The Promises Science Could Not Keep: Science and the Corrupting Influence of Neoliberal Capitalism

N.J.W. van Deursen
s4372905
Supervised by dr. P.C. Lemmens
Word count: 19,676
2 juli 2022
Scriptie ter verkrijging van de graad “Master of arts” in de filosofie Radboud Universiteit Nijmegen

Hierbij verklaar en verzeker ik, Nina van Deursen, dat deze scriptie zelfstandig door mij is opgesteld, dat geen andere bronnen en hulpmiddelen zijn gebruikt dan die door mij zijn vermeld en dat de passages in het werk waarvan de woordelijke inhoud of betekenis uit andere werken – ook elektronische media – is genomen door bronvermelding als ontlening kenbaar gemaakt worden.
Nijmegen, 2 juli 2022.

The images on the title page were generated using craiyon, an AI model which draws images based on text prompts. The text prompt I used was “utopian sciene”.

Abstract

In this thesis it will be argued that the neoliberal form of capitalism has had detrimental effects on the practice and quality of science. This will be done by first constructing a normative ideal of science, based largely on Merton's four norms of science. In the second part this ideal will be compared to the current reality of science, to show where science under capitalism diverges from what we would want science to be. Lastly, an alternative to capitalist science will be proposed by re-imagining science as a commons, a system under which the ideals of science will be more likely to thrive.

Table of Contents

I Introduction: of Science and Disillusion

Science is a powerful idea. Ideally it is an endeavour driven by curiosity, pursued to find truths about the world. It is a process of empirically investigating reality, critically examining evidence and making explicit assumptions based on said evidence to logically formulate testable hypotheses that are repeatable by other scientists. This method of gaining reliable knowledge about the world around us has not been unsuccessful for humanity. Application of the knowledge gained from scientific inquiry has given rise to various technologies, many of which could be said to have had a positive impact on the quality of human life. Yet at the same time, there are problems with science. It being a powerful idea means that it bestows authority upon the things said in its name. After all, if science says so, then it must be worth listening to. For knowledge that flows out of curiosity driven research, this does not have to be a problem, but there exists the possibility that one might value the *authority* granted by science more than science itself. For example: there is a long history of appropriation of the language and aesthetic of science to justify dubious, unscientific, beliefs, for instance in "social Darwinism" and so-called "race science". These movements would in hindsight rightfully be called pseudoscientific, but their lasting influence shows that their appropriation of scientific authority was successful at the time. The potential for misuse of scientific authority muddies the waters on what science is to be trusted.

Just as a focus on obtaining scientific authority distracts from the curiosity-driven pursuit of science, so can a focus on profiting from science distract from it too. Science obviously has value outside of itself, and that is far from a bad thing. Were it a mere intellectual pursuit it would probably seem rather frivolous to everyone except scientists themselves. Applicability of scientific knowledge is what makes it valuable to more people than just scientists. Problems arise from decisions about what kind of values science and scientists ought to pursue. Ideally the values of science would come from the ways it can help all of humanity. However, if the value science should generate is first of all monetary, as nowadays demanded of an increasing number of human activities under capitalism, its more noble and socially valuable goals get out of sight quickly.

All this is to say that there are enough reasons to be disillusioned with science as it currently is, especially for those who see it as a worthwhile pursuit. To illustrate this point further I shall first briefly describe my own experiences with it as a young "scientist-in-becoming".

I.1 A brief personal story

When I was young I wanted to be a scientist. I would like to believe that this was driven by curiosity, by the simple joy of knowing things. What "being a scientist" meant exactly was probably still vague to me at the time. There were popular scientific books I read that instilled some cultural ideas in me about what it could mean. In these books scientists were framed as somewhat heroic figures, people who through critically examining the world, asking the right questions, and conducting experiments would find answers to the problems humanity is faced with, and demystify the universe. Being a scientist was not merely a job, it was almost a kind of higher calling. This impression was formed by a simplified popular account of the history of science. The focus on a few great scientists - typical for popularising accounts of science - left out the contributions by scientists who did not make the history books, let alone the institutional, political, economic, and cultural context in which scientific discoveries were made. I do not think this was done with any sinister intentions. Most of these books were aimed at children, some things just had to be left out or simplified to keep them engaging and digestible to the target audience. Whatever problems they may have had retrospectively, they did awaken in me an enthusiasm for science, and a willingness to take part in whatever that was.

In school I performed well at those subjects that would fall under the natural sciences. Perhaps my affinity with those subjects came from that early interest in science. Science is more than just the natural sciences, but for a long time natural sciences were all there was to science as far as I was concerned. The image of a scientist was someone wearing a lab coat, and the image of scientific work was that of carrying out experiments in a laboratory setting. I do not think that reducing science to only the natural sciences is an uncommon misconception. On the one hand there is the potential for biology, chemistry, or physics to be more "spectacular", which makes them easier to sell to a young audience, something that was reflected in the subject matter of the popular scientific books I read as a child. At the same time, cultural ideas of scientific "purity" could play a role in what we believe belongs under the label "science". The spectrum from fundamental science to applied science, or the spectrum from "hard, objective, exact" sciences, to "squishy, subjective, social" sciences, gets misinterpreted as a value hierarchy which orders sciences from most to least scientific. Or perhaps it could be that the conclusions natural science draws are considered to be less divisive than those of social science, fueling disagreements about whether or not the latter should be considered a genuine science. Whatever the case, when I talk about wanting to be a scientist, I meant the natural sciences, even though I know now that science encapsulates more than just that.

When it came time to choose a subject to study in university, I simply chose chemistry, as it was the scientific discipline I performed best at. On the theoretical side the knowledge of students on chemistry was deepened and brought up to date. Some previously learned theories were revealed to be simplifications, and were replaced with more refined models. There were also subjects that introduced students to the practical side of chemistry, and to the future workplace of many students, the chemistry laboratory. The way knowledge was delivered created the sense that all relevant ground in chemistry had already been trodden, and that the task of new chemists would be to use the knowledge handed to them to streamline well-known reaction processes. This is not to say that it is not important to learn what is already known in a field, there is little use in making the same discovery twice, but at the same time little was done to encourage deeper curiosity. It felt as if I was being educated to become a skilled knowledge worker, not a real scientist. Even if at times it felt more like work than science, doing the work of chemistry was not a negative experience. Carrying out reaction mechanisms in reality makes chemicals into more than just structure formulas, it shows that these schematic representations give an at least functional description of reality. It shows that what can theoretically be imagined is never quite so simple in reality, and that sometimes you have to take a detour to get where you want to be. On the best of days, it was a delightful synthesis of cooking and puzzle solving. There was enjoyment to be gained from working in a chemistry laboratory. However, the chemist's work can be instrumentalized, as they are expected to solve the chemical problems that are handed to them and nothing more than that. No matter how enjoyable the work can be on its own, it is not good when one does not feel in control of it.

The feeling of alienation reached its height during the internship I did towards the end of my bachelor's degree. I was put to work under a postdoc who was researching a compound for a project called the European Lead Factory (ELF)[1]. The stated goal of the ELF was to boost drug discovery by teaming academics up with pharmaceutical companies. The companies would contribute their compound libraries to a big shared compound library, and academics were encouraged to add novel compounds to this library. Compounds would be submitted for screening, and the ones that showed promise in pharmaceutical use could then be patented by the academic that submitted it. My task was to test the possibility and efficiency of certain reactions that my superior had hypothesised his compound could undergo. I had little to no input in this, and for the majority of my time there it just felt like I was performing free labour for this project. Upon finishing my degree, I left chemistry behind in favour of philosophy.

I.2 What is wrong with science?

I did really want to be a scientist, but what I found ended up driving me away. What I expected it to be, differed from the reality of present-day scientific practice. It could be chalked up to youthful naiveté, childhood illusions shattered by growing up, but I do not think this covers it. My idea of science was perhaps in some ways simplistic, but it did not come from nowhere. It was informed by the ideas and representations of science present in the society around me. If the reality of science does not match with what we think science is or should be, it is a legitimate question to ask: What is wrong with science? Why did the work I was educated to perform make me feel alienated? Taking another look at the ELF could provide an answer to the second question, and a starting point for the first.

The ELF is a public-private partnership, a type of construction that has been criticised for the way it can serve to put public resources into private hands, under the guise of a mutually beneficial agreement.[2] It was supposed to bridge the gap between the creativity and innovativeness of academic chemists and the capital of the pharmaceutical industry, but it seemed like a way for the companies to reap the benefits of innovation without truly having to commit to investing in it. Participating did seem like a bad deal for scientists. They could gain a patent from it if they did everything right, but it was unclear if the project would have compensated them for their work if their results came back negative. Promotional material for the project was covered in individualistic language, participating would grant a scientist the chance to follow their own brilliant ideas, and gain ownership of them by patenting them. But the ownership of a patent is not very meaningful if one does not also own a factory to bring it into production. In order to gain something from their patent the chemist would have to surrender control over it to a pharmaceutical company. Despite all the talk of self-determination, the scientists did not seem to get much more control over their work by participating in the project. Moreover, the race to patent placed scientists in competition with each other, discouraging the sharing of results, making the overall scientific process less efficient. But whatever negatives could be observed, this arrangement was treated as if it were "business as usual".

The ELF can be seen as an example of what happens when capitalism finds its way into science, and starts determining how science is conducted. The late anti-capitalist theorist Mark Fisher stated in his 2009 book *Capitalist Realism* that "...capitalist realism has successfully installed a 'business ontology' in which it is *simply obvious* that everything in society [...] should be run as a business."[3], and science has not been spared from this. Doing science for the purpose of making profits is for sure not as nefarious as doing science for the purpose of legitimising power, but it is not harmless. As it becomes seen as normal for science to function as a business, its harms can be justified as just the way the world works.

This thesis is not going to be a critique of the ELF, however much that project might deserve one. Rather, it is going to offer a more general look at science, and the ways it has been influenced - and corrupted - by (neoliberal) capitalism. In doing so I hope to formulate a critique that could be applied to the ELF as well as other projects similar to it.

The first part will not go into capitalism yet, but instead focus on science as an ideal. Science deals with the ideal in multiple ways. The theories of science are for example idealised translations of reality. However, in this case science as an ideal concerns ideas of what science ought to be. What kind of scientific practice is considered good science? What purpose should science serve for society? What is the ultimate goal of science? What scientific values should be upheld to ensure good scientific practice? In trying to answer these sorts of questions I hope to form a normative ideal of science, as it is important to not just point out the negative, but also to form something positive to strive for.

The second part will map out the ways in which capitalism has influenced and corrupted the pursuit of science. To keep the critique relevant to the present day, and to prevent it from being overly long, it will only focus on the influence the most recent stage of capitalism, neoliberalism, has had on science. This will come with a brief discussion of what neoliberalism is exactly. Neoliberal capitalism has its own prescriptive ideals, and these can be at odds with the ideals of science. What are the consequences for scientific practice when scientific values and capitalist values come into conflict with each other?

The third and final part will discuss some solutions to the predicament science finds itself in. What will it take to bring science closer to its ideals? A proposed solution for the future is treating the breadth of accumulated scientific knowledge as a commons, and the merits and possible pitfalls of this emerging approach will be discussed. How can a paradigm shift from capitalist science towards a commonist science be accomplished? And can such a non-capitalist science come to fruition in a capitalist society? What is to be done to reinvigorate the scientific values that were brought in jeopardy by capitalist values?

Science is a powerful idea. It should not be discarded lightly. Its ideals deserve to be defended, recovered, and possibly even improved.

Notes and references for part I

[1]: Kingwell, Katie. "European Lead Factory hits its stride" *Nature Reviews Drug Discovery*, vol. 16, 2016, pp. 221-222, doi:10.1038/nrd.2016.64.

[2]: Hall, David. *Why Public-Private Partnerships don't work: The many advantages of the public alternative*. PSIRU, 2015, pp. 30, http://www.psiru.org/sites/default/files/2015-03-PPP-WhyPPPsdontworkEng.pdf.

[3]: Fisher, Mark. *Capitalist Realism: Is there no alternative?* Zero Books, 2009, pp. 17.

II An Ideal of Science

Science is an idealising pursuit. It deals with the ideal. Scientific theories are not objectively present in reality, they are idealised descriptions of natural phenomena.[1] From a limited number of observed particular instances a general law can be inductively reached, by filtering out the small, less important ways in which the occurrences differ, and by universalizing the major important ways in which they are similar. When done right, this process can lead to the formation of scientific theories with great predictive power. Because scientific theories are produced by inductive reasoning it is however also the case that even the most long-established scientific theories are not *True*. No matter how many times experience corroborates them, they can never truly be said to be right in every instance, not until the end of everything is reached, and every instance has come to pass - and even then, the end would prove them wrong, for how can they be right if there is nothing to be right about? Scientific theories can be treated as functionally true, as long as there is no substantive cause to doubt their accuracy. It should however be kept in mind that they are idealised constructions, so if reality contradicts a theory the scientist's first impulse should not be to make reality conform to the theory. Popper's falsification theorem might have been a bit out of touch with the real-life practice of science when it asserted that a theory will have to be replaced when it gets falsified, but it points to a useful principle to hold as a scientist. Every scientific theory could potentially be discovered to be incomplete or incorrect, so no theory should be exempt from critical re-examination.[2]

Science is itself also an idealised pursuit. Certain actions or behaviours are considered to be "scientific" or "unscientific" based on some idealised notion of what science ought to be. Even as I was describing how science idealises reality, I was already constructing an ideal of science. By stating that no scientific theory is beyond re-evaluation, I was simultaneously stating that a science which prioritises the conservation of established theories would be a deviation from a scientific ideal. That is not to say that such a science would be definitively disqualified from the category of science. Science is after all a human invention, it is up to humanity to decide what it is. But this also means there are no definitive answers to what science should look like, or what it should prioritise. When we ask the question "what is science?", what we are really asking is "what do we want science to be?". The normative question about the ideal shape of science is what will be explored in this part. Science has an effect on the world, application of scientific knowledge does give a measure of control over our surroundings, which has ramifications outside of the scientific field. The question of what science *ought* to be is thus of interest to more than just scientists and philosophers. How science is conducted, and how scientific knowledge is wielded, has material consequences.

