The religious theories and their resulting instruments available will therefore always correspond, in some way, to the goals of the social unit in question. It by no means indicates a direct determinism, but the parallels in religious structure to social structure are very strong. It admittedly does not say much about the actual content, which would be a different kind of history and discussion, while the current one restricts itself mostly to structural features. Would social and personal goals change, possibly as a result of change in society at large, so it is likely the religious relations will change with it.[217] On the one hand religious theory can be seen as an extension of social

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[207] Yim, Dawnhee. "Psychocultural Features of Ancestor Worship in Modern Korean Society." Confucianism and the Family. Eds. Slote, Walter H. and George A. Devos. Albany: State University of New York Press, 1998. 163-86. Print.
[208] Yim, 172, 174
[209] Yim, 176
[210] Yim, 172, 174
[211] Yim, 176
[212] Yim, 178, 180-1
[213] Yim, 177. Punctuation added.
[214] From Horton, 369. Examples added.
[215] Horton, 31
[216] Horton, 34
[217] Horton, 35

and daily experience, while on the other also as being shaped by the goals and obstacles inherent to it.

One familiar example of this is 16th century Europe, which was confronted with a rise in the pursuit of personal wealth.[218] A wealth increasingly available with advances in science, society and trade. Originally a condition for damnation, Christianity was gradually reinterpreted into what is later praised profusely by Max Weber as The Protestant Work Ethic.[219] Christian doctrine was reinterpreted to let "financial individualism of a most ruthless sort became not a condition of damnation but, if successful, a sign of election for the enjoyment of bliss in the world thereafter."[220] Being a hardworking participant in the economy had become a religious virtue for the Calvinists. They believed that success in this life proved god's grace. This example makes very explicit how the goals and interests of the merchants and rising Burgher class changed, and with it, changed their religion. Max Weber's famous work argues it is the Protestant Work ethic itself which enabled capitalism and the success of the regions in which it was active. Horton does not necessarily disagree with this, but in the least wants to make clear causality in these cases cannot said to be unidirectional. It is just as much the change in society that caused the work ethic, as the ethic that reinforced the change in society. The importance for now is understanding the relation, not understanding which one was first.

Another line of correspondence of social life to religious practice is that of the tribal or city gods of Mesopotamia.[221] The area was geographically, economically and socially highly concentrated, causing significant competition between cities and peoples.[222] With scarce land and resources, military organization and action became important, and corresponding to it, gods became more aggressive and competitive with other gods. Gods representing cities or certain peoples were aggressively posited as superior, or even as purveyors of universal laws.[223] As one community would achieve military victory over the other, the loser's god and religion, having been proven inferior or false, would be repressed or even physically carried away as a prisoner to the other god.[224] This interaction is also recognizable in Judaism. The names Baal, Astarte, and Asheroh, which are in popular culture known as demons from hell, are actually gods worshipped by neighboring peoples who rival the Jews in their historical homeland.[225] In daily life when there is room for potential action, or a specific need which presents itself, religious theory or reform always appears. Horton notes that when comparing different religious traditions:

> "if what the participants want to do involves disintegrative competition, then the world of their gods is likely to include some who are defined as helping their human partners in such competition; or if what they want to do involves little competition, their world of gods is likely

[218] Horton, 40. Referencing: Tawney, R. H. Religion and the Rise of Capitalism; a Historical Study. New York: Harcourt, Brace and Co., 1926. Print.
[219] Weber, Max. The Protestant Ethic and the Spirit of Capitalism. New York: Scribner, 1958. Print.
[220] Horton, 40
[221] Marangudakis, Manussos. "The Social Sources and Environmental Consequences of Axial Thinking: Mesopotamia, China, and Greece in Comparative Perspective." European Journal of Sociology / Archives Européennes de Sociologie 47.01 (2006): 59-91. Print.
[222] Marangudakis, 61
[223] Marangudakis, 66-7
[224] Marangudakis, 67
[225] Becking, Bob. "The Boundaries of Israelite Monotheism." The Boundaries of Monotheism: Interdisciplinary Explorations into the Foundations of Western Monotheism. Eds. Korte, Anne-Marie and Maaike de Haardt. Leiden; Boston: Brill, 2009. 16. Print.

> to be more concerned with the collective welfare and harmony of all. …religious activity tends to be as integrative or disintegrative as the particular congregation or individual wants it to be."[226]

Thus, competition between groups will stimulate a development in particularistic and competitive religious phenomena.

A more peaceful example of religion as an extension of social relations, is the demography of conversion during early Christianity.[227] A large proportion of early converts to Christianity were migrants moving from rural areas to urban trading centers. The religious traditions they carried with them were based on local groups and the local environment or village, all of which had been abandoned in the act of migration. The Christian message is a universal one which is not concerned with locality, and which provides a strong parental bond with God; by association they also bond with their fellow Christians with whom they have no other affiliation. It provides a convenient way of organizing and identifying a new social life for an uprooted migrant in the confusing big city life, not unlike what student associations, hazings, and other rituals do for young students moving to the city to study at university. For the candidate-Christian migrants, their new city follows deities and traditions that do not relate to the migrant, or which might even reject the migrant. Dedication to an overarching spirit or god can help an individual free the self from communal obligations or social pressures.[228] In this case it frees the migrant from the religious tradition where he came from, while at the same time not requiring the difficult adaptation of local elite religions. The Christian god is perfect for the migrant. Similarly, the surprisingly high rate of conversions to Islam by young Chinese women in today's Hong Kong is likely indicating their successful search for a way of wrestling free from suffocating social and traditional expectations from their Chinese families and peers, a way to assert their individuality.[229] For the new migrants too their personal goals and needs made a perfect connection to the Christian cult as it developed. Christianity was an outsider just like the migrant, focusing on the individual, promising equality, and intimate relations to an authority figure they had left behind.