II.1 What do we want science to be?

The question "what do we want science to be?" can be answered in a multitude of ways, depending on what aspect of science we are talking about. To demonstrate this, and to aid in finding a full answer to it, the question and science can be divided into three layers. The first layer concerns the base level of scientific practice, the tasks that make up scientific work. What should a scientist do with regards to the object of their study? What does it mean to scientifically study a phenomenon? These questions are practical as well as ethical in nature. Expertise goes into the work of the scientist, but there might also be certain virtues that are expected from a good scientist.

Secondly, there is the layer of social interactions within science. Science is not a solitary endeavour. However much there might be a cultural idea of the scientist as a lone genius, a scientist presumably does not carry out their work in solitude and solely for their own pleasure. Doing scientific work in isolation is not impossible, but with little to no contact with other scientists, one might just end up discovering something that has already been discovered. A scientist cannot do all of science alone, and even if they could, a lot of that work would be redundant. Scientists will have to interact with each other, so there are questions about the ideal shape of interactions within science. What should a scientist do with regards to other scientists? What should the exchange of knowledge between scientists look like? Science is a collective effort, so how should the social space of this collective be structured?

Thirdly, there is the place science occupies in the world. As mentioned before, science has consequences for more than just science itself. Application of scientific knowledge affects the world and its inhabitants. Desired or not, there is a relation between science and the world outside of it. A scientist will have to keep the possible effects on the rest of the world in mind when conducting research. What should a scientist do with regard to non-scientists? What responsibility does science bear towards society?

All three layers need to be considered when constructing an ideal of science. The work of atomised scientists, no matter how perfectly they follow the best practices of science, will lead to a lot of reinventing of the wheel. A community of scientists holed up in an ivory tower will eventually find a mob knocking at their door.

In the introductory chapter I already made the prescriptive statement that science is ideally motivated by curiosity, rather than by profit or power. What motivates scientific inquiry informs what science becomes. "Good science" must have the right motivations, the right means of scientific practice, and must take into consideration the relations within the field and outside of it. To figure out what this means, and to build a normative ideal of science upon it, I will for the next part largely rely on the work of sociologist of science Robert K. Merton. As one of the founders of the field of sociology of science he has relevant things to say for my purposes about what science should look like.

II.2 The Normative Structure of Science

In his 1942 text *The Normative Structure of Science*, Merton describes four norms that comprise what he calls the ethos of modern science.[3] These norms are universalism, "communism", disinterestedness, and organised skepticism.[4]
Universalism is taken to mean that all truth-claims in science are to be judged by the same impersonal criteria, regardless of the source of the claims.[5] Whether or not a claim is accepted should not depend on personal or social attributes of the person making the claim. Their race, nationality, religion, class, personal qualities, sexuality, or gender[6] are irrelevant. None of these attributes can exclude one from contributing to science. The norm of universalism was quite relevant to the time Merton was writing in. Cultures which had embraced ethnocentrism opposed universalism. Nazi Germany would distinguish between the "good" aryan science and the "bad" non-aryan science. Dubious claims would be made of the racial heritage of prominent scientists, so they could be claimed as part of this aryan science, but still they could not prove that the "outsiders" were inherently incapable of science. Whatever they did to hide or obscure it, there were always exceptions remaining, scientists who were not part of the aryan race, but whose contributions to science could not be ignored. This is enough to reject nationalistic forms of science, as these would always prevent outcasts from participating, resulting in a poorer science than one that embraces universalism. How to implement universalism within science is something Merton remains vague on. Thought needs to be given to what the impersonal criteria are on which scientific claims are to be judged. Societal changes might be required as well to achieve the goal of universalism in science. Not being barred from contributing to science means very little if one still experiences discrimination in education.

By *"Communism"* Merton does not refer to the political ideology, instead he means it in the nontechnical and extended sense of common ownership of goods.[7] Science is a collaborative effort, and the fruit of this effort, scientific knowledge, thus also belongs to the community. This attitude of common ownership towards science is captured well in a passage from anarchist philosopher Pyotr Kropotkin's *The Conquest of Bread* (Although for Kropotkin this was applicable to many more things than science):

"All belongs to all. All things are for all men, since all men have need of them, since all men have worked in the measure of their strength to produce them, and since it is not possible to evaluate every one's part in the production of the world's wealth. All things are for all."[8]

The only "ownership" a scientist should be able to claim over their work is recognition, the esteem gained from having a piece of science named after you. Merton would allow for competition between scientists to be the first to make a major discovery. As long as the product of this competition gets communised, it does not challenge the status of science as common property. Keeping secrets runs counter to this norm. A secretive scientist, however competent, will be regarded as selfish and anti-social when viewed through the norm of communism. Trying to assert ownership over science in a way that grants the exclusive right to utilise knowledge would be a violation too. Merton states: “The communism of the scientific ethos is incompatible with the definition of technology as ‘private property’ in a capitalistic economy.”[9] Here he was criticising the practice of patenting scientific research. In depth discussion of the issues with patents will be left for the next chapter. For not it suffices to say that keeping knowledge out of the collective pool of science results in an overall poorer science, while it contributes little as a driving force for research, and might in some cases halt further research.[10] As a response to the conflict between the scientific norm of communism and capitalist private property, some scientists have taken to defensively patenting their work, to ensure its availability for public use. This approach is however only available for scientists that have no need for the economic returns granted by a patent, and to maintain an open science within the current system would require every scientist to patent defensively. Defensive patenting is a quick fix, not a lasting solution. For the norm of communism to come to fruition scientists would have to promote an overhaul of the scientific reward system, or perhaps even advocate for a change in the social system.

Science also includes *Disinterestedness* as a basic institutional element.[11] It is there to ensure that the activities of science are carried out to the advancement of science, not to the personal gain of individual scientists, or the gain of other parties. This does not mean that a scientist cannot have personal motivations to participate in science, just that those motivations should not influence or corrupt the way science is carried out. Merton attributes the relative absence of fraud in the history of science to the norm of disinterestedness. Disinterestedness is in a way already built into the scientific process. Scientific results are supposed to be verifiable and replicable, so scrutiny from fellow scientists is already an expected part of research. Because it is an institutional element of science, scientists will conform to it on pain of sanctions, if they had not already internalised this norm. The issue of interested action in science is then not necessarily that science cannot stamp out dubiously motivated research from itself, but rather that laypersons could be fooled by claims wearing the guise of science. As stated before, the authority of science can be wrongfully appropriated. It should not be expected from non-scientists to distinguish between science and pseudoscience, so the responsibility to dispel myths falls on scientists. To ensure trustworthiness of science the norm of disinterestedness has to be maintained.

Organised Scepticism is both a methodological and an institutional mandate in science.[12] One’s own findings should of course be subject to detached scrutiny, but established beliefs, things we hold to be true, are not beyond critical examination either. This attitude has at times put science into conflict with institutions that hold certain things to be deserving of uncritical respect. The subjects science asks questions about of course might require a level of respect or care when studying them, but the potential that scepticism might destabilise or invalidate dogma, makes questioning it at all already tantamount to tampering with the functioning of society.

There is a vague worry that scepticism threatens the current distribution of power. Merton does not definitively state whether or not this fear is justified, but he does say that the scientific norm of organised scepticism seems to have been the source of revolts against the alleged intrusion of science into other spheres.[13]
The possibly radical implications of organised scepticism will be revisited later on, but first the place of science and the scientist in broader society will be examined.

II.3 Science and Activism

The scientific process requires scientists to make observations unclouded by judgement and to draw unbiased conclusions. This neutrality in the practice of science would lead one to believe that the field of science should be a neutral field. Pure science should be apolitical, disengaged, and autonomous. Merton's norms seem to back up this statement. The norm of universalism means that science should disregard the social or cultural background of scientists when assessing their contributions. A scientist ought not to be excluded nor be given preferential treatment based on anything but their scientific work. The norm of communism strengthens this norm, making sure that access to the accumulated pool of scientific knowledge forms no barrier to any aspiring scientist. The norm of disinterestedness explicitly states that the work of science should be done to the advancement of science, not for ideological gain. The norm of organised scepticism means that scientists' own beliefs are also to be scrutinised, and not dogmatically held on to.
Stated like this, very little seems wrong with desiring a pure and neutral science. The devil is however in how this supposed neutrality is defined. Because in a way, striving for neutrality is also at odds with Merton's norms. If the norm of universalism is not present in the society science exists within, not getting involved with the structure of society will make science's universalism less meaningful, as the social order of society will simply carry through to the social order of science.[14]
Participating in science is work that deserves to be rewarded, but as the norm of communism demands the fruits of science are communal property, the rewards for the scientist cannot be gained from "selling science". The majority of scientists would not be able to afford foregoing payment for their work, so to ensure a science in which the breadth of scientific knowledge is accessible to all without making it into a pastime only the wealthy can participate in, scientists will have to advocate for alternative reward systems in science, which might at times force them to become politically active. The norm of disinterestedness does not absolve scientists from having to consider the effects their discoveries could have outside of science. Giving no thought to the implications or possible uses or abuses of scientific advancements is not keeping outside influences out of science, but turning a blind eye to the fact that science affects the world. The organised scepticism of science puts it from time to time into conflict with established social mores. It could choose to remain neutral, being a provider of findings without making a definitive judgement. But depending on the nature of the findings, society will bring the conflict to science, at which point it becomes impossible to remain neutral.

Merton too is critical of the desire to maintain the purity of science. He understands it as motivated by a want to preserve the autonomy of science, but in a way this exaltation of pure science might be an over-correction.[15] Scientists proclaim the uselessness of pure science with a sense of pride. This aversion to the practical application of science undermines that by which the public determines the usefulness of science. Laypeople do not read papers, but they notice the improvements to their lives from the application of technology derived from scientific knowledge. Popular support for science rests on this. The social esteem of science is further eroded when scientists ignore all considerations apart from scientific progress in their research, overlooking what social consequences their findings might have. Incapability or refusal to control the direction in which discoveries are applied, means someone else will find applications for it. Outrage over bad applications will still be addressed to science, as it was science that brought the misused knowledge into the world. Scientists might try to wash their hands from this by saying that it was not their own actions that led to the perversion of their discoveries, but this is unlikely to satisfy those who rail against science.[16] Scientists might assume that all scientific progress is beneficial to society in the long run, but it is clear that failure to guide discoveries has led to results that are far from beneficial, which simultaneously has eaten away at the societal support for science. Paradoxical though it may seem, to maintain a science that is neutral and autonomous, scientists will from time to time have to get involved with society, to make a case for the usefulness of their work, and to defend science against appropriation towards detrimental ends.

Why is there a demand for neutral science anyway? It is assumed that to be scientific is to reserve judgement, to take no stance in even the most critical issues.[17] Scientific objectivity means being aware of biases, and acting to minimise them while testing claims against evidence. But this does not mean that a scientist cannot have a point of view of their own. Moreover, accepting a given framework without question is considered antithetical to science. So why is science considered to be stepping out of its lane when its findings have political implications? Perhaps it is due to a confusion of the different layers of science. The impartial stance scientists are expected to take during research is extrapolated to mean that to be scientific is to never take sides. A more damning explanation is that demanding science to be neutral is part of a revolt against science in order to maintain the status quo.[18] What is to be done with scientific discoveries is not to be decided by scientists, but should be left to politicians and policy makers, or perhaps even business owners, or more widely by the public at large. Scientists are allowed into the spaces outside of science to proclaim some facts, but doing anything more, such as proposing societal action based on these facts, runs the risk of being accused of being a biased ideologue, and thereby a bad scientist. This limits the things science can say. Perhaps it comes from a genuine belief that science is at its best when it does not take a stance, but it seems rather convenient that this means that any scientific research that poses a threat to dominant power structures can be waved away as science intruding where it should not be. Or, for discoveries that are too big to be ignored, the power to prescribe action is taken out of the hands of the scientists.

Neutral science is neutered science, if not subservient to the political system it exists within, then at least vetoable by it, or self-censoring for fear of stepping out of its lane. As said before, to maintain its values science has to get involved with society. If science wants to be truly neutral, it cannot suffer society to define what neutrality means for it. But why cling to neutrality at all? Does being neutral produce good science? What the idea that science ought to be neutral seems to do is provide fuel for attacks against science. Rather than keep up this facade, science might be better served by admitting the impossibility of remaining neutral, and free itself from the expectation to be so.

If science is inevitably political there is still a question what its political presence should look like. There is likely a fear that by foregoing the guise of neutrality, science risks losing its integrity. If science were to ever pledge its allegiance to a political party, that would indeed be an issue, but there are more ways to engage in politics besides mingling in the world of electoral politics. There is an inherent political dimension to many scientific questions.[19] The kind of questions scientists ask, and the questions they do not ask, carry value judgements about the world. Being aware of this enables the scientist to occasionally step back and ask "am I asking the right questions?" This might also lead scientists to questions about what political structure, what value system, caused them to ask certain questions over others. Ignoring it however, leads to the mistaken assumption that the question a scientist pursues is the only sensical one to ask. Its alternatives remain unknown, and the system that led the scientist to formulate the question like that retreats into invisibility.[20]
To give an example, there is the issue of anthropogenic climate change, and the contributions made to greenhouse gas emissions by fossil-fuel driven technologies such as cars and aeroplanes. Presented with this problem, a scientist might research how the engines of these vehicles might be made more efficient, or how to synthesise green carbon neutral fuels to replace the fossil fuels used by them. On their own, there is nothing wrong with these lines of research. Making existing technology greener is important. But there are questions that remain unasked. Are biofuels the only viable path to avert climate collapse, or are they the preferred solution because they can be implemented without challenging existing paradigms?[21] If individualistic car culture and infinite material growth are taken as facts of the world, then the solution to the problems they pose must be green cars and green growth. But it might be worthwhile to question if there are alternatives, because greening current paradigms, while strictly an improvement, comes with its own problems. Leaving car culture untouched, and choosing to engineer biofuels to replace the current fossil-fuel usage is not a neutral action. A great increase in the planting of fuel crops will lead to deforestation, so answering the current demand for fuel means valuing continued intensive use of cars above the ecology of standing forests.[22] It might make fuel use carbon neutral, but an old problem is replaced with a new one. Moreover, Jevons Paradox indicates that time and again increased efficiency in energy use has not led to a decrease in use or demand of energy, but rather an increase that undoes and outpaces any gains in efficiency.[23] If this holds true for the full implementation of biofuels, the arable lands these take up can only

increase. Merely greening technology without challenging the paradigm of infinite growth does not seem to be a lasting solution.
How to challenge dominant paradigms as a scientist? Countering car emissions by saying people should use their car less and start riding bicycles is not likely to go over well.[24] But why? For starters it is considered outside the field of science to propose lifestyle changes. What does a scientist know about getting people to ride bicycles after all? It is of course more complex than simply saying it, some changes to the social structure would be necessary to accommodate a shift from car culture to bike culture. But more than it being out of lane, it is not an answer people expect or even want to hear from science. When problems are brought to science the answer is already known. Not the exact answer, but the type of answer desired. It is expected that science "does science" to a problem, and so makes the problem go away. If the answer that is sought is already known, alternative types of answers are rejected by default. "Doing science to it" is just one of possible answers, and it is not always the best answer. Expecting science to behave as a dispenser of predictable answers makes it a narrow and subservient field.
So, what can be done to prevent the narrowing of science? Part of this could be accomplished in the education of new scientists. Inspired by the idea of the *Activist Engineer*[25] as thought up by Darshan Karwat, I would argue for educating scientists to be activist scientists. Scientists should naturally be knowledgeable in their field, but they should also be aware of the social context within which their field exists. They must be aware of the value judgments inherent to certain scientific questions, so they can step back and ask if they are pursuing the right line of inquiry. The narrow field of questions with expected answers would cease being the way of the world, but just one of multiple options. Activist science also means taking an activist stance with regards to science. Scientists should make the case for and stand by their work, especially when society would rather ignore their findings. Climate scientists who agitate for political change based on their findings are not out of line; they are doing what should be expected of scientists.

II.4 Digging for the Roots

What is ultimately the goal of science? To what end do humans pursue scientific inquiry? From the previous section one could draw the conclusion that I believe that science should serve the well-being and progress of humanity at large. On some level I do think this is a valid expectation, but this should not be the motivational core of science. Alternatively, I would formulate it as "science should be allowed to affect humanity and be allowed to have an impact on our relationship with the world", because as also explored in this chapter, there are issues with science being motivated solely by goals outside of science, even if those goals are noble. While we would expect at least some moral considerations about the common good to be present in the back of the mind of every scientist, overemphasis on usefulness and applicability would distract from scientific research, if only because the use of a discovery is not always readily apparent. A similar sentiment is expressed in that cited-to-the-point-of-cliché quote attributed to theoretical physicist Richard Feynman:

"Science is like sex: sometimes something useful comes out of it, but that is not the reason we do it."[26]

But what is then the actual reason we do it? To satisfy our curiosity? Because of the existential pleasure of knowing? To be smug about it? All possible answers, but also somewhat unsatisfactory ones. Engaging in gossip can also satiate our curiosity. Reading the vast appendices of J.R.R. Tolkien's The Lord of the Rings can also please that part of us that wants to know stuff. And being smug is often better achieved by confidently knowing less. What then is it about science that sets it apart from any other human activity that scratches the same itch? Before answering this question, it is useful to look at a dividing line within science. Within science a distinction is made between applied science and fundamental science. Shortly put, the first one concerns research conducted to solve or address specific problems, while the latter includes research to gain deeper understanding of the world. Research for application is usually short term, as the question is narrow and in a way the scientist already knows what answer they are looking for. Research for fundamentals is usually long term, the question is much broader and the kind of answer one seeks is not readily apparent. It is clear that capitalism would favour the sure and quick turnout of applied science over the uncertain dive into the unknown of fundamental science, but the two categories are not easily separated, they blur into each other. Where does research fall that seeks to address a specific issue, but for which the relevant science is still unknown? It could be given a place by splitting the two categories into four quadrants, based along an axis of consideration of use, and an axis of depth of research.[27] That kind of research would then fall into the quadrant with a high consideration of use and a search for fundamental knowledge. Research with little consideration for use that seeks fundamental understanding, and research with high consideration for use that does not seek fundamental understanding both respectively cover the distinction of fundamental and applied that we started with. Little of note would go on in the final quadrant, no consideration for use and no quest for fundamental understanding, but it is there to round out the four-quadrant system.
This categorisation is undoubtedly better than the simple distinction between applied and fundamental, but the categories are still artificial. Drawing the lines like this fails to appreciate the interdependence between the categories. It is evident that the continued existence of science hinges upon societal support, and that much of this support hinges upon the usefulness of science to society. In this regard applied science is favoured by society. But trying to argue for the right of fundamental research to exist because some of it is actually conducted with applicability in mind is not the right way to react to this. The quest for fundamental understanding should not have to make the case for its usefulness, because from what else does applied science draw but the pool of accumulated scientific knowledge found through fundamental research? This relationship between fundamental science and applied science is captured well by anarchist activist and theoretical physicist William Gillis: "One burrows down to the roots, the other takes the simple nutrition from these roots back out and blossoms it into a million applied particulars."[28]

This “digging for the roots” is what I think is the core of science. A search that stretches ever on, always looking for the layers of causes that underlie phenomena. Stretching existing theories until they either break or morph into better theories. All in search for the deepest roots.[29] The roots that might never be fully uncovered, but for which it is nonetheless worthwhile to reach. This radical inquiry is not to be limited to the space partitioned off as the domain of science, but should flow free where it is needed, and question all it can. This is Merton’s norm of organised scepticism taken to a radical conclusion. He stated that there is a vague recognition that scepticism poses a threat to the status quo, but that this does not mean that conflict is necessary.[30] Here however, upsetting the status quo becomes an almost inevitable result of following the scientific impulse. Science can be, and perhaps even should be, radical.

Notes and References for part II

[1]: This perspective on the constructed nature of scientific knowledge has been formed by observing and participating in the discourses surrounding science and objectivity, but doing so I fear I lost the ability to trace a claim like this back to a definitive source.

[2]: I have no real reference for this introduction, but in no way is it wholly original. It is a view of science informed by the ideas of several philosophers of science, such as Feyerabend, Lakatos, and Popper, whose work was largely introduced to me through Chalmers, Alan F. *Wat heet wetenschap?* (original title: *What is this thing called science?*) Translated by Rob van den Boorn, Boom Amsterdam, 1999.

[3]: Merton, Robert K. "The Normative Structure of Science" (1942) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 270.

[4]: At times these norms have been abbreviated with the acronym CUDOS, for "Communism", Universalism, Disinterestedness, and Organized Skepticism. Later thinkers have also added Originality as a fifth norm, to make every letter in the acronym represent a single norm. Some thinkers also replaced the norm of "Communism" with Communalism, possibly to avoid association with a controversial political system during times of ideological strife. All these were additions after Merton's initial text. I will discuss the Mertonian norms in the order they were presented in The Normative Structure of Science (1942, 1973) and largely ignore the later additions.

[5]: Merton, Robert K. "The Normative Structure of Science" (1942) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 270.

[6]: The last two attributes, sexuality and gender, are personal additions to the list of attributes Merton sums up in his paragraph on universalism. In his text scientists seem to be men by default. Whether this was his genuinely held belief, or just a safer way of writing in a time where sexism and homophobia were still the norm, I do not know. The absence was noted by me, and adding to the list felt in keeping with the spirit of Merton's norm of universalism.

[7]: Merton, Robert K. "The Normative Structure of Science" (1942) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 273.

[8]: Kropotkin, Pyotr. *The Conquest of Bread.* G.P. Putnam's Sons, 1906, pp. 14.

[9]: Merton, Robert K. “The Normative Structure of Science” (1942) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 275.

[10]: Radder, Hans. “Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions” *Philosophy and Technology*, vol. 26, 2013, pp. 294, doi:10.1007/s13347-013-0109-8.

[11]: Merton, Robert K. “The Normative Structure of Science” (1942) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 275.

[12]: Merton, Robert K. “The Normative Structure of Science” (1942) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 277.

[13]: Merton, Robert K. “The Normative Structure of Science” (1942) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 278.

[14]: Morales-Doyle, Daniel. “There is no equity in a vacuum: on the importance of historical, political, and moral considerations in science education” *Cultural Studies of Science Education*, vol. 14, 2019, pp. 489, doi:10.1007/s11422-019-09925-y.

[15]: Merton, Robert K. “Science and the Social Order” (1938) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 260.

[16]: Merton, Robert K. “Science and the Social Order” (1938) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 263.

[17]: Podur, Justin. “Science and Liberation” *Briarpatch Magazine*, 6 Jan 2014, https://briarpatchmagazine.com/articles/view/science-and-liberation.

[18]: Merton, Robert K. “Science and the Social Order” (1938) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 265.

[19]: O’Brien, Mary H. “Being a Scientist Means Taking Sides” *BioScience*, vol. 43, no. 10, 1993, pp. 706, doi:10.2307/1312342.

[20]: The idea that a system can be naturalised to the point where it gets regarded as fact rather than value, and is enabled to become invisible was borrowed from

Fisher, Mark. *Capitalist Realism: Is there no alternative?* Zero Books, 2009, pp. 16&66.

[21]: Karwat, Darshan M. *On Combustion Chemistry of Biofuels and the Activist Engineer.* 2012, University of Michigan, PhD Thesis, pp. 127.

[22]: Karwat, Darshan M. *On Combustion Chemistry of Biofuels and the Activist Engineer.* 2012, University of Michigan, PhD Thesis, pp. 109.

[23]: Karwat, Darshan M. *On Combustion Chemistry of Biofuels and the Activist Engineer.* 2012, University of Michigan, PhD Thesis, pp. 137.

[24]: Karwat, Darshan M. *On Combustion Chemistry of Biofuels and the Activist Engineer.* 2012, University of Michigan, PhD Thesis, pp. 131. Admittedly this statement would be less controversial over here in the Netherlands compared to how it would land in the United States, where railing against car culture is considered downright un-American.

[25]: Karwat, Darshan M. et al. "Activist Engineering: Changing Engineering Practice By Deploying Praxis" *Science and Engineering Ethics*, vol. 21, no. 1, 2014, pp. 232, doi:10.1007/s11948-014-9525-0.

[26]: This quote is ubiquitous in pop culture and memes, but my first encounter with it in an academic paper came from Castelfranchi, Christiano. "Six Critical Remarks on Science and the Construction of the Knowledge Society" *Journal of Science Communication*, vol. 6, issue 4, 2007, pp. 1, doi:10.22323/2.06040303.

[27]: Whitesides, George M. "Reinventing Chemistry" *Angewandte Chemie International Edition*, vol. 54, issue 11, 2015, pp. 3207, doi:10.1002/anie.201410884.

[28]: Gillis, William. "Science as Radicalism" *Human Iterations*, 18 Aug. 2015, pp. 15, http://humaniterations.net/2015/08/18/science-as-radicalism/. Gillis names the distinction which I call "fundamental science and applied science" simply "science and technology".

[29]: Gillis, William. "Science as Radicalism" *Human Iterations*, 18 Aug. 2015, pp. 10, http://humaniterations.net/2015/08/18/science-as-radicalism/.

[30]: Merton, Robert K. "Science and the Social Order" (1938) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 265.

III Science under Neoliberal Capitalism

In the previous chapter I purposefully kept myself from talking about capitalism directly, although at certain points it could not be avoided. This was to keep the chapter's main focus on examining ideals of science, and not get muddied by extensive critiques of the current economic structure science exists within. However, idealising efforts like this are usually not merely some frivolous mental exercise in order to construct a perfect fantasy world. Formulating an ideal of science serves the purpose of restating the norms the field ought to strive for, in response to an observed undesired state.[1] This undesired state in Merton's time was among other things the propagation of nationalistic forms of science by ethnocentric regimes. The undesired state of science I observe in this time comes in the form of how the priorities of science have been distorted by capitalist incentives. How capitalism, and in particular its current incarnation of neoliberalism capitalism, has influenced science is what will be explored in this chapter.

The choice to focus on the current moment of capitalism is to keep the critique at a reasonable length, but it should be noted that the tension between capitalism and science was already present before the dawn of neoliberalism. (Although a case could be made that neoliberalism has heightened this tension.) There was no past in which capitalism and science coexisted harmoniously, the fact that Merton's critiques are still relevant today is proof enough of that. In any case, even if things were better in the past, a return to it is neither feasible nor desirable.
From the tone of my writing my personal opinion on capitalism can easily be gleaned, but I do my best to make it as approachable as possible, whatever opinion a potential reader might hold on the matter. It is insufficient to conclude that the influence of capitalism on science is a bad thing because capitalism is bad. Instead I intend to show that the norms of capitalism are incompatible with the norms of science. Allowing science to be guided by capitalist norms crowds out scientific norms, and makes science worse overall. Some harsh words might still be spoken about capitalism, but I hope to make arguments that are compelling even to the capitalism enthusiasts.

What do I mean by "capitalist norms"? Without defining them first this chapter would fall into a trap of arbitrarily blaming every problem with science on capitalism. It would fail to adequately explain the link between the current state of science and capitalism. To really make the case that capitalism bears responsibility for the current state of science, it must not only be pointed out that science as it is deviates from how we think science should be, but also how exactly these deviations connect to a capitalist economic system. In order to do this, some ground work on capitalism needs to be laid out. So before getting into how it has influenced science, it first must be discussed what is understood by neoliberal capitalism.

III.1 What even is Neoliberalism?