These examples were to show how the social situation and the needs it presents to a person or people can lead to the appropriation or modification of religious beliefs, just as needs predispose to certain religious activities or beliefs. This is not about causation, but a relation, like the relation between Theory Of and Theory For. It is very hard to argue that the social situations and culture determine religion, just as hard as it is to argue that religion determines the society and individual life experience. The fact that they do both, is however certain.

Religion as Explanation, Prediction, and Control

Up to this point religious theory, relations, and objects have been discussed. Theory is a conceptual tool overlaying daily life and the world, giving more meaning and handles to engaging it. Engaging the world to change or maintain anything by definition requires engaging the theory. This goes for the exercise of power, for sense-making, for seeking stability and control over life and the world, and for understanding it. The religious objects, theories and relations all represent some symbolization, and give rise to capacity for expressing or working with needs and desires. The overall approach to understanding religion in this way is designated by Horton as Theoretical-Pragmatical. It reflects how theory always

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[226] Horton, 37

[227] Horton, 374. Refers to: Brown, 60-5, 51-6.

[228] Horton, 44.

[229] My own observation, but arising from a discussion with Dr. Paul O'Conner, who studies and teaches Anthropology of Islam in the Chinese University of Hong Kong.

reflects practice, and how practice leans on theory for its actions and ideas. It summarizes the theory Of/For dynamic, the role of power in religion, the reciprocity of social and religious relations, and the plethora of religious objects and their uses. Taking all these together Horton summarizes religion as a system for explanation, prediction, and control.

Religious theories make descriptions of the world, from which predictions and further theories can be inferred that lead to measures of control and influence. The sacrifices and prayers made by practitioners may seem superstitious, but to the practitioners they are real, corresponding to their descriptions of the world. Just as phrenology, Mesmerism, para-psychology, and astrology were considered real, despite their now apparent invalidity, it cannot be denied they are systems of explaining, predicting and controlling parts of our lives. Empirically these activities are responding to world descriptions which posit some reward or response to specific activities. Just as the Nuer people will sacrifice to the gods to receive blessings for the hunt, so the Christian prays and follows the Christian doctrine to receive blessings in this life and the next, all from a conviction that this is how the world works. It is for these reasons, that Horton ultimately understands religious theory as concerning explanation, prediction, and control, and that he posits the Similarity Thesis that it has fundamental similarities to the practice of science.

The Similarity Thesis

Early religion can be considered evidence of the initial development of higher thought and consciousness, because it consisted of a collection of "ideas about an order of events which lies outside the direct grasp of the senses."[230] That religion in its many forms comes down to different configurations of explanation, prediction, and control, which for an important part still resemble today's science, is more provocative. Horton endorses this perspective by promoting his own Similarity Thesis. It is not meant to argue science and religion are the same thing exactly, but that they arise out of the same needs and human traits causing us to search explanations, infer predictions and assert control. This comparison is meaningful because it shows how important science is in our daily life: for millennia religion and its offspring have dominated discourses on how we should live, what the world is, how it works, who we are, and how we should behave. The importance of this realization comes from the scientific ideals of objectivity. Ideals of objectivity actively deny that 'objective' knowledge is by definition without effect on our subjectivities. It conceives of knowledge as existing separate from us, as discussed in partly in Kuhn and in Latour. Science is considered isolated to a degree that its influence and role ends up being overzealously denied. Understanding the Similarity Thesis is one way of understanding that at its core, science is still what leads our understanding of the world even in spheres of influence not usually associated with it.

Addressing both scientific and religious theory and practice, the Similarity Thesis states:

> "(1) Both types of thought enter into human social life to make up for the explanatory, predictive and practical deficiencies of everyday, common-sense reasoning.
> (2) Both perform this function by portraying the phenomena of the everyday world as manifestations of a hidden, underlying reality.

[230] Horton, 72

> (3) Both build up their schemas of this hidden reality by drawing analogies with various aspects of everyday experience."[231]

The three Similarity statements are another way of explaining Horton's creed of explanation, predication, and control. The first statement says that religious theory is used to give meaning, and explain what is not self-evident, or create new relations between things important in daily life somehow. The second statement says that meaning and engagement with the world is enabled by assuming patterns, laws, and phenomena which underlie our initial observation. It hypothesizes forces in nature and daily life, whether they be spirits causing evil or good, or the free market or radiation. The third statement says the first two statements are understood by relating them to our own primary senses, and preceding understanding. It is a complex version of saying God is Love, because God cannot be understood, but Love can.

A predictable criticism of the Similarity Thesis is that religious statements make no effort to discover and describe an underlying reality, and that they have no framework for incorporating change and challenges to the canon.[232] This is the natural reflex, which is to point out the difference in method, and that science has been more successful in creating new knowledge objects and theories than any other knowledge structure. For the critic it means religion is not serious about explaining or predicting. The criticism states that religion and science are not alike because religion and its methods are wrong or inferior, and refuse to accept it. This criticism does not take intentions into account. It uses the achievements of science to differentiate it from other people's knowledge traditions. Instead, when looking at the ones who create and maintain the ideas and theories on spirits and the like, they most certainly seek to "provide explanations of present phenomena, predictions of future phenomena, and recipes for control of the future course of events".[233] Horton is not afraid to admit that between the two, science is better endowed to process conceptual change.[234] The difference in method is however irrelevant to the current argument. That science wields a superior method and is responsible for much recent change does not change the fact that for a large part it fulfills the same role: that of an extension of common sense applied to the experienced world. The difference between religion and science concerning explanation, predication and control is one of degree, and not one of kind. The fact that one is more successful than the other does not change this similarity.

Religion should not be discarded, either as archaic or irrelevant. It would mean the continuum of the historical and contemporary interplay of theory Of/For in science are discarded as well. This is historically inaccurate, and against the record that science is the offspring of religion.

The shared ancestry of science and religion

Horton is happy to notice that historians of science are acknowledging that the two were indistinguishable up until the 18th century.

> "Before the eighteenth century, the Western quest for explanation, prediction and control of the world was pursued *through* religion, and was indeed the most vital shaper of religious ideas. […] Before this time, the idea of religion and science as distinct and contrasting fields of thought

[231] Horton, 348
[232] Horton, 350
[233] Horton, 350
[234] Horton, 351

> and action simply did not exist. […] Theories of modern Western science did not grow up *alongside* the personal schemas of religion, but rather grew slowly and steadily *out of them*."[235]

There are a plethora of examples in history of science to support this, and these days it has become increasingly public knowledge that many of the scientific heroes were deeply religious in their personal and scholarly life. One example of science as the flower of religion's soil is Eric Jorink's *Reading the Book of Nature in the Dutch Golden Age*. Among much else, it shows how studying nature was first about appreciating and understanding God through His creation, as if looking in a magic mirror. This initial interest developed up to a point where in 1651, Johannes de Mey dared to give secular explanations of all the natural phenomena in the old testament of the Bible.[236] At first Man had studied God's work, but unwittingly the rigorous scholarly criticism and standards used made it the religious Man who drove a wedge between God and nature by virtue of his religious pursuit of knowledge and truth. As studies in the name and honor of God advanced, well-intentioned Christians found their results accused of atheism.[237] Those who sought to correct what they considered heretical, could end up saying something theologically offensive themselves.[238] Faithful and critical minds eroded the very thing they sought to defend. The importance of this historical development is that science should be considered an extension of religion, instead of its antithesis. This is also why the Similarity Thesis is viable, and sensible.

Religious Theory: Theory and Narrative/Communion

The Similarity Thesis and explanation, prediction and control perspective treats religion as a theory. It can be argued at least certain parts of religion are not theory, but myth or narrative without theoretical intent.[239] This is tempting, but it does not correspond to the beliefs of many religious practitioners for whom the narrative is also as part of the theory, as fundamentalists still do in modern settings.[240] Horton acknowledges this problem and patches it up by arguing the myth and the theory are part of two separate needs. The first is that humans seek fulfillment of a need for community, and the second is that they seek a sense of control: social fulfillment and participation as a social need, and some measure of power over the self and environment as a need for control and understanding.[241]

Comparing the existing religious theories, the balance varies, with an emphasis on either a narratological or theoretical emphasis.[242] Looking at the type of religious action which is prevalent with each type, theoretical discourse is linked to putting causal theory into practice, while narrative discourse is linked to re-enactment and re-creation.[243] This difference can be understood as the difference between a religion that focusses on the commemoration and celebration of a prophet, and one in which making sacrifices and petitioning spiritual entities is common practice. Entering the Christian church, and partaking in the rituals is primarily to identify with the narrative, general theory being secondary. Other religious situations, rituals like sacrificing and petitioning the gods for a plentiful harvest, recovery

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[235] Horton, 353. The quote is his own, but Horton makes a reference to Charles Webster, Richard Westfall and Lynn White (see bibliography). Punctuation added.
[236] Jorink, Eric. "Reading the Book of Nature in the Dutch Golden Age, 1575-1715." Brill 2010. Web. 41, 63
[237] Jorink, 84
[238] Jorink, 103. See also: Rossi, Paolo. The Dark Abyss of Time: The History of the Earth & the History of Nations from Hooke to Vico. Chicago: University of Chicago Press, 1984. Print. e.g. 120, 269.
[239] Horton, 365
[240] Horton, 366
[241] Horton, 42
[242] Horton, 367
[243] Horton, 367

from sickness, or dancing and sacrifices to request and discuss with ancestors; these are about obtaining some result or answer. This manipulation and interaction with existing spiritual entities is basically applied theory. Religion always has a mix of narrative and theory, but the emphasis differs. With the advent of modern science the applied-theory and manipulation part of religion has been losing ground.