Neoliberalism is what could be considered the current moment of capitalism. It is still capitalism, but it is its own specific form of capitalism. One could say that it is in some sort of crisis right now, but as long as its core assumptions hold it is unlikely that this crisis will spell its end. It might re-emerge in a slightly altered form, but it is those core assumptions that are of most interest here, not any particular set of policies designed to bring them into practice. It is this core of neoliberalism that could be used to explain the current predicament of science. These assumptions can be traced back to the end of the 20th century, when they inspired the implementation of several neoliberal policies in countries around the globe. It is important to note that these were not solely of that time. Some of them predated neoliberalism by decades, while others took form during the haphazard process through which these policies were implemented. There was no ready-made plan lying around forged up by some cabal seeking to bring about neoliberalism, rather it was the culmination of political choices that seemed rational.[2]

So, what are these assumptions? The core of it seems to be an unfaltering belief in the efficiency of markets. The flexibility of the market is contrasted with the sluggishness of government control.[3] It is therefore believed that the ideal market is a market that is as free as possible, unhindered by regulations and government interference. The neoliberal project has thus been one of market deregulation (or reregulation)[4] to achieve this ideal market. Since markets are seen as the ideal form of human interaction, increasingly more areas of human activity are conceived as markets. The neoliberal policies enacted to achieve these ends could be characterised as “destructive” on many fronts.[5] The rights of workers had to be rolled back to get them to compete in the labour market. Funding for public services such as healthcare, education, and transportation, was scaled back to make them more competitive. International trade was loosened up so production could easily be moved to places with low-wage labour forces. All this created a disenfranchised and atomised working class.

But if these neoliberal policies were so destructive of the hard-won rights of workers, one might wonder why the neoliberalisation of society has not been met with more resistance. There are of course examples of neoliberal policies being enforced through or under the threat of explicit violence, but this is far from the main means by which neoliberalism was implemented.[6] Neoliberalism has been more than merely destructive, it has also produced new social relations, new ways of living, new subjectivities.[7] The need to enforce policies from the outside becomes obsolete as individuals take the norms of neoliberalism into themselves, and thereby become their own enforcers. Neoliberalism envisions humanity as always being in competition among itself, with the market as the ideal arena to let this competition play out. There is little room for solidarity when a fellow worker is a competitor first and a colleague second. And this attitude of competitiveness is not merely confined to the workplace. It has subsumed whole swathes of human activity. Nearly every choice must bring us ahead in some way.

There is something to be said about how a lack of alternatives has allowed neoliberalism to become so all-encompassing. Its rise coincided with the so-called “end of history”, as proclaimed by Francis Fukuyama.[8] The neoliberal way of doing things has become naturalised to the point that it has become “*simply obvious* that everything in society [...] should be run as a business”.[9] But this obscures the fact that the impulse to give everything over to the market was based on a particular view of human nature. A view that in part only became reality though implementing policies that were based on it. This is actually where a first conflict between capitalism and science can be found, albeit a narrow and specific one. Scientific theories that contain alternate accounts of human nature are disregarded in favour of theories that fit more comfortably within the capitalist conception of human nature.[10] For example, the Kropotkinian theory of evolution, with its emphasis on cooperation as a factor in the success of species, gets largely ignored, as the dominant theory remains the more individualistic Darwinian theory.[11] This is not to say that the former is superior to the latter, rather that the obscurity of one, and the mainstream status of the other, seems to hinge more on their agreement with capitalist values than on their merits as scientific theories.

The neoliberal conception of human nature is not the definitive truth, and it could be argued that implementation of policies based on it is at least partly responsible for making this view reality. By extension, the market is not the only or most perfect way to determine the value of things.[12] Bringing everything under a market system will lead to missing the non-market values things might hold.

III.2 The Value of Science

What is the market value of science? And more importantly, what values go underappreciated through the lens of the market? A way to approach answering these questions is to take the norms of science as laid out by Merton in *The normative structure of science*, and examine where clashes occur when science is also expected to conform to the demands of the capitalist market.

The way the norm of universalism clashes with a capitalist system might not be readily apparent. If anything, one might say that this is the area where capitalism and science hold the same values. The story of capitalism is nominally meritocratic, one where through hard work anyone can make it, and this story maps well onto a view of science where anyone is allowed to contribute, provided their contributions are good. But this individualistic framing does not tell the entire story of the meritocracy of capitalism. Yes, theoretically anyone can make it, but what is left unsaid is that not everyone will. It is a thin coat of paint over a system that is still rigidly hierarchical, and it breaks down when brought into contact with statistics: movement within the hierarchy is possible, but not likely. This hierarchy matters when the accumulation of wealth, or lack thereof, corresponding to the place in the hierarchy one is born into plays a determining role in the chances one has in life. Without access to free or affordable education, one’s economic class determines whether one will be able to contribute to science or not.[13] When one is forced to abandon further studies to start working, one’s economic class prohibits contribution to science. With rising tuition costs, and cuts to social safety nets

through austerity, access to higher education is more and more becoming linked to class in Europe, where in the United States it might already have been the case for a longer time. On paper nobody is kept out, but without a scientific education it becomes near impossible to contribute to a field as advanced as science. Not explicitly barring anyone is a nice sentiment, but it is meaningless if there are social barriers to even obtaining the necessary mental tools to carry out scientific work. Scientific work is not a road out of poverty, and it is not supposed to be a source of great monetary wealth, but in a capitalist society in which the gap between the rich and the poor is growing, this will in practice mean that science will increasingly turn into a pastime for the wealthy, just as it was more than a hundred years ago. And let us not merely focus on that collection of countries nebulously called "the west". The chances are even more dire in those countries which were underdeveloped through years of colonialist and still ongoing neo-colonialist exploitation. Millions of people denied any chance of ever contributing to science. It should be clear that the norm of universalism is not the reality in science under capitalism, even if occasional lip-service is paid to it. We love an underdog story of someone making it despite the odds, but the hardships endured by the underdog only accentuate the incredible luck it took to make it and the mundane and common misfortune of all those who did not make it. The state of universalism under capitalism is captured well in a quote from evolutionary biologist Stephen Jay Gould:
"I am, somehow, less interested in the weight and convolutions of Einstein's brain than in the near certainty that people of equal talent have lived and died in cotton fields and sweatshops."[14]

More readily apparent is the tension between the scientific norm of communism and capitalism. After all, communism is supposed to be a step away from capitalist notions of private ownership and profit driven economic practices. By "communism" Merton of course did not mean the political ideology, but the nontechnical and extended sense of common ownership of goods. Some glimpse of the supposed end goal of the political project of communism can be seen in this description, namely the society arranged after the doctrine of from each according to their ability to each according to their needs. Science is supposed to be a community of shared work and shared results. Anything that prevents the sharing of scientific knowledge is antithetical to this norm. Outright secrecy is rare in modern science, but information does not flow as freely as Merton might have wanted it. In order to make a profit from knowledge, its free flow must be restricted. Scientific research is seen as an investment in a capitalist market, and this investment does not pay off if the product of it belongs to all. Patents are a way to maintain a monopoly on the commercial use of knowledge. The philosophical issues with patents will be discussed more in the next paragraph. Interesting to note is that patents might be less a violation of the norm of communism than one might think. A patent is not obtained by keeping an invention secret, to claim it, it must be submitted publicly.[15] How else is the originality of the invention to be determined? Insofar as science is still capable or allowed to be non-commercial it could in theory still use this knowledge for the purposes of scientific research. The knowledge is not as free as it could be, but patenting is more a violation of the spirit of the scientific norm of communism than it is a hard barrier on the use of knowledge.

Patents on scientific knowledge do cause conflict with the scientific norm of disinterestedness. After all, not every scientific discovery is patentable, as will be pointed out later on, and not every patent is profitable. Generally speaking applied science is patentable, whereas fundamental science is not. As the market favours knowledge it can exploit, this tips the funding of research in favour of knowledge that is patentable. Applied science would have a quicker and more certain return on investment, especially when the application of science takes the form of a product one can sell.[16] The value of fundamental research could of course also be captured in market terms, as application flows from fundamental knowledge, but the potential applications can be massively dispersed through time. The pay-out takes longer and is more uncertain if these scientific projects would be taken on as an investment by market actors. The open-ended search for answers to scientific problems becomes muddled when one specifically incentivises searching for answers that are monetizable. Beyond biasing research to the end of patentable knowledge, the market can also incentivise dishonest behaviour, to the detriment of scientific integrity.[17] A strong believer in the market might object to this point. Surely a free market would filter out dishonest actors. Sooner or later their fraudulence would be exposed and consumers will take their money elsewhere. This does not bear out in reality. Individual consumers might care about honesty, but the market only really cares about what sells. A purchase made, even one later regretted once dishonesty came to light, is still a market signal. The problem with knowledge in a marketplace is that, barring any regulatory bodies outside of the market, truthfulness can only be determined once a transaction has already taken place, which grants legitimacy in the market.[18] That is assuming that dishonesty always will get exposed, but this does not have to be the case. If dishonesty is a profitable strategy, then keeping consumers in the dark, denying them the tools to make more informed choices, is a profitable strategy as well. Sure, there may have been some major scandals, but none seem to have led to paradigm shifts in the market. If there is information that could dissuade consumers from choosing for a certain product, there is an incentive to withhold this information, distort this information, or even seize control of the institutions that generate or disseminate this information.[19] To name an example of this, science on the health risks of smoking was of little value to tobacco companies, widespread knowledge of it would diminish their customer base. It was therefore in their interest to maintain ignorance of and cast doubt upon this research.[20] A similar dynamic can be observed surrounding the research on anthropogenic climate change. It must be noted that none of this requires such companies to become explicitly anti-science. In fact, it could be argued that it is more effective to still appear to be on the side of science. Funding the science that could threaten their bottom line creates the image of a company that cares about their impact, while it simultaneously grants a measure of control over the conclusions drawn by the research. Effectively this hollows out science to merely the legitimising power of scientific authority.[21] This abuse of the authority of science erodes the trustworthiness of science as a whole. If science can in some way

be bought, even if it is just a small fraction of scientists, it becomes harder to assume disinterested conduct from any scientist.
The need to control and the output and process of science by market actors to ensure the furtherance of their interests also causes friction with the scientific norm of organised scepticism. The norm of organised scepticism encourages scientists to never take established knowledge for granted, there is always room for improvement or revision of scientific theories. The market on the other hand seems to favour definitive knowledge. A place in science where this tension can be observed is in the so-called replication crisis. Vital to the scientific process is the replicability of scientific studies, that way it becomes more certain that the results of a study indicate a generalisable trend and not just merely a random fluke. However, repeat studies are not as lucrative as novel studies, which means less funds are made available for this not very spectacular but still vital scientific work. This has led to a situation where a bulk of scientific studies has never been legitimised through repetition.[22] The market demands simpler, more definitive truth than science can provide. Treating every bit of scientific knowledge once discovered as established, whilst discouraging further scientific scrutiny, makes the store of scientific knowledge drift further away from anything we would call truth. Actual calls for scepticism will only be heard from market actors when a newly forming dogma threatens to replace an established dogma. Think again of the science surrounding climate change, where doubt is spread by market actors with a vested interest in not changing anything by continuously raising the bar for sufficient proof of anthropogenic climate change.[23] Their sudden dedication to the scientific norm of organised scepticism could almost be called admirable, but this scepticism is not consistently applied. It is weaponized scepticism, not organised scepticism.

III.3 Owning Science

There are problems with conducting science solely motivated by market gain, but the part where scientific theories get applied in physical products to be sold on the market is not necessarily problematic from the standpoint of science, although it can still have a detrimental effect on the direction of scientific research when application becomes the main driver of science. But to exploit scientific knowledge to its fullest, one would want to do more than merely use it to make a product. To ensure returns on the investment in scientific research, one would want to establish exclusive rights to the scientific discoveries applied in the product as well. One would have to find a way to own scientific knowledge.
The legal means to have ownership over some scientific knowledge is through patenting, but as shall be explored here, there are philosophical issues with owning knowledge. The stated aim of patents is on the face of it not a bad one. If we accept that scientific research is an investment, then ensuring exclusive rights to the use of a discovery for a limited time after it is made is a means of making sure that this investment is worthwhile to whoever undertakes it. Issues come when determining what kind of knowledge can be patented, and what counts as a breach of a patent. The criteria knowledge must meet in order to be patentable are that it must be novel,

non-obvious, and useful.[24] Further requirements include that the patentable subject matter must be non-natural, must be a human-made invention and not a discovery of a freely occurring phenomena, must be reproducible by skilled peers, and it must be material rather than merely theoretical.[25] As much as these criteria try to create a clear distinction between patentable knowledge and non-patentable knowledge, they still contain grey areas, leading to problems where pieces of knowledge could fall under either category, depending on how one interprets the terms. For example, "natural" is philosophically speaking already a problematic term. It could be defined as "everything that occurs spontaneously without human intervention", but such a definition already rests upon a realist ontology, it presupposes a distinction between the domains of human-independent nature and human-dependent technology.[26] Even then it is still subject to legal fiddling about, such as in the case of genes. Genetic material would be considered natural in a realist ontology, and as such would not be eligible for patenting. However, numerous patents on genes have been granted. It could perhaps be argued that the process of purifying and isolating makes a natural thing like a gene into something non-natural, as it does not occur in this purified state without human intervention. But in that case any purified compound is to be considered non-natural, which might not be an acceptable consequence. It might strictly speaking be true that purified water is non-natural, in that it does not occur without human intervention, but it would make the category of non-natural less useful. Everything humans touch would become non-natural. Besides, this does not get applied consistently, in some cases isolating a gene was considered enough to make it a human-made artefact eligible for patenting, yet in other cases it was considered insufficient.[27]

In a similar fashion, a distinction between discovery and invention presupposes a sharp divide between science and technology, but different ways of seeing the relation between science and technology are possible. One could also see science as a form of technology. Scientific discoveries are not simply found, they are constructed through observation, and could therefore be said to be just as much human inventions. In this view discovery and invention are not separable, as the process of discovery is simultaneously a process of invention.[28] If this holds water there is no reason to exclude a scientific discovery from patentability, as long as it meets every other requirement. This is likely not desirable, so instead one would have to judge on a case by case basis what is a sufficiently human made invention. This approach admits that there is more going into what we consider an invention or a discovery than some special status that absolutely and sharply distinguishes the two. However, it also seems to reveal that whether or not a piece of knowledge is considered fair game to claim ownership of, hinges more upon how that knowledge is viewed than something inherent to the knowledge itself.