Even though the previous paragraph made a distinction between theory and narrative, narratives can still be considered a Theory Of. It still consists of a Theory Of the world, if not a Theory Of a people and history; in its mildest interpretation it is a metaphor for its identity, but still a Theory Of that identity. The applied theories for interacting with the spiritual, or acting in accordance or in the name of the spiritual, are still going to be somehow derived from a Theory Of into a Theory For. Just as the survival of Christianity is allowing the traditions for interacting with god to endure. Description always comes before worship. The discursive aspect of this interaction ensures a change in the one will create a change in the other. As such, science dominating Theory Of, and the fact that politicization of science is eschewed, religious theory still has room to breathe in the narrative aspect of the formation and maintenance of community and identity. It binds and grounds a person, by giving it a place in a narrative which provides crucial links for the individual in relation to values, traditions, and identities. Because of its scholarly virtues, directly influencing community and identity through science is resisted by practitioners and the public. In terms of identity politics, this makes science weak.

Because this room is left to religion, because its Theory For (community) remains, its Theory Of is saved. Free market capitalism and socialism tried very hard, but have failed to eradicated religion completely. Christianity is effectively used to create and uphold an identity, and certain values and practices. The purpose it serves, and the needs it fulfills, are not taken up by science. At the same time, science as a Theory Of is attacking religion while not providing a substitute for the Theory For.[244] The point of these paragraphs was not to argue in favor of either, but to point out how the relation of narrative/theory, and Theory Of/For plays out in today's world. It is another example of how religion and science are part of the same venture, and their balance and characterization as influencing each other.

Science as impersonal, hiding its politics

As argued above, science grew out of religion: intellectual modernization happened before intellectual secularization. A new way of thinking developed while in the explanation/prediction/control frame of reference of religious thinking. As mentioned earlier, scientists attributed with the scientific revolution were not less religious and spiritual than anyone else, if not more.

Standing in the way of understanding the Similarity Thesis is the exclusive and impersonal understanding of the practice of science: the idea and ideal that science happens outside of us in an objective and depoliticized space. It is also this impersonality which Latour finds in his anthropological observations, both as a power, and an illusion. Power, in the sense that the lab allows the creation of new politics, of new descriptions, without direct conflict with existing realities. But illusion, in the sense that created descriptions need to be reconciled with contemporary reality. They need campaigning and translating in order to be integrated in our world views. Objectivity can only be communicated subjectively. Impersonality is needed to create new descriptions in a safe space, but also to translate those new descriptions into relations which can be infused into daily practice, otherwise they will stay in the lab. Science needs to be related to our experience, to our subjectivity, or it will be rejected.

[244] This is also part of the classical debate of modernity and science as making the world into a cold, rationalist, and mechanized place.

And yet, a common ideal of science is that it is inherently a-moral, objective, does not relate directly to daily life, and is independent of questions how to live or act: an impersonal ideal of science. The ideal that science is impersonal is actually an exception, and particular to only the very recent centuries in the West. So too is Horton's explanation/prediction/control seen as separate or even opposed to what religion is about.[245]

And yet for Plato, philosophers throughout history, and for a significant number of people in today's world still this is not the case. Any traveler in a predominantly Islamic country will be surprised with the confused stares of locals when explaining that the visitor is not aligned with any faith, and does not believe in god. Not having any religion is impossible according to those who have not been raised with the concept of an impersonal idiom.[246] Today's Chinese government still considers itself as determinant of the Theory Of society, it considers itself the provider of the social blueprint, of morals and of truth, which is why it censors universities. It seeks to maintain the monopoly on Theory Of, it is aware universities by nature produce new politics, politics in the sense as described by Latour earlier. Original ideas and creative activity is characteristic of students who participate in this supposedly de-politicized environment, that of university and scholarship. Censorship is ironically a sign that the Chinese are more aware and honest about the fact that scholarly work is political, while the West keeps clinging to their banners of objectivity and ideals of the ivory tower. It should not be thought that a Muslim or Chinese official does not believe in this type of science or its importance, it is simply an acute sensitivity to science's effect on society and on world-views in general, on its role in explanation/prediction/control.

Even though the scientific objective ideal is necessary for it to work, it denies the interplay between Theory Of and Theory For, and obscures understanding the role that science plays in society. Clearly the Chinese model would be disastrous to many of the Western scientific ventures, but the opposite is also not without consequences and entails ignorance.

Horton's place in the Science Debate

It may have been noticed that method is playing a small role in the argument until now. This should prove as evidence how insignificant method is in comprehensively understanding what a science is about. When asking how results are achieved and what is most successful at doing so, methods do become very important. These are however questions that should only be asked after the Theory Of is established. That is the major problem of Theory For-based thinking: it emphasizes results and methods to the point that the origin and context of knowledge work is forgotten. It is valid to doubt the results and cite method as a source of that doubt, but it is only secondary to the subject of the study or its relevance.