A final issue with patents that I want to raise here is the question about what is actually patented. What is the thing that is protected by a patent? The patentable thing must be material, but the protection does not just cover one particular instance of it. It covers every instance of the material thing described in the patent. But does this protect the product regardless of how it is made, or does it only protect products obtained through the specific methods described in the patent? Take for example a patent for a specific chemical compound. If the patent covers every instance of the compound being synthesised, then an alternate pathway for synthesis would still be considered a breach of patent. In effect, the patent holder is granted ownership over scientific work they did not carry out, simply because it leads to the same product.[29] A patent on the process, in this case the specific synthesis pathway formulated by the patent holder, would seem the fairer approach. One could perhaps make the claim that alternative processes are more easily formulated when the product is already known, but this would still not entitle the patent holder to ownership over this ostensibly lesser work. There is no special status to being the inventor of something either. As indicated by numerous examples of discoveries or inventions made near simultaneously and independently from each other, being the first to invent something, or in some cases just the first to patent something, is just that, being the first. Not the only one who could have, and not the only one who would have. In practice however, broad product patents are often granted, and there are incentives to pursue such patents over narrow process patents.[30] A broad patent not only grants the exclusive right to exploit an invention, but extends to further claims that could be based on the invention. This is how a single modification of a soybean cell could lead to a patent that covered all genetically manipulated soybeans.[31] These patents that cover much more than what was actually discovered might not even be used to develop into products, but might be held on to as a weapon in legal battles against the competition.

The goal of this section is not to "fix" patents. Although the issues with patents discussed here might have specific solutions, these will not be discussed here. Patent law could definitely be better than it is right now, but the problems with patenting seem to point to a bigger issue, namely an incompatibility between science and capitalism. Capitalism likes the products derived from scientific knowledge, but does not seem to know how to value the knowledge itself. Knowledge after all differs from other resources. Knowledge is not finite, no matter how many times or by how many people it is referenced, it does not run out, and it is easily shareable, especially in the digital age.[32] These aspects are fantastic for science, where holding the store of accumulated knowledge as common property is supposed to be the norm. But it brings problems when science is brought under the logic of capitalism. Science is labour, and scientists deserve compensation for that labour. Scientific knowledge is undoubtedly valuable, but its abundance makes it impossible to capture that value in market terms. After all, a product that does not run out has a market value that will tend to zero.[33] To make it have market value it must be made artificially scarce. Patents are then the flawed result of forcing market conditions onto a field where they do not naturally occur, nor really make sense.
A free market enthusiast might say to this that patents are there to encourage innovation through competition, but does this actually bear out in reality? It once again seems to rest upon that unproven assumption that through competition on the market all things become more efficient. Moreover, patenting, granting exclusive legally protected use of knowledge for a limited time, actually seems antithetical to the free market ethos.[34] Suspending market forces for the winner of the innovation race seems like a tacit admission that the free market does not actually encourage innovation. But neither does a patent really encourage further innovation once it is

secured, as can be seen in the numerous cases of a company simply sitting on a patent to prevent the use of it by competitors.[35] Patents do little for the actual progress of science, and could even be argued to be detrimental to it. Scientists deserve to be compensated for the scientific work they do, but attempting to own science, if it was ever of use to them at all, is not the way to go.

III.4 The University as a Business

The unbridled search for science that sells™ above all other scientific pursuits, spurred on by the incentive structures of the capitalist market, has clearly had negative consequences for the products of science. But it has also been detrimental to the institutions in which science is conducted, and to the scientists that work there. The modern-day university has been described as occupied by the "multi-headed wolf" of management.[36] Management should run the university as a business towards the goal of efficiency, driving down costs and increasing productivity. However, the measures implemented to make the university conform to the logic of the market have unintended and often contrary side effects. To make the university function like a business the work of scientists must be made measurable and must be made to reach certain targets. The first stumbling block here is what metric to use to measure the output of science. Presumably measuring is done to judge the quality of science, but a nebulous concept like quality is not easily captured, so one has to settle for supposed indicators of quality. So the work of an academic is evaluated by looking at how much they publish, how much their work gets cited, how many students they successfully supervise, and/or how much grant funding they manage to secure.[37] These could certainly be indicators of quality, but they could also become misleading numbers that gloss over the actual contents of the scientific work they are supposed to quantify. It is possible for scientific work to not be of quality, whilst still scoring good on these metrics. Worse, letting these metrics become the means by which it is determined which scientist does good work and which does bad work, and thereby which scientist might get promoted and which one might get laid off, will distort the motivations and priorities of scientists. In the 2016 paper *Academic Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition* authors Marc Edwards and Sidharta Roy speak of exactly that: a climate of perverse incentives in academia. In an effort to increase the productivity of science incentives are put into place based on the quantitative measures of scientific productivity. However, in reality the effects of these incentives are quite different from the intended effects.[38] Promising rewards for increased numbers of publications does not lead to a greater amount of useful papers, but to an avalanche of substandard papers. The sheer amount of papers leaves less time for extensive peer review of each and every one of them, increasing the chance of bad papers to slip through the cracks, and contributing to the previously mentioned replication crisis. Rewarding researchers for the number of times their work gets cited should incentivise the creation of influential quality work, but instead it leads to bloated lists of references. Citation cartels are formed to boost each other's numbers.[39] Focus on getting cited leads to writing more for one's own field of study, and diminishes engagement with other fields of study or the public. Rewards based on the number of students that finish a given course with good results should increase the quality of the education granted by a university, but in reality it leads to lowered standards for passing a course. Rewarding scientists based on their ability to secure research funding should ensure that every research gets properly funded, but it results in increased time spent polishing up research proposals to win over third parties, and this can even involve inflating the benefits and downplaying the negatives of the proposed research. Let it be clear that this is all not to place blame on individual scientists. The negative outcomes of perverse incentives are often a result of the crunch researchers are placed in by the demand from management to reach certain targets. It is however also true that perverse incentives leave the door open for dishonest behaviour, although at the same time they make it hard to distinguish between an otherwise honest scientist trying to survive in the academic culture and a dishonest scientist deliberately trying to boost their numbers. Quantitative metrics are easier to measure than the quality of scientific work, and this has led to placing quantity above quality to evaluate scientific productivity. It pressures scientists to cut corners to obtain the optimal amount of publications or citations. Maintaining integrity becomes difficult in this climate, a sort of negative selection takes place that either weeds out the scientists honestly interested in scientific quality or forces them to let go of their principles.[40]

In the paper *Paradoxen van het academisch kapitalisme*, published in the 2008 bundle *If you're so smart, why aren't you rich?*, authors René Boomkens and René Gabriëls talk in a similar way about how decisions made by university management bear out in reality in ways contrary to the stated aims. They trace these paradoxes of academic capitalism to the conflict between the logic of the manager and the logic of the academic professional.[41] The three main paradoxes of academic capitalism they discuss are the paradox of innovation, the paradox of social relevance, and the paradox of professionalisation. The paradox of innovation takes place in the attempts to streamline and accelerate the process of scientific innovation.[42] Streamlining science means creating a standardised science, whilst scientific innovation benefits from a pluralism of scientific methods. Innovation cannot be forced, one cannot map out the path to an unknown destination, and narrowing the roads of scientific inquiry would only decrease the likelihood of any real innovation being made.

All this innovation must of course be relevant to society. Here the paradox of relevance comes into play. The "tyranny of relevance"[43] within science goes back to the distinction between fundamental science and applied science. Applied science creates relevant innovation, whereas fundamental science is written off as irrelevant intellectualising. In a market society what is relevant and what is profitable get conflated. Market actors have been made the judge of what is relevant and their funding for relevant projects has largely replaced government funding for science.[44] This leads to an underfunding of fundamental research, but also of the social sciences.[45] Scientists have to argue for the relevance of their work to corporate sponsors, which does detract from their ability to do other scientific work. This way they gain less control over their research, they do not get to be the judge of the relevance of their own work. While social relevance is demanded from their work, they are discouraged to actually interact with society to figure out what is needed.[46] The demand for social relevance makes it harder for science to engage with society, because the market has been made the middleman between science and society. The market brings the wants of society to science, and returns the findings, all filtered through the logic of the market.

In this narrowing of the societal role of science we find the final paradox Boomkens and Gabriels discuss, the paradox of professionalisation. During the past century science has gone from a calling engaged in by a small elite who could afford it, to a profession like any other.[47] This has had the good effect of making it easier to engage in scientific discourse. In becoming a profession some necessary standards about what it means to be a scientist have been introduced, but there are downsides to the process of professionalisation as well. In part it comes down to the question through what frame it is decided what counts as professionalism. A neoliberal definition of professionalisation rests upon the logic of management, and is primarily focussed on the efforts of management to make an organisation as efficient as possible.[48] Control over the content of their work is taken away from scientists and handed over to management. So, although the organisation as a whole as a whole might be made more professional by neoliberal standards, this results in deprofessionalising and deskilling of scientists themselves.[49] A scientific professional needs an amount of discretionary space to act according to personal insight into their work, to follow certain paths of inquiry based on their own knowledge in the field. Under the guise of streamlining this space gets diminished, and with it the ability of the scientist to reflect on their own work gets disparaged. The scientist gets reduced to a mere executor of the demands of management, and ceases to be a professional.

These perverse incentives and paradoxes can be traced to academic capitalism.[50] This means of conducting science is based upon the previously mentioned neoliberal metaphysical claim that an organisation is always more efficient when it is run as a business. To make universities compete with each other in the market, rankings are brought into existence through which, based on certain metrics, it is decided which university is the best one. The place in the rankings determines a lot for a university, from the funding they can secure from third parties, to the number of students they can attract. Thanks to the so-called Matheus effect, this causes inequalities between institutions to snowball.[51] The ones with good numbers generally receive more, and the ones lower in the ranking are left further behind. So it is of the essence to appear as good as possible in the rankings. An obsession with the appearance of quality takes priority over the actual pursuit of quality. The problem with quality is that it can be pointed out, but it cannot be measured.[52] But in a market system, universities must be compared to each other, since they must compete with each other, and so the market enforces the measuring of the unmeasurable. As can be seen from the perverse incentives in academia and the paradoxes of academic capitalism, this system does not do much good for the universities themselves. It seems that the only thing really measured by the metrics used in university rankings is the capacity to play the numbers game.[53]

III.5 The Science Worker

Where is the scientist left in all of this? The changing structure of the university has inevitably been accompanied by the forming of a new kind of scientist. As was pointed out by the paradox of professionalism, the push to make science more professional according to market logic leads to scientists whose only task is to "do science". Responsibility and control over the direction of science has been surrendered to management. The job of the scientist takes place in a narrowly defined part of the knowledge factory that is the university, and this narrowing can also be seen in the education of new scientists. It could be said that the scientist has become proletarianized. Proletarianization, the process of becoming proletarian, is understood here as a process of losing knowledge.[54] This might sound strange because scientists are generally regarded as smart people, but through the process of professionalising and streamlining they are no longer required to know certain things, and all they do know is supposed to serve the efficient generation of new knowledge. They become alienated from their work, both in terms of getting a say about the contents of their research, as they are forced to make it conform to the demands of management and the market, and in terms of getting a say in what happens with the results of their research.

But it would be too simplistic to define scientists solely as an exploited underclass, lorded over and pushed around by an academic bourgeoisie in the form of management. As is the case in broader neoliberal society, where the categories of exploiter and exploited have started to blur into each other, scientists engage in self-exploitation and self-proletarianization. The systems of control and evaluation to which scientists are subject are based upon the assumption that humans are fundamentally self-serving, and constant monitoring is the only way to ensure that they act in service of the greater good.[55] Intrinsic motivation of scientists, if it is even believed to exist at all, is denigrated as not reliable enough to satisfy the demand for scientific productivity.[56] Productivity is only believed to be achievable through surveillance and competition, through the promise of financial gain, or the threat of financial ruin. In one way or another scientists take within themselves the idea that they must be more competitive to survive, and by doing so become participants in their own exploitation. The shifting motivations lead to the formation of a different kind of scientist, one less driven by intrinsic motivation and more so by entrepreneurial urges.

Can science function like this? Scientists can adapt and have adapted to the shifting rules of science.[57] Some might even thrive under neoliberal science, and there is no real point in begrudging them the success they found by playing the game they found themselves in. It should however be questioned if this is the kind of game we should be playing with science. Does neoliberal science serve to achieve the goals we think science ought to pursue? Can we still speak of good science when it is ruled by market forces? The evidence discussed in this chapter points out that the norms of science do not go together well with the norms of capitalism. Through the logic of the market, science becomes instrumentalized, the pursuit of knowledge can no longer be a goal in itself, it must serve the creation of profit by turning it into a marketable commodity.[58] The abundant good of knowledge gets privatised to obtain a monopoly on the exploitation of it. In an attempt to run academic institutions like businesses, perverse incentives are introduced that achieve contrary effects and enable corruption.[59] Scientists must either compromise their scientific ideals and adopt the mindset of an entrepreneurial scientist, or they might leave the field disillusioned.[60] From the side of the market there might not be much wrong with this, there is no lack of new papers being published, no lack of new knowledge to be exploited. But for those who like science, and those who like seeing science do good things for humanity, it might be interesting to explore alternative ways of managing science. Is it possible for science to be better than this?

Notes and references for part III

[1]: Merton, Robert K. “The Normative Structure of Science” (1942) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 267.

[2]: Dardot, Pierre and Laval, Christian. *The New Way of the World: On Neoliberal Society.* (Original title: *La nouvelle raison du monde: Essai sur la société néolibérale*) Translated by Gregory Elliott, Verso, 2013, pp. 14.

[3]: Boomkens, René and Gabriels, René. “Paradoxen van het academisch kapitalisme” *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 121.

[4]: Dardot, Pierre and Laval, Christian. *The New Way of the World: On Neoliberal Society.* (Original title: *La nouvelle raison du monde: Essai sur la société néolibérale*) Translated by Gregory Elliott, Verso, 2013, pp. 338. Deregulation might be a bit of a misnomer. Markets do not emerge naturally but are constructed by state intervention. It is as such not so much deregulation as it is a different kind of regulation, regulation towards the constructed ideal of a free market.

[5]: Bourdieu, Pierre. “The essence of neoliberalism” (Original title: “L'essence du néolibéralisme), Translated by Jeremy J. Shapiro, *Le Monde diplomatique*, Dec. 1998, https://mondediplo.com/1998/12/08bourdieu.

[6]: Dardot, Pierre and Laval, Christian. *The New Way of the World: On Neoliberal Society.* (Original title: *La nouvelle raison du monde: Essai sur la société néolibérale*) Translated by Gregory Elliott, Verso, 2013, pp. 11.

[7]: Dardot, Pierre and Laval, Christian. *The New Way of the World: On Neoliberal Society.* (Original title: *La nouvelle raison du monde: Essai sur la société néolibérale*) Translated by Gregory Elliott, Verso, 2013, pp. 8.

[8]: Fisher, Mark. *Capitalist Realism: Is there no alternative?* Zero Books, 2009, pp. 6.

[9]: Fisher, Mark. *Capitalist Realism: Is there no alternative?* Zero Books, 2009, pp. 17.

[10]: Dardot, Pierre and Laval, Christian. *The New Way of the World: On Neoliberal Society.* (Original title: *La nouvelle raison du monde: Essai sur la société néolibérale*) Translated by Gregory Elliott, Verso, 2013, pp. 132.

[11]: Example borrowed from Gorrion, Alex. “Science: A continuation of ‘For the Love of God'” *The Anvil Review*, 29 May 2015, https://theanvilreview.org/print/science/.

[12]: Crouch, Colin. *The Knowledge Corrupters: Hidden consequences of the financial takeover of public life.* Polity Press, 2016, pp. 41.

[13]: *Towards universal access to higher education: international trends.* UNESCO IELSALC, 2020, pp. 42.

[14]: Gould, Stephen J. "Wide Hats and Narrow Minds" *New Scientist*, vol. 81, no. 1145, 1979, pp. 777.

[15]: Radder, Hans. "Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions" *Philosophy and Technology*, vol. 26, 2013, pp. 293, doi:10.1007/s13347-013-0109-8.

[16]: Whitesides, George M. "Reinventing Chemistry" *Angewandte Chemie International Edition*, vol. 54, issue 11, 2015, pp. 3200, doi:10.1002/anie.201410884.

[17]: Crouch, Colin. *The Knowledge Corrupters: Hidden consequences of the financial takeover of public life.* Polity Press, 2016, pp. 29.

[18]: Crouch, Colin. *The Knowledge Corrupters: Hidden consequences of the financial takeover of public life.* Polity Press, 2016, pp. 28.

[19]: Crouch, Colin. *The Knowledge Corrupters: Hidden consequences of the financial takeover of public life.* Polity Press, 2016, pp. 48,50,58.

[20]: Oreskes, Naomi and Conway, Erik M. "Defeating the Merchants of Doubt" *Nature*, vol. 465, 2010, pp. 686, doi:0.1038/465686a.

[21]: Podur, Justin. "Science and Liberation" *Briarpatch Magazine*, 6 Jan 2014, https://briarpatchmagazine.com/articles/view/science-and-liberation.

[22]: Edwards, Marc A. and Roy, Siddhartha. "Scientific Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition" *Environmental Engineering Science*, vol. 34, no. 1, 2017, pp. 53, doi:10.1089/ees.2016.0223.

[23]: Oreskes, Naomi and Conway, Erik M. "Defeating the Merchants of Doubt" *Nature*, vol. 465, 2010, pp. 686, doi:0.1038/465686a.

[24]: Radder, Hans. "Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions" *Philosophy and Technology*, vol. 26, 2013, pp. 285, doi:10.1007/s13347-013-0109-8.

[25]: Radder, Hans. “Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions” *Philosophy and Technology*, vol. 26, 2013, pp. 286, doi:10.1007/s13347-013-0109-8.

[26]: Radder, Hans. “Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions” *Philosophy and Technology*, vol. 26, 2013, pp. 291, doi:10.1007/s13347-013-0109-8.

[27]: Radder, Hans. “Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions” *Philosophy and Technology*, vol. 26, 2013, pp. 290, doi:10.1007/s13347-013-0109-8.

[28]: Radder, Hans. “Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions” *Philosophy and Technology*, vol. 26, 2013, pp. 292, doi:10.1007/s13347-013-0109-8.

[29]: Radder, Hans. “Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions” *Philosophy and Technology*, vol. 26, 2013, pp. 297, doi:10.1007/s13347-013-0109-8.

[30]: Radder, Hans. “Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions” *Philosophy and Technology*, vol. 26, 2013, pp. 295, doi:10.1007/s13347-013-0109-8.

[31]: Radder, Hans. “Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions” *Philosophy and Technology*, vol. 26, 2013, pp. 296, doi:10.1007/s13347-013-0109-8.

[32]: Hess, Charlotte and Ostrom, Elinor. “Introduction: An Overview of the Knowledge Commons” *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, The MIT Press, 2007, pp. 9.

[33]: Mason, Paul. *PostCapitalism: A Guide to Our Future*. Penguin Books, 2016, pp. 163.

[34]: Crouch, Colin. *The Knowledge Corrupters: Hidden consequences of the financial takeover of public life.* Polity Press, 2016, pp. 62.

[35]: Radder, Hans. “Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions” *Philosophy and Technology*, vol. 26, 2013, pp. 294, doi:10.1007/s13347-013-0109-8.

[36]: Halffman, Willem and Radder, Hans. “Het academisch manifest: Van een bezette naar een publieke universiteit” *Krisis: Tijdschrift voor Filosofie*, issue 3, 2013, pp. 2.

[37]: Osterloh, Margit and Frey, Bruno S. "Evaluitis: de ziekte van de 'gecontroleerde' wetenschap" *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 235.

[38]: Edwards, Marc A. and Roy, Siddhartha. "Scientific Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition" *Environmental Engineering Science*, vol. 34, no. 1, 2017, pp. 52, doi:10.1089/ees.2016.0223.

[39]: Osterloh, Margit and Frey, Bruno S. "Evaluitis: de ziekte van de 'gecontroleerde' wetenschap" *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 237.

[40]: Edwards, Marc A. and Roy, Siddhartha. "Scientific Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition" *Environmental Engineering Science*, vol. 34, no. 1, 2017, pp. 53, doi:10.1089/ees.2016.0223.

[41]: Boomkens, René and Gabriels, René. "Paradoxen van het academisch kapitalisme" *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 108.

[42]: Boomkens, René and Gabriels, René. "Paradoxen van het academisch kapitalisme" *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 112.

[43]: Vohland, Katrin et al. "Citizen Science and the Neoliberal Transformation of Science – an Ambivalent Relationship" *Citizen Science: Theory and Practice*, vol. 4, issue 1, art. 25, 2019, pp. 3, doi:10.5334/cstp.186.

[44]: Boomkens, René and Gabriels, René. "Paradoxen van het academisch kapitalisme" *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 114.

[45]: Boomkens, René and Gabriels, René. "Paradoxen van het academisch kapitalisme" *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 115.

[46]: Boomkens, René and Gabriels, René. "Paradoxen van het academisch kapitalisme" *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 116.

[47]: Boomkens, René and Gabriels, René. "Paradoxen van het academisch kapitalisme" *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 117.

[48]: Boomkens, René and Gabriels, René. “Paradoxen van het academisch kapitalisme” *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 118.

[49]: Boomkens, René and Gabriels, René. “Paradoxen van het academisch kapitalisme” *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 120.

[50]: Boomkens, René and Gabriels, René. “Paradoxen van het academisch kapitalisme” *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 120.

[51]: Boomkens, René and Gabriels, René. “Paradoxen van het academisch kapitalisme” *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 122.

[52]: Boomkens, René and Gabriels, René. “Paradoxen van het academisch kapitalisme” *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 129.

[53]: Osterloh, Margit and Frey, Bruno S. “Evaluitis: de ziekte van de ‘gecontroleerde’ wetenschap” *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 239.

[54]: Stiegler, Bernard. *States of Shock: Stupidity and Knowledge in the 21st Century*. (Original title: *États de Choc. Betise et savoir au XXIé siecle*) Translated by Daniel Ross, Polity Press, 2015, pp. 127.

[55]: Lock, Grahame. “Hellzapoppin… De universiteit van vuur en zwavel” *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 95.

[56]: Castelfranchi, Christiano. “Six Critical Remarks on Science and the Construction of the Knowledge Society” *Journal of Science Communication*, vol. 6, issue 4, 2007, pp. 1, doi:10.22323/2.06040303.

[57]: Moore, Kelly et al. “Science and neoliberal globalization: a political sociological approach” *Theory and Society*, vol. 40, 2011, pp. 512, doi:10.1007/s11186-011-9147-3.

[58]: Radder, Hans. “The Commodification of Academic Research” *The Commodification of Academic Research: Science and the Modern University*, edited by Hans Radder, University of Pittsburgh Press, 2010, pp. 14.

[59]: Edwards, Marc A. and Roy, Siddhartha. “Scientific Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and

Hypercompetition" *Environmental Engineering Science*, vol. 34, no. 1, 2017, pp. 52, doi:10.1089/ees.2016.0223.

[60]: Edwards, Marc A. and Roy, Siddhartha. "Scientific Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition" *Environmental Engineering Science*, vol. 34, no. 1, 2017, pp. 53, doi:10.1089/ees.2016.0223.

IV The Possibility of a Better Science

Part II was dedicated to constructing a prescriptive ideal of science, drawing from sources old and new. In part III it was discussed how science in its current form does not live up to this ideal. There is a tension between what we think science should be, and science as it exists in reality. The purpose of this final part is to explore what can be done to dispel this tension. It is all well and good to imagine a theoretical perfect science, but just thinking of it does not bring it into existence. So, what can actually be done to make science more closely resemble its ideal?
Before talking more in depth about the possibility of a better science, some words should also be dedicated to the *necessity* of a better science. In previous parts arguments have already been made that those who like science should be dismayed by the current state of science, but these might not do much to convince those who do not share the enthusiasm of scientists. However, in a world so impacted by the findings of science and the technologies that have sprung from them, the state of science should be of concern to all. Science is not isolated from society, the actions of scientists, what they do and what they do not do, whether they are led by an earnest desire to contribute to the good of humanity, or they are led around by perverse incentives introduced by market forces, will have ramifications for the world at large. As problems such as climate change continue to escalate, humanity will turn to science for solutions. The efficacy of "doing science" to the problem of climate change will depend on the lens through which scientists try to envision solutions. The capitalist way of doing science is one of providing individualistic, commodifiable fixes, such as more efficient cars, "green" energy sources, and "sustainable" products. The belief seems to be that if we innovate really hard our current carbon intensive ways will eventually become carbon neutral. The paradigm of unsustainable infinite growth does not have to be challenged, because science will make the inventions needed for sustainable infinite growth. The belief that such innovations will inevitably be made is hardly justifiable, let alone the belief that these developments will happen in time. The more sustainable technologies that get discovered in the meantime will undoubtedly be better than what came before, but they too are not without environmental impact. New technology that does not get accompanied by a change in the usage of technologies is just another turn of the old technological crank.[1] By building a better science, one liberated from the incentives of capitalism, it could be empowered to provide lasting solutions to the problems of the 21st century.

IV.1 Reclaiming Science from Capital

How does one reclaim science from the forces of capitalism? One of the reasons science has to comply with capitalist modes of management is because of its dependence on outside forces like governments and increasingly corporate sponsors to obtain the necessary funds to carry out scientific work. This money is not given freely, it comes with an expectation of control over the trajectory of science. The belief is that those who pay hold sway. The scientist is expected to make the case for the usefulness of their work to the funding bodies. Of course, some degree of accountability is to be expected, but scientists are not called here to justify themselves to the public, but rather to government bodies which want the conduct of science to conform to strategic goals of scientific growth as caught in quantitative publication numbers, or worse, to corporations which expect their investment to be paid off in exploitable knowledge. Neither of these are conducive to scientific freedom. Scientific discovery is a process that cannot be forced, and by setting a deadline for discovery it is denied the time it often needs. It is well known that many prominent scientists of the recent past have said that their kind of research would not have been possible in today's scientific climate.[2] Because of this, some long for a return to a science that enjoys autonomy from the entities that fund it. In order to achieve this autonomy, philosopher Herman Philipse argues for a Tetras Politica as an expansion of the Trias Politica, in which academic science will be granted an independent place among the legislative, judicial, and executive branches of government.[3] He argues for this because with the growth in scope and accumulated knowledge science has enjoyed it has become a society-shaping power in its own right, and as such, to protect it from instrumentalization and corruption, it should enjoy the same level of independence the judiciary branch has. Making science an independent institution in society would give it the autonomy to engage in the open-ended search for truth needed for the progress of science, free from pressures of time or profitability. This would definitely have a positive effect for fundamental science, which is severely underfunded under capitalism, but it also seems to imply that the best solution to the problems posed by capitalism is to simply retreat from it. This will leave problems unaddressed and might give rise to some new ones. Without additional actions this move will do little to challenge the misuse and commodification of scientific knowledge under capitalism. There is also a problem with the optics of retreating into an independent institution. It creates the image of the ivory tower of a bygone era of science, and if not done carefully will recreate the follies of that time. Science will have to rely on public support if it wants to break free from the influence of capitalism. To prevent a revival of elitism and exclusion, science must strive to become a public institution.[4] Open science means a more direct line of accountability to the public, and free access to science, for those who want to learn, and for those who want to contribute. What can be won by reimagining science as a commons is something that will be discussed in detail in the next paragraph.