The choice for including Horton's religious theory is because it speaks of an interaction between theory and practice that should be applied to science as well. Science has taken over most of the explanation/prediction/control elements of religion, while religion and e.g. nationalism are still strong in terms of identity, meaning, values and community.[247] If it is acknowledged that, historically, religion was,

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[245] Horton, 368-9

[246] This derives from my own experiences travelling in Egypt, Israel, Palestine, Turkey and Iran. I encountered similar experiences in: Berger, M. S. Islam Is Een Sinaasappel. Amsterdam: Contact, 1999. Print. See later chapters especially.

[247] Parts of Social Science and Human Science have and could make attempts to take over the role of providing for what religion has traditionally done. For different reasons, these disciplines have refused to do so, or tried and failed. Some of these attempts could be considered libertarian theory, socialism and communism, fascism,

and still is, a broad venture of EPC, than what is true of the role of religion and its interaction with society, must also be true for the role of science and its interaction with society. This refers specifically to the Theory Of/Theory For dynamic, the Shadow Recipes, and to it as the cognitive tool for engaging the experienced world. It treats science with the school of Universal-Human-Effort scientific philosophy: a very long process of understanding and curiosity representative of our humanity. It adds the insight that it is necessary to seek where in society science is reflected, and how it determines interaction with the world.

Both religion and science theory arises from a natural desire for explanation, prediction, and control: both seek to uncover and engage with underlying or invisible patterns in the experienced world. Both give shape to the patterns and phenomena they perceive, but in the process also create deeper meaning and opportunities to exercise influence based on these perceptions. They arise out of basic human needs for social participation, power and control. Interacting with the world and the practice of daily life will always go through these created theories, theories which frame the opportunities to change and maintain whatever they describe. An important consequence of accepting these comparisons and observations is that, just like with religion, structural parallels between the structure of science and the structure and content of society can be expected. Latour had described scientific practice as affecting society and our experience in a way that was somewhat unidirectional. Taking Horton on board, not only the effect of a theory on society should be considered part of science, but also the context in which that theory arose. In other words, science should be seen as always representing something, or corresponding with, something within society.

Following Theory Of/For, and the argument that knowledge structures are used to engage and understand daily life, science's influence is therefore assumed either directly or through intermediaries. It can be the way the new physical sciences encouraged a mechanical life philosophy, or the way technology influences our lives.[248] The way Philologist J.R.R. Tolkien has set a standard for many fantasy cultural products, or the way studies of the concept of Civil War in the 60s strongly influenced the legal and conceptual parameters of the political and diplomatic debate on the current war in Syria.[249] Some do not accept the direct influence of academia on society, but then science can nonetheless be considered an expression of society and therefore worth understanding as such.

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scientism, free-market capitalism, communitarianism, multiculturalism, none of which completely succeeded nor completely failed to get anything done. These repeated failures to achieve successful scientific self-determination and organization has made us cautious and afraid of its power and burdens.

[248] For philosophy see for instance: Dear, Peter. "A Mechanical Microcosm: Bodily Passions, Good Manner, and Cartesian Mechanism." The Scientific Revolution: The Essential Readings. Ed. Hellyer, Marcus. Malden, MA: Blackwell Publishing, 2003. 103-29. Print.

[249] From a seminar by David Armitage 11-5-2015 organized by Free University and University of Amsterdam, see upcoming publication: Armitage, David. Civil War: A History in Ideas. New York: Alfred A. Knopf, 2016. Print.

Conclusion: Putting it Together

At the start of this quest to understand science, Popper showed the trouble of finding absolute truth when faced with inductivism, and the need to jump to conclusions. He puts his faith in critical thinking and falsification: by making risky testable theories, truth can be approached and progress achieved by negation. It is not watertight, but it does correspond to general scientific ideals, and is refreshing for its honesty about the murky origins of theories. In short, Popper can be said to locate the essence of science in Method. Kuhn responds by defending the large amount of work being done that falls outside Popper's definition. According to him, normal science is when scientists are not making new theories, but engage in a process of puzzle solving. Tough scientific choices are made before testing, an uncertain part of science which neglected. The choices scientists make, and their chosen targets and ways of working, are determined by the interpretation of scientific values. The difference in interpretation is also a better explanation of much of scientific history and its differing outcomes. This subjective, sometimes personal, philosophy of science is part of the tacit method scientists wield. If not the essence, it is at least a very important part of science. Thereby, Kuhn points to the importance of values in scientific work, values which determine what science is and what is not. Thirdly, Latour shows that the process of knowledge creation is not the kind of discovery-based work it is imagined to be. It is an elaborate construction of information, concepts and categories, which is created by people, and of which others are convinced to accept and use. The concentration of action and information into a theory or concept like a microbe or otherwise, means that power is invested in the language, users and owners of those words. Science creates theories and concepts which can be used to address new issues, frame them, and to mobilize action towards them. It shows science as the practice which creates the world. For Latour science is cultural, social, political, and a much greater force on our daily lives then given credit for in its usual impersonal and autonomous ideals.

They are three views of science, one methodological and the second moral and value-based, both of which are most popular with the public and scientists, and the third sociological and archeological, and held mostly by historians, sociologists and anthropologists. They are all about the same science, but flesh out different aspects. The method and value perspectives are generally most popular, and applying Horton's theory of religion, the third aspect has been given some more attention. Using his ideas on explanation/prediction/control, theory Of/For, and the Similarity Thesis, he shows how religion and science can both be understood as a continuing human enterprise. Science may be different in terms of method, but is still a continuation of a general need for EPC which became more complex as society grew more complex as well. Both science and religion provide conceptual for engagement with experienced reality. Both exhibit reciprocal relations and reflections between their canon, practice and social relations. Both function in fulfilling social and material needs. And both provide for, and engage with frameworks of meaning. It is important to note that theory is not simply used in service of something else: theory always arises in the context of some situation or experience, in a clear interaction between practice and theory. Therefore, when considering what a study or discipline is about, the element of society it is aligned with should be part of the analysis. Anything said about a certain canon, theory, or discipline, implicitly addresses whatever it parallels in society. This question should never be asked with words like value, usefulness, relevance, or profitability, but always first be a question of what something is about, after which the question of value can be answered in the appropriate context.

Latour had said understanding people meant understanding science, and understanding science meant understanding people. Horton can be used to add that understanding science is understanding

culture and society, and understanding society and culture means understanding science. Science as culture means science is closely related to who we are. The impersonal ideal should be considered a cultural phenomenon, one that creates a de-politicized space in scholarship for the purpose of free speech, the development of criticism and new politics, and essential for democracy. Kuhn and Latour are often read as criticism, but their analysis can just as well be used to show that science, after the news media, is the fifth estate of democracy. A place where new politics and culture can be created, sheltered from political, religious and social opposition. These new politics can be necessary for new reasoning, new perceptions of the world, and progress. Accepting that the scholarly work of all the sciences create new and necessary politics, is a step in the direction of understanding what science is, and in saving it from the scourge of its own isolationist ideals.

Essentially the difference is subtle: ask what it is about instead of what it is for, and debates about universities, science and education will look very different. This subtle alteration is justified by understanding the whole of science as an expression of our civilization, as a means to explain, predict and control our environment, all the way from the first religious theory, to Marx, to Network Theory and the Large Hadron Collider. This argument is not to say universities are causally antecedent for all progress and innovation, it is more about a realization of their integration in the bigger process. When considering that the great canons of knowledge are representative of something, and figuring out what that something is, the result will be a better judgment on what it is that should be done with them.

The conclusion is by no means a call to treat science as religion. It is the realization of science's functional, structural, and sociological history; a realization that appears in comparison with religion. There are still a lot of buts, maybes and how-abouts, which is why I am eager to develop more practical examples of this theory in action in future research. For now it is important to conclude that understanding science means understanding society, and that understanding society means understanding science. Studying this link is the key to learning about both, and advancing them to greater heights.

Further Research

Applying the lessons from the analysis will mean asking the right questions when discussing particular studies, their subjects, and their value. Another way of expressing the use of this analysis is by letting it inform a philosophy of education, which seeks to use concept-based teaching to promote an exploratory type of interdisciplinary thinking which is also exhibited in the thesis. A type of analysis that seeks to find what theories have in common, how they can build on one another, and how their interrelation can make each individual insight more meaningful.

Renewed understanding of Science: Asking the right questions

It is my belief that the philosophical and theoretical insights presented here can lead to inspire a new rhetoric on the character of the different disciplines, and a new discourse on science and its place in society. Would questions on the sciences be about method, understanding it would be about how a study proceeds and what the direct value of the results are. Further research would however be restricted and ignorant of understanding its larger context. Would questions on science be about philosophy, than understanding it would be done in terms of what people believe in: about what they consider true, important, applicable, correct, accurate, and about significant and valuable data. It would be a mix of ideology and rationalism, but probably one-sided because it favors one rationalism over another. Instead of some knowledge machine or ideology, the third treatment focusses on science as a constitutive and interacting element of our society.

All sciences address certain subjects in the external world, build around it, approach it with different methods, and at the same time create and reproduce them. To use this perspective means learning to analyze and understand the different sciences as being *about* something instead of being *for* something. As explained by Horton, theory Of always produces theory For, even without intention: description is never isolated or completely innocent. Therefore, when there is a wish for understanding a certain study or discipline, more weight should be put on what it is a theory Of.[250] From this method of understanding science and disciplines two analytical exercises should recur. One, search what part of society corresponds with the discipline, and two, ask what the difference is between understanding the discipline as theory Of, or theory For, while emphasizing Of.

Subject-oriented, new questions:

- What exactly is the study Of? What part of society does it correspond to?
- What is the study describing and reproducing in the process of its own study?
- Is what it is a study Of important? Why? How does it express itself into a study For?
  - Should it be studied differently?

Problematic method/result-oriented traditional questions:

- What is the study For? (Which does not work because the application of the theory does not sufficiently explain why it exists in the first place)
- What is the result or product? (Does not work because generally the subject of the study is both the product and cause of the study, like with the god's favor example)
- What does the study contribute to society? (Which should be asked only after answering the subject-oriented questions)

[250] In the sense of focusing on a cause instead of an effect.