The role of the scientist has become narrower with the introduction of professional management. At the same time management has increased the workload of scientists with the introduction of bureaucratic busywork. A tactic that can be used by scientists to fight the influence of capitalism over their field is then to disrupt the managerial practices, to refuse participation in the busywork, to reclaim control over their own work, and prove that science would function just fine without the targets demanded by academic capitalism. Willem Halffman and Hans Radder provide in their academic manifesto a number of ways such a resistance to management can take place.[5] From strikes to sabotage, selective refusal of bureaucratic tasks, or demonstrations, there are a lot of tactics to choose from. There are things that some individual scientists might be capable of doing to improve their

individual circumstances, but while Halffman and Radder do not seem to begrudge scientists that decide to seek greener pastures elsewhere, this provides no lasting solution. In order to leave no scientist behind, and accomplish lasting positive change for the field of science, collective action is required.
There is however more to do to reinvigorate the role of the scientist besides disobedience to management. Proletarianization of scientists has narrowed being a scientist down to just “doing science”, merely carrying out tests and experiments, mere fact finding. Being a scientist could and should be so much broader than that. Not just collecting knowledge, but also critically reflecting on the implications of that knowledge, communicating findings to the public, and possibly even engaging in political action when the implications of scientific findings are not taken seriously by the ruling class. One might say that scientists already have too much work on their hands to engage in these activities, but since a large portion of the scientists’ current work consists of bureaucratic busywork the solution there seems obvious. Of course, not every scientist has to be a public figure or an activist, but there should be room for the scientist as philosopher, as communicator, as activist, not just as hobbies a few scientists engage in in their free time, but as aspects of the societal role of the scientist. To this end, a means to combat the role science has been assigned under capitalism as a commodified knowledge factory, is also to be sought in how new scientists are educated. While it is true that those who study and try to solve the current climate crisis are people with degrees in science, it is equally true that those exacerbating the crisis, for example by devising new ways to extract every last drop of oil from the earth, enjoyed an education in science as well.[6] This contradiction is acknowledged in the joking banter between chemistry students, when they say that they always have the option to “sell their soul to Shell” in case their other career plans do not pan out. But not much more is done with this knowledge, it seems rather a means of creating ironic distance[7] from the knowledge that science education might contribute as much to the worsening of climate change as it contributes to solving it, without really challenging this state of affairs. This is not supposed to be an argument against science education. On the contrary, we might need science education now more than ever. But the following question must be asked about it: Why is it not seen as a failure of science education when a graduated chemist takes up a cosy job in the fossil fuel industry? One might counter this by saying that that industry does still need scientists working in it, so we better make sure that they are good scientists. What better place to change the industry for the better than from within? And this may very well be true. But how much change can they really accomplish if their education does not grant them the tools to envision it. They will simply be consumed by an environment that is hostile to change. Or more likely, the naturally idealistic students will simply not bother with these industries, and their less discerning peers will take up positions there. If it is true that industries such as these have a need for scientists, then it is best to make sure that no scientist they hire is willing to uncritically aid them in the continuous exploitation and pollution of the world. The goal of science education should not be to create compliant science workers, but to prepare a new generation of critical scientists to face the challenges of the 21st century.

IV.2 Science as a Commons

There is an aspect of science that lends it especially well to an alternative to capitalism. That is the fact that knowledge is an inexhaustible resource, it does not deteriorate no matter how many people share it. On the contrary, privatising knowledge, as is done under capitalism through legal procedures such as patents, under-utilises the potential of knowledge. Knowledge wants to be free, but to make a profit off of it, the free flow of information must be restricted.[8] As pointed out by Merton's scientific norm of communism, the ethos of shared scientific knowledge is not compatible with the capitalist notion of technology as private property.[9] Knowledge lends itself well to sharing, and science flourishes when knowledge is shared freely. Therefore, science would not be best run by the principle of private property, but instead as a commons that holds knowledge as a common good. Commons in this case is taken as a general term that refers to a resource shared by a group of people.[10] It can be applied to things that vary widely in scale, from a small community garden shared and maintained by a neighbourhood, to the earth's atmosphere which we all must share. It also applies from things with clear boundaries to things that are more or less boundless. The knowledge commons would belong to the category of commons that are globally shared and have no clearly defined boundaries.

It could be said that the university was once a "constructed cultural commons".[11] It used the commons paradigm to help scientists work together to generate new knowledge. The goal was not profit, but the advancement of knowledge, and to that end relationships of trust and collaboration were promoted. However, with the rise of neoliberalism came the erosion of this ethic. The academic commons became enclosed by the state and the market so that its resources could be used to spur short term economic growth.[12] A movement against this rampant commodification of science needs to propose an alternative to it. A possible alternative can be found in reimagining science as a commons.

"Reimagining" is the term used here because as stated before a wholesale return to a past state of science is not desirable, if at all possible. We should be able to point out what worked in the past without overlooking the flaws that surrounded it. While it may have been true that the fruits of science were held in common by scientists, it was also the case that who could become a scientist, who had access to a scientific education, was gatekept along lines of class, race, and gender. A universalist science should not recreate the conditions that allowed science to be such a closed off and conservative institution in the past. Luckily conditions are now in place that could make science more open than it ever was. Where before the shareability of information was still limited by the physical mediums on which it was printed, the internet has largely done away with this limitation, making information potentially as close to infinitely shareable as we need. The internet has come with a rise in the free sharing of knowledge, information, and culture, despite the attempts of legal enclosure by those who want to maintain a monopoly on the dissemination of it.[13] Extending this impulse to set information free to the pool of scientific knowledge could very well be what is needed to rejuvenate the idea of treating science as a commons.

When the feasibility of holding a resource in common is discussed, inevitably a host of dilemmas concerning the construction and maintenance of a commons get brought up. Most (in)famous among these is the model of "The Tragedy of the Commons", thought up by biologist Garret Hardin. Hardin's narrative imagines a situation wherein the free use of a common resource by all inevitably leads to ruination and depletion of that resource. It could however be argued that Hardin created a strawman of the commons here. He seemed to assume little to no communication between the individuals in the commons, and assumed that people would only act in their immediate self-interest, while missing that individuals could also think in terms of shared benefits.[14] The tragedy of the commons and dilemmas like it paint the desire to share resources as well-intentioned but ultimately misguided, and present privatisation as the only sensible solution to prevent the worst possible outcome. There is compelling evidence that suggests tragedy is not the inevitable outcome of a commons, but to defend the idea of a knowledge commons from them it can already suffice to point out that the situations illustrated in commons dilemmas simply do not apply to a knowledge commons.[15] The dilemmas often concern physical, highly substractible, resources, while knowledge is a resource of low substractibility. If there is a tragedy to be found in the knowledge commons it is the underuse of scientific resources caused by excessive intellectual property rights and overpatenting: The tragedy of the anti-commons.[16]
There are however still potential problems to be considered if one wishes to maintain the knowledge commons. Creating a commons of digital knowledge is not as easy as simply uploading a bunch of books and papers to the internet. It must be made accessible in a broad sense of the word. A mass of disorganised knowledge is not really accessible, work must be put into organising it so scientists, both amateur and professional, will have an easy time navigating it. Care should also be taken to eliminate misinformation and redundancy from the shared pool of knowledge. Luckily for this already a lot of the necessary digital infrastructure already exists, and it can be as easy as opening the digital collections of universities to the public. Another issue in maintaining a digital archive of knowledge is its relative vulnerability compared to physical libraries. Physical books and journals would be present in multiple libraries, the decentralised copies provide a sort of robustness.[17] In digital form however the works are centralised, making it vulnerable if something were to happen to the place hosting it. Server outage or cyber-attacks become concerns when a knowledge commons is organised this way. There is a balancing act between ensuring the security of digital knowledge whilst not blocking access to those who want to use it. On top of that the digital commons still has to deal with the threat of enclosure and commodification. While it makes it easier to distribute knowledge, it can and has also been used to monitor who accesses knowledge. The internet will not magically set knowledge free, a digital knowledge commons will have to be fought for, or else the same tools that could set knowledge free will be used to restrict it further.
There is a misgiving about the effects of holding the fruits of science in common that needs dispelling. That is some variation of "what incentive is there to work in science if you do not own your discoveries?". Of course, it would be unreasonable to expect scientists to do the work of science without at least providing them with

the means to live a comfortable life. That said, ownership of discovered knowledge through patents seems like a poor reward system for science, both from a standpoint of motivation and from a standpoint of adequately paying scientists. As a motivating impulse it assumes that scientists will only perform at their best for monetary gains. Not only does this denigrate the intrinsic motivation of scientists, but it also introduces an incentive besides purely the progress of science. It is a violation of the Mertonian norm of disinterestedness. Moreover, the length one holds the monopoly over patented knowledge might actually disincentivise working hard on new discoveries.[18] Why rush to the next discovery if you can just comfortably sit on a patent for a decade before you need to start working again? The reality is that the length of a patent has little to do with creating an incentive for scientists to work hard on scientific discoveries. This is because the main beneficiaries of patents are not scientists but corporations.[19] One could still say that they provide the incentive for corporations to invest in science, they expect a return on their investment in the form of knowledge they can exploit. However, much knowledge that is held in private hands was also funded by public money. So, if it creates perverse incentives, creates unnecessary competition, might actually slow down scientific progress, and does not actually reward the scientists who do the work, this is not a reward system that works towards good science. The alternative I would propose is to simply pay scientists a living wage for their work. A sort of universal basic income for scientists. This should eliminate perverse incentives, and should create a secure and well-fed scientist class, which can then focus on what is important, progressing science for the good of humanity. In the current system that would mean funding science with tax-payer money, but as this is already part of the income of scientists that will not be a very drastic adjustment. Corporations will have to do with funding science without getting a decisive say in it. They will not lose the ability to use scientific knowledge for their products, they will just lose their monopoly over it. Contributing to science should be a normal and expected cost of participating in a society that benefits from the fruits of science, and it is time to hold those who were previously allowed to exploit science to that expectation.

IV.3 Non-Capitalist Science in a Capitalist World

The goal of this thesis was to investigate why modern-day science does not live up to its ideal, and to propose an alternative that would better embody the ideals of science as constructed with the help of Merton and other thinkers. With reimagining science as a knowledge commons this goal seems to have been reached. It would however be dishonest to say that this is a satisfactory end for me. The idea of the knowledge commons provides a good direction for science to evolve in, but at the same time it raises new questions. A question that I have grappled with is if it is at all possible for non-capitalist science to exist within a capitalist society. The commons and the market do not have to be adversaries, it could be argued that the commons complement the market by taking care of public needs that the market is ill-equipped to provide.[20] The knowledge commons could reinvigorate the market by freeing up usable knowledge. This knowledge remains valued as a commodity, so for the knowledge commons in a capitalist society the threat of enclosure and exploitation remains a constant possibility. Science as a common good will have to be fought for constantly. A stable state could be found if the balancing act is played right, but I find myself wondering if we can ask for more.

Here I run into one of my biases. Beyond just the detrimental effects it has had on science I do not see capitalism as having much left to do for humanity except make way for something better. But as someone who holds that opinion of course I would not be satisfied with a solution that only addresses the problems of the institution of science while leaving the rest of society mostly untouched. Of course I would be inclined to ask the question if that is all we can wish for. Because in some way I already wanted to ask for more. I do not argue here that advocating for better science must necessarily be done as part of a broader anti-capitalist movement. Important gains for science can be made within the current system, it does not require waiting for the fall of capitalism. I am also not under the impression that the end of capitalism would automatically solve the problems with science. Those who try to imagine systems beyond capitalism would thus do well to make arguing for better science part of their advocacy. Once positive changes for the field of science have been achieved I would also invite those who argued for them to start examining the system in which science exists. Much as my position might be influenced by my distaste for capitalism, I do believe that there are legit reasons to not limit the search for better science to only the field of science itself. As argued before, science and the way it is wielded have effects far beyond the academic world. The problems of commodification of knowledge do not limit themselves to the generation of knowledge within science, but are present as well in how knowledge is used in society. Decommodification on one end by making science a common good still leaves the possibility for misuse of scientific knowledge for profit. Just banishing market forces from the field of science would be a hollow victory without changes to the way scientific knowledge is wielded. Broader decommodification of science should mean challenging the destructive ends towards which scientific knowledge can be put in the name of profit. By all means, make the field of science better, but do not stop there, do not forget about the world in which we conduct science. A world that feels the influence of science. A world that could cease to be ours if we wield our knowledge recklessly. A world that could be saved if we apply our knowledge carefully. Scientists bear a responsibility for that which they bring into the world. The ivory tower of academia will not shield you from the consequences if you don't.

Notes and references for part IV

[1]: Karwat, Darshan M. et al. "Activist Engineering: Changing Engineering Practice By Deploying Praxis" *Science and Engineering Ethics*, vol. 21, no. 1, 2014, pp. 230, doi:10.1007/s11948-014-9525-0.

[2]: Examples of this include Nobel prize winning physicist Peter Higgs telling the Guardian in 2013 that he would not be able to get an academic job today, because he would not be regarded as productive enough: Aitkenhead, Decca. "Peter Higgs: I wouldn't have been productive enough for today's academic system" *The Guardian*, 6 Dec. 2013, https://www.theguardian.com/science/2013/dec/06/peter-higgs-boson-academic-system.
and a former collaborator of double-Nobel prize winning biochemist Fred Sanger saying that a scientist like him would not have survived in today's world of science: Dzeng, Elizabeth. "How Academia and Publishing are Destroying Scientific Innovation: A Conversation with Sydney Brenner" *King's Review Magazine*, 24 Feb. 2014, https://www.kingsreview.co.uk/interviews/how-academia-and-publishing-are-destroying-scientific-innovation-a-conversation-with-sydney-brenner.

[3]: Philipse, Herman. "De Universiteit als vierde macht: Een pleidooi voor de Tetras Politica" *If you're so smart, why aren't you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 33.

[4]: Halffman, Willem and Radder, Hans. "Het academisch manifest: Van een bezette naar een publieke universiteit" *Krisis: Tijdschrift voor Filosofie*, issue 3, 2013, pp. 9.

[5]: Halffman, Willem and Radder, Hans. "Het academisch manifest: Van een bezette naar een publieke universiteit" *Krisis: Tijdschrift voor Filosofie*, issue 3, 2013, pp. 12.

[6]: Morales-Doyle, Daniel. "There is no equity in a vacuum: on the importance of historical, political, and moral considerations in science education" *Cultural Studies of Science Education*, vol. 14, 2019, pp. 489, doi:10.1007/s11422-019-09925-y.

[7]: I see in this attitude a parallel to how Mark Fisher, citing Slavoj Žižek, described that the continued functioning of capitalism relies on a structure of disavowal in the form of creating ironic distance from its worst aspects. Fisher, Mark. *Capitalist Realism: Is there no alternative?* Zero Books, 2009, pp. 13.

[8]: Bollier, David. *Think Like a Commoner: A Short Introduction to the Life of the Commons*. New Society Publishers, 2014, pp. 64.

[9]: Merton, Robert K. “The Normative Structure of Science” (1942) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 275.

[10]: Hess, Charlotte and Ostrom, Elinor. “Introduction: An Overview of the Knowledge Commons” *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, The MIT Press, 2007, pp. 4.

[11]: Bollier, David. *Think Like a Commoner: A Short Introduction to the Life of the Commons*. New Society Publishers, 2014, pp. 67.

[12]: Bollier, David. *Think Like a Commoner: A Short Introduction to the Life of the Commons*. New Society Publishers, 2014, pp. 70.

[13]: Bollier, David. *Think Like a Commoner: A Short Introduction to the Life of the Commons*. New Society Publishers, 2014, pp. 65.

[14]: Hess, Charlotte and Ostrom, Elinor. “Introduction: An Overview of the Knowledge Commons” *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, The MIT Press, 2007, pp. 11.

[15]: Hess, Charlotte and Ostrom, Elinor. “Introduction: An Overview of the Knowledge Commons” *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, The MIT Press, 2007, pp. 13.

[16]: Hess, Charlotte and Ostrom, Elinor. “Introduction: An Overview of the Knowledge Commons” *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, The MIT Press, 2007, pp. 11.

[17]: Hess, Charlotte and Ostrom, Elinor. “Introduction: An Overview of the Knowledge Commons” *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, The MIT Press, 2007, pp. 14.

[18]: Hess, Charlotte and Ostrom, Elinor. “Introduction: An Overview of the Knowledge Commons” *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, The MIT Press, 2007, pp. 17.

[19]: Bollier, David. *Think Like a Commoner: A Short Introduction to the Life of the Commons*. New Society Publishers, 2014, pp. 68.

[20]: Bollier, David. “Growth of the Commons Paradigm” *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, The MIT Press, 2007, pp. 38.

V Conclusion: Keeping the Promise

Wrapping up this thesis I find myself filled with doubts. After the amount of time I spent immersed in the subjects of scientific ideals, academic capitalism, and the knowledge commons, I can confidently say that I have never felt less confident about it than now when I am finished with writing. I guess that is what philosophy does, add caveat upon caveat to each statement, because every sentence requires at least two more to explain it in full. In trying to be as correct as possible you end up verbose to the point of incomprehensibility. Suddenly 20,000 words becomes a very small number. But 20,000 is all you get, and eventually you have a responsibility to get something said. I hope that what I ended up saying was something worth saying. Failing that, I hope to at least have been wrong in interesting ways, which is worthwhile in its own way.

I opened this thesis with a personal story about my disappointment in science. This experience has been a major driving force in writing this. But did I do right by making my problem with science so explicitly personal? Did it not impossibly stack the deck against the current state of science because I felt personally wronged by it? Would I have felt the same about science and capitalism if this had not happened? Am I not just spitefully trying to tear down both science and capitalism because I could not make it as a scientist? I feel like accusations of spite and envy get brought up easily against those who criticise capitalism. Through the lens of neoliberalism their failures get seen as individual failures rather than systemic ones, their systematic critique gets dismissed by calling on them to individually compete harder. I hope I have evidenced well that my personal story was a symptom of deeper issues in the field of science, and that these are linked to the capitalist system science finds itself in.

Before reading the texts of Merton I feared that his scientific norms would be hopelessly outdated. On the contrary I found out that they could still be very relevant. Capitalism is nothing new, and efforts to restate the norms of science against the onslaught of commodification and appropriation are similarly nothing new. Supplemented with more recent texts, the norms of Merton form a good basis for what science ought to strive for. This then formed an ideal to compare against when the time came to discuss the problems with the current state of science. Science, as it exists today, does not live up to this ideal informed by the norms of Merton. This causes numerous issues for the field of science, from its trustworthiness to its capacity to have a positive impact on the lives of humans and the world as a whole. The ways in which science deviates from the ideals ascribed to it can be traced to the rising influence of capitalism on the trajectory of science. The norms of capitalism and the norms of science are not compatible with each other, so this influence means that the first starts taking precedence over the latter. So to make the ideals of science flourish means to free it from the influence of capitalism. To finish it off, science as a commons is proposed as an alternative way to organise the field of science. A way that works better to accommodate the ideals of science, and would lead to a better science.

It is a simple argument: Science is expected to do many good things, but often it does not deliver on those promises, so here is how it can be made better. If only it were that simple. Science is entangled in the mess of our world, shaped by it and shaping it. To make a better science, to make it do better things, the world cannot be left untouched. Wielding science can shape the world, but in turn the world shapes the way science is wielded. The world is shaped by ideology as well, and if what is taken into the shape of science is not critically regarded there is no telling what horrors it could unleash. I am convinced that creating a better science involves more than dealing with the domain of science alone, because science can spill over into everything. This is where things intertwine, because the broken promises of science are linked to the empty and broken promises of capitalism itself. Promises of progress, promises of freedom, promises of a future worth living in. Whether these promises were ever genuine or just stories we told ourselves to soothe our conscience does not matter. The world is haunted by lost futures of grand hopes and desires. But these futures are only lost if we let our ideals be killed by the world we find ourselves in. The only answer I have here is that we must learn to dream big again, but I do not know how to do that, as capitalism has occupied the horizon of the thinkable for as long as I can remember.[1] As someone born after the "end of history" I only know tales of a time before capitalist realism. Yet I find comfort in the words of Ursula K. Le Guin:

"We live in capitalism. Its power seems inescapable. So did the divine right of kings. Any human power can be resisted and changed by human beings. Resistance and change often begin in art, and very often in our art, the art of words."[2]

History will keep on marching as long as we are still here. There is nothing wrong with adjusting to the world you find yourself in, for after all, to dream you must live. But do not give up the dreams. A dream of a better kind of world, a dream of a better kind of science. A better world through better science, better science through a better world. It starts with ideals either way. To reignite our imagination. To fulfil the promise of science.

Notes and references for part V

[1]: Fisher, Mark. *Capitalist Realism: Is there no alternative?* Zero Books, 2009, pp. 8.

[2]: Le Guin, Ursula K. "Speech in Acceptance of the National Book Foundation Medal for Distinguished Contribution to American Letters." 19 Nov. 2014, https://www.ursulakleguin.com/nbf-medal.

Bibliography

Books

Bollier, David. “Growth of the Commons Paradigm” *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, The MIT Press, 2007, pp. 27-40.

Bollier, David. *Think Like a Commoner: A Short Introduction to the Life of the Commons*. New Society Publishers, 2014.

Boomkens, René and Gabriels, René. “Paradoxen van het academisch kapitalisme” *If you’re so smart, why aren’t you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 107-130.

Chalmers, Alan F. *Wat heet wetenschap?* (original title: *What is this thing called science?*) Translated by Rob van den Boorn, Boom Amsterdam, 1999.

Crouch, Colin. *The Knowledge Corrupters: Hidden consequences of the financial takeover of public life*. Polity Press, 2016.

Dardot, Pierre and Laval, Christian. *The New Way of the World: On Neoliberal Society.* (Original title: *La nouvelle raison du monde: Essai sur la société néolibérale*) Translated by Gregory Elliott, Verso, 2013.

Fisher, Mark. *Capitalist Realism: Is there no alternative?* Zero Books, 2009.

Hardt, Michael and Negri, Antonio. *Commonwealth*. The Belknap Press of Harvard University Press, 2009.

Hess, Charlotte and Ostrom, Elinor. “Introduction: An Overview of the Knowledge Commons” *Understanding Knowledge as a Commons: From Theory to Practice*, edited by Charlotte Hess and Elinor Ostrom, The MIT Press, 2007, pp. 3-26.

Kropotkin, Pyotr. *The Conquest of Bread*. G.P. Putnam’s Sons, 1906.

Lock, Grahame. “Hellzapoppin… De universiteit van vuur en zwavel” *If you’re so smart, why aren’t you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 87-106.

Lorenz, Chris. “Inleiding” *If you’re so smart, why aren’t you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 7-24.

Lorenz, Chris. “Van homo academicus naar homo economicus” *If you’re so smart, why aren’t you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 41-66.

Mason, Paul. *PostCapitalism: A Guide to Our Future*. Penguin Books, 2016.

Merton, Robert K. “The Puritan Spur to Science” (1938) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 228-253.

Merton, Robert K. “Science and the Social Order” (1938) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 254-266.

Merton, Robert K. “The Normative Structure of Science” (1942) *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 267-278.

Osterloh, Margit and Frey, Bruno S. “Evaluitis: de ziekte van de ‘gecontroleerde’ wetenschap” *If you’re so smart, why aren’t you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 235-242.

Philipse, Herman. “De Universiteit als vierde macht: Een pleidooi voor de Tetras Politica” *If you’re so smart, why aren’t you rich?* edited by Chris Lorenz, Boom Amsterdam, 2008, pp. 27-40.

Radder, Hans. “The Commodification of Academic Research” *The Commodification of Academic Research: Science and the Modern University*, edited by Hans Radder, University of Pittsburgh Press, 2010, pp. 1-23.

Stiegler, Bernard. *States of Shock: Stupidity and Knowledge in the 21st Century.* (Original title: *États de Choc. Betise et savoir au XXIé siecle*) Translated by Daniel Ross, Polity Press, 2015.

Storer, Norman W. “Prefatory Note to The Normative Structure of Science” *The Sociology of Science: Theoretical and Empirical Observations*, edited by Norman W. Storer, The University of Chicago Press, 1973, pp. 223-227.

Articles – Academic

Castelfranchi, Christiano. “Six Critical Remarks on Science and the Construction of the Knowledge Society” *Journal of Science Communication*, vol. 6, issue 4, 2007, pp. 1-3, doi:10.22323/2.06040303.

Edwards, Marc A. and Roy, Siddhartha. “Scientific Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition” *Environmental Engineering Science*, vol. 34, no. 1, 2017, pp. 51-61, doi:10.1089/ees.2016.0223.

Gould, Stephen J. “Wide Hats and Narrow Minds” *New Scientist*, vol. 81, no. 1145, 1979, pp. 776-777.

Halffman, Willem and Radder, Hans. “Het academisch manifest: Van een bezette naar een publieke universiteit” *Krisis: Tijdschrift voor Filosofie*, issue 3, 2013, pp. 2-18.

Karwat, Darshan M.A., Eagle, Walter E., Woolridge, Margaret S., and Princern, Thomas E. “Activist Engineering: Changing Engineering Practice By Deploying Praxis” *Science and Engineering Ethics*, vol. 21, no. 1, 2014, pp. 227-239, doi:10.1007/s11948-014-9525-0.

Kingwell, Katie. “European Lead Factory hits its stride” *Nature Reviews Drug Discovery*, vol. 16, 2016, pp. 221-222, doi:10.1038/nrd.2016.64.

Moore, Kelly, Kleinman, Daniel Lee, Hess, David, and Frickel, Scott. “Science and neoliberal globalization: a political sociological approach” *Theory and Society*, vol. 40, 2011, pp. 505-532, doi:10.1007/s11186-011-9147-3.

Morales-Doyle, Daniel. “There is no equity in a vacuum: on the importance of historical, political, and moral considerations in science education” *Cultural Studies of Science Education*, vol. 14, 2019, pp. 485-491, doi:10.1007/s11422-019-09925-y.

O’Brien, Mary H. “Being a Scientist Means Taking Sides” *BioScience*, vol. 43, no. 10, 1993, pp. 706-708, doi:10.2307/1312342.

Oreskes, Naomi and Conway, Erik M. “Defeating the Merchants of Doubt” *Nature*, vol. 465, 2010, pp. 686-687, doi:0.1038/465686a.

Radder, Hans. *Wetenschap als koopwaar? Een filosofische kritiek*. VU Uitgeverij, 2003.

Radder, Hans. “Exploring Philosophical Issues in the Patenting of Scientific and Technological Inventions” *Philosophy and Technology*, vol. 26, 2013, pp. 283-300, doi:10.1007/s13347-013-0109-8.

Vohland, Katrin, Weißpflug, Maike, and Pettibone, Lisa. “Citizen Science and the Neoliberal Transformation of Science – an Ambivalent Relationship” *Citizen Science: Theory and Practice*, vol. 4, issue 1, art. 25, 2019, doi:10.5334/cstp.186.

Whitesides, George M. “Reinventing Chemistry” *Angewandte Chemie International Edition*, vol. 54, issue 11, 2015, pp. 3196-3209, doi:10.1002/anie.201410884.

Thesis

Karwat, Darshan M. *On Combustion Chemistry of Biofuels and the Activist Engineer*. 2012, University of Michigan, PhD Thesis.

Reports

Hall, David. *Why Public-Private Partnerships don’t work: The many advantages of the public alternative*. PSIRU, 2015, http://www.psiru.org/sites/default/files/2015-03-PPP-WhyPPPsdontworkEng.pdf.

Towards universal access to higher education: international trends. UNESCO IELSALC, 2020.

Articles – Other Publications

Aitkenhead, Decca. “Peter Higgs: I wouldn’t have been productive enough for today’s academic system” *The Guardian*, 6 Dec. 2013, https://www.theguardian.com/science/2013/dec/06/peter-higgs-boson-academic-system.

Bourdieu, Pierre. “The essence of neoliberalism” (Original title: “L’essence du néolibéralisme), Translated by Jeremy J. Shapiro, *Le Monde diplomatique*, Dec. 1998, https://mondediplo.com/1998/12/08bourdieu.

Dzeng, Elizabeth. “How Academia and Publishing are Destroying Scientific Innovation: A Conversation with Sydney Brenner” *King’s Review Magazine*, 24 Feb. 2014, https://www.kingsreview.co.uk/interviews/how-academia-and-publishing-are-destroying-scientific-innovation-a-conversation-with-sydney-brenner.

Gillis, William. “Science as Radicalism” *Human Iterations*, 18 Aug. 2015, http://humaniterations.net/2015/08/18/science-as-radicalism/.

Gorrion, Alex. “Science: A continuation of ‘For the Love of God’” *The Anvil Review*, 29 May 2015, https://theanvilreview.org/print/science/.

Le Guin, Ursula K. “Speech in Acceptance of the National Book Foundation Medal for Distinguished Contribution to American Letters.” 19 Nov. 2014, https://www.ursulakleguin.com/nbf-medal.

Podur, Justin. “Science and Liberation” *Briarpatch Magazine*, 6 Jan 2014, https://briarpatchmagazine.com/articles/view/science-and-liberation.