Especially the last question is problematic, because it often assumes that knowledge work is like a factory that produces some kind of profit or tangible product. Thus it is important to realize, like Popper mentioned about jumping to conclusions, Kuhn mentioned about scientific ideals, and Latour mentioned about the importance of the de-politicized space: central parts of science are not about results at all. More importantly, as Latour shows and Horton supports, often the very knowledge frames themselves are actually the product, providing insights, and cognitive and conceptual tools for engaging with reality. To find out what exactly they are doing, the subject-oriented questions need to be asked, because when the subject of the study is clear than so too the product will become clearer.

The questions could be used for disciplinary history writing, or in organizational and interdisciplinary questions. They are also relevant to the contemporary place a discipline takes, aiding debates on prioritization, funding and restructuring. A history or tradition is not necessarily a justification for the privileges or status that something occupies today. Contexts change, and so do justifications and relations to society. With this framework – which coincidentally fits the human sciences a lot better - a discussion can be had in which the discourse is not predetermined by biased starting points about results and application. The following two examples serve as a short intellectual experiment, following the questions as described above.

Concept-Based Teaching as a new Focus in Pedagogy and Interdisciplinary Academia

As with the interaction of religious theory and social structure, so concepts too are products of knowledge structures, and used to engage with those structures. The intensified study of concepts can therefore act as a decentralized key to studying larger knowledge structures that make up our society without forcing the student into a paradigm.

Looking back, the result of this master thesis was actually, accidentally, a modest interdisciplinary overview of the concept of science. It touched on the perspectives of the physicist, philosopher, historian, sociologist, and anthropologist. This was very exciting to do, and very illuminating. I noticed that with additional perspectives came more diverse arguments, bringing with them more phenomena and examples to consider. In other words, the broader the description, the more topics I could tie into it, and the more applicable it became. By the end of the project I found conversation topics and situations all around me about which my thesis had something to say. On the one hand Popper would warn that if a theory fits too much, it is not really describing anything.[251] Though on the other hand, it meant that the concepts and categories I was developing and learning were giving me access to new interpretations and understandings for broad use in my life. My hypothesis is that this was caused by two things: the magnitude of the concept of science and its pervasive role in our lives, and the willingness to reconcile multiple points of view to reconstruct the network of meanings surrounding the concept. Using the concept as a vantage point, the interdisciplinary binoculars gave a unique way to learn about society. A metaphor could be that if you study a fruit intensely, you should eventually seek to understand the whole tree, and from there onwards the whole ecosystem.

From the outset it was never the intention to find an essence, or a final definition, but to seek where all the theories and ideas pointed at: how they related to each other, and what that says about science as a whole. Just as the fruit and the ecosystem, studying science led me to explanation, prediction and control, which led me to knowledge production, and knowledge production led me to considering the whole of society and civilization. I am eager to see if this can be done to other concepts

[251] See Popper's complaints about Marxism, Adler, and Freud. Page 7-9.

as well, and most importantly, whether this learning experience can be more specifically formulated and put into practice.

Hence the idea of interdisciplinary concept-based teaching. In an interview with Head of Social Science Sennay Ghebreab of Amsterdam University College, I asked him about concept-based teaching, and he revealed that he has secretly already implemented it. He existing theme courses, such as Information, Communication and Cognition, and reoriented it around the concept of bias. It uses the same interdisciplinary literature as before, but as a teacher he indirectly steers students to reflect on bias. This is something that does not appear in the course manual, and yet has vastly improved the teaching quality. This is because it uses a concept to induce the development of interdisciplinary thinking.

I decided to try and find literature addressing this issue, and one of the sources I found was Allen Repko's *Interdisciplinary Research: Process and Theory*. It is an extensive guide to doing interdisciplinary research, and teaching others how to do it.[252] The book is used as a manual by the Liberal Arts and Sciences bachelor program of the University of Utrecht. A book like this is a good inspiration, and provides many useful basic models, but in its focus on research does not explain how to develop interdisciplinary thinking itself. Another book that stood out was Mieke Bal's *Travelling Concepts in the Humanities*, with another brand of ideas on introducing interdisciplinarity into teaching and research.[253] She also thinks concepts are important: "Concepts, I found over the years, are the sites of debate, awareness of difference, and tentative exchange."[254] Concepts are in a sense miniature theories, and a tool of intersubjectivity.[255] The book is helpful in thinking about concepts, but stays very much within the traditional boundaries of the humanities using concepts such as the image, mis-en-scène, framing, and performativity. These are important concepts in doing basic humanities research, but are still strongly based in the ivory tower. Even my own thesis, though I am happy with the result, is too philosophical to really engage directly.

What I seek is a middle ground, a way to invite the development of an interdisciplinary mindset which does not force any paradigm, and stimulates the formation of new theories and perspectives which also engage the students to develop themselves personally. For this reason I am interested in liberal arts, common core, and general education departments in universities, and what they are doing. In the past weeks I have already arranged several interviews to help me think how I can feed my enthusiasm for doing research into creating accessible high-level interdisciplinary educational experiences in the form of concept-based courses.

Basic Research and the fruits of Human Sciences

This desire has another source and motivation, which has to do with the current state of the human sciences. In the past, human sciences had a monopoly on certain knowledge that in the digital age is increasingly publically available. Scholars should not only lean on their access to information, but concentrate on their expertise and ability to teach thinking skills and use the virtues of comparing

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[252] Repko, Allen F. Interdisciplinary Research: Process and Theory. Thousand Oaks, Calif.: SAGE Publications, 2012. Print.

[253] Bal, Mieke. Travelling Concepts in the Humanities: a Rough Guide. Toronto, Ont.: University of Toronto Press, 2002. Print.

[254] Bal, 13

[255] Bal, 22

different cognitive frameworks.[256] Concept-based teaching could be a manifestations of this, by not stressing research methods or the cramming of information, but on the presentation of an assortment of cognitive frameworks which can be navigated and combined for a greater awareness of context and meaning.

The bad reputation of the human sciences that some hold is actually the equivalent of what is called basic research in the natural sciences. Subjects such as: deviant philosophers in the 13th century, the development of certain tropes in literature, the parallels between philosophy and ballet, the biography of an obscure artist, or the study of an endangered dialect on the other side of the world. This basic research provides what could be termed data sets, in the form of books, ideas, criticisms, and concepts. These are important in secondary and tertiary analysis, and can unexpectedly inspire other related research. Though the studies make sense from within the resident paradigm, it often looks irrelevant outside it, with no direct application or value being apparent. Basic research in physical science has this same problem, and is also forced to justify its inability to promise direct result or predict precise application. It is an amusing exercise to see a justification for basic research at CERN only needs very little editing to be a justification for Human Sciences.[257]

The physical sciences have nonetheless been faring relatively well in justifying basic research, which is regrettably less so when it comes to human science. The connection of basic research in human science to civilization, the state of law, social progress, culture, politics, human behavior, insight, criticism, and the philosophical groundwork for all other types of knowing is not widely acknowledged and appreciated.

The popular mode of argument to prove this link insists that it is there, often with vague ideological or historical examples. Concept-based teaching would draw on human science and apply it to concepts and contemporary issues, making this link explicit. It not only enriches the student's awareness and analytical prowess, but also makes them familiar with the value of the human sciences at the same time.

Building Bridges

It seems sensible, as Repko argues, that interdisciplinary work should not seek to remove the boundaries between disciplines.[258] Lisa Lattuca in her book *Creating Interdisciplinarity* also mentions that while building bridges one should be careful to respect the epistemologies of the disciplines it tries to connect.[259] Nonetheless, skillful bridge building can be of great value. Courses in university often focus on a method or on a canon of knowledge within a single discipline, which is mostly only of interest to those who want to specialize in that direction. There should be more opportunities for students to

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[256] See for instance the empirical result from: Shapiro, Johanna, and Lloyd Rucker. "Can Poetry Make Better Doctors? Teaching the Humanities and Arts to Medical Students and Residents at the University of California, Irvine, College of Medicine." Academic Medicine 78.10 (2003): 953-57. Print.

[257] Comparison originally made by Martin Willis in a keynote lecture at Mount Allison University, February 11, 2012. See here for the original CERN text: http://public-archive.web.cern.ch/public-archive/en/About/Fundamental-en.html Quote: Some areas of human science "seem remote from everyday life and unlikely to bring immediate practical applications. Are they worth the effort in human and material resources? This research may take us far away from the conditions of everyday life, but because it continually pushes at boundaries in thinking and in [analysis], it is a springboard for many new developments. Fundamental [human] science is where new ideas and methods begin that later become commonplace."

[258] Repko, 7-11, 22

[259] Lattuca, Lisa R. "Creating Interdisciplinarity Interdisciplinary Research and Teaching among College and University Faculty." Vanderbilt University Press 2001. P. 29-34. Web.

explore different types of questions close to contemporary issues and the students themselves, without have to change their major or specialize. Much of what history and philosophy (which included science) has been in the past had either directly or indirectly to do with either some social activism, protecting a status quo, building it, or breaking it down.[260] As discussed in the thesis, science is political by its very nature. These knowledge structures have a direct bearing on ideology, the philosophy of state, and the expression and experience of values, identity, social theory, and so on.

To access and understand this dynamic, concepts are the threads that, when pulled correctly, unravel these underlying structures. As an experiment I have already made some preliminary course formats, which proved relatively easy because of my interdisciplinary background. It turns out that with little effort a concept like *Authority* can be linked to family feuds, democracy in Hong Kong, student-teacher relations, national identities, dating culture, religion and morality, and the roman emperor Augustus. The purpose of this exercise would be to discuss the particular topics first contributing to general knowledge, but then also repeatedly ask the question: what have we learned about the crucial role of authority in our society and in our lives? How do these different views add up to one another? The same is possible with concepts such as such as identity, sex, science, problem, and work, of which I already have ideas how to do it.

In order to justify the educational value and pedagogic methodology behind this, further research is required. Specifically research into interdisciplinary and educational theory, as well as the construction of test courses which are closely monitored and evaluated for their effects and results.

[260] Again the parallel with Horton on religious theory and social configurations/structures.

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