Potentiality and Actuality

A multi-dimensional critique of value-free science

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Introduction

If we take a look at popular scientific literature, documentaries or interviews with scientists, we may notice that they usually refer to the idea that *scientific progress* ensures *societal progress*. The idea of scientific progress is roughly that science is continuously improving its understanding of nature. Because of the utility of scientific knowledge, this improvement can be linked to improving society. Earlier authors have emphasized the possible public benefits of scientific knowledge, but no developed version of the idea that scientific progress ensures societal progress appeared before the works of Francis Bacon[1]. So, the ideal of scientific progress can be attached to two general aims. The first is to gain an evermore improved understanding of nature, and the second aim is to contribute to the public benefit by teaching society how to use this understanding for human purposes. The latter aim can be taken as serving all kinds of social *values*, yet science is said to be a *value-free* enterprise.

The claim that science is value-free means that both the object of study and the methods of studying are separated from human values. According to this claim, social, political or ethical value considerations should not play any role in scientific reasoning. This is to ensure the reliability and objectivity of scientific knowledge, which is a condition on the first aim. In order to be value-free, science needs *autonomy*. This means that the production of scientific knowledge, and, *ipso facto,* the institutions where it takes place, should not be influenced by society in any way that affects the contents of the knowledge produced.

The traditional autonomous space for scientific research is the university. Although the universities have a long history of providing industry with scientific knowledge and trained experts, they always managed to maintain autonomy in the areas of fundamental research. But this situation seems to belong to the past. What we see now is that the strict separation between science and society is being dissolved. In the last couple of decades, more and more knowledge production started taking place in institutes outside the university, with the aim of utilizing science for commercial purposes. Since companies can have their own Research and Development departments, or can order research from private scientific institutions, the universities lost their special status as the only institutions for

[1] see: Zilsel 1945 for the socio-historical origins of the ideal of scientific progress.

reliable knowledge. They were now just one type of player in the knowledge market, and in order to play along, they adapted a vast part of their research activities:

> *"With the intensification of international competition, the extraction of economic benefit from university research, and from publicly funded research, more generally, is now a matter of concern. It is seen less in terms of the need for new knowledge than in terms of commercialization of what is already available; less a matter of research than of technology transfer. This transformation is one of the most far-reaching that we have described because it involves drawing universities in the heart of the commercial process. The universities are no longer the remote source and wellspring of invention and creativity but are part of the problem solving, problem identification and strategic brokering that characterize the knowledge industries."*[2]

Gibbons et al. (1994) described this trend as a shift from "mode 1" to "mode 2" knowledge production. One of the big differences between the two modes is that the first involves more emphasis on fundamental research, while the second places more emphasis on applied research, made to fit the needs and interests of its (potential) users[3]. Not only are the universities more attuned to the direct needs of industry (and other "interest groups"), but governments are actively stimulating their cooperative efforts:

> *"The financial contributions of industry to the university will steadily increase. [….] In addition, the governments as well as the EU will increasingly recognize and reward universities for their efforts to interact with industry. Such changes will bring criticisms against the university for not being protective enough of their reputations of objectivity in engaging into efforts aimed at commercialization. This is why clear and well articulated policy and mission statements will be needed, in which the universities emphasize their role in serving society through technology interchange activities."*[4]

[2] Gibbons et al. 1994, p.86
[3] Gibbons et al. 1994, p. 54
[4] Gibbons et al. 1994, p. 88

The trend described by Gibbons is still ongoing. The mission statements of current governmental projects like the European SiS (Science in Society programme), or the Dutch "topsectorenbeleid", which stimulate this trend, talk of the "valorization" of scientific activity. Valorization means to give something value, to turn it into a value. Science had to be given value for society. Why? Because the critique of value-free science concerned exactly its detached and disinterested position. It was said not to adequately respond to the needs of society. Science remained in an ivory tower, while the tax payers could see no immediate benefits from its activities. What we see now is that science is being increasingly valorized. But it is a specific value which it serves, namely the value of money. Currently, science contributes to society by contributing to economical growth, which seems to be regarded as equal to societal progress.

In the book 'The commodification of academic research', different writers analyze the problems associated with commercialized research. Harry Kunneman, one of the writers, summarizes from their contributions three main problems. The first is that commercialization is perceived as a threat to the epistemic autonomy of science: commercial influences dominate research agendas and can corrupt the methodological standards of science. The second is that the commercialization threatens academic culture. This marginalizes critical voices both within the academy and in public debate. The third problem is that commercialization threatens to undermine the social responsibility of modern science: "its responsibility for the alleviation of human suffering by addressing themes of general social interest, irrespective of commercial gain."[5]

The new developments cast doubt on the supposed beneficial role of science in society, and on the integrity of science and its institutions. In the media, many scientists have argued for more autonomy to ensure the freedom and the quality of research. They feel threatened in their academic freedom, and point to the importance of fundamental research for society. Hasn't history shown that apparently useless research turned out many times to be of value after all? Indeed, science has shown its utility to mankind from the beginning. But does that tie science to human progress?

[5] Kunneman 2010, p. 308.

Remember that autonomy, which is necessary to maintain value-freedom, means that it is up to society to decide the purpose of the application of science, and not to science itself. Science has a neutral position with regard to the aspirations of society. This means that the relation between science and the benefit of mankind or "progress" is at least ambiguous. For fundamental physics can be used for making the A-bomb, or for providing the world with sustainable free energy. Biological research can provide us with a cure for AIDS, or with improved face-lifting techniques. Science might be used for malevolent or benevolent purposes. It can be used for charity or for profit. There is of course one problem with this representation. Aren't scientists the people who are most qualified to assess the potential uses of a scientific discovery, as well as their potential social and environmental risks? Social and ethical considerations must play a role in thinking about application. But science is said to be value free. Exactly where should considerations of social responsibility come in? Before, during, or after the application?

The questions I have is whether science can be autonomous from (the values of) society and, if so, whether striving for it is desirable. In other words, is science value-free, and if so, can it be science socially responsible? To answer these questions, I will begin with the basic idea of value-freedom and its historical and philosophical origins. I will then offer two kinds of critique of the idea of value-free science. One comes from the feminist philosophy of science, and is more about the influence of society in science, questioning the possibility of value-freedom. The other comes from Critical Theory, and is about the role of science in society. The critical theory I will use comes from Herbert Marcuse, one of the philosophers of the Frankfurter Schule. Unlike the somewhat more conservative notions of progress used in contemporary discussions about the knowledge society, the critical theory of science contains a very different idea about what progress means. It is one which emphasizes the emancipatory possibilities of scientific knowledge. In other words, the idea that the proper role of science should be concerned with possibilities for realizing some well known utopian ideals for humanity: a perfect society with freedom from want, from toil, where man lives in sustainable relationships with nature and so on. An important difference between these ideas and the "social responsibility" idea is that they are truly utopian: they aim to transcend the contemporary political and economical framework.

The critical claim of Marcuse is that scientific thought, whether fundamental or

applied, imposes its own limits on the range of possible social purposes for which it might ever be used. The value-freedom ties science essentially to purposes of control. I will attempt to explain this claim and will argue that value-freedom, where it extends beyond detached fundamental research areas, poses all kinds of social problems, and restricts us in finding solutions. The possibilities of attuning natural science to human values which are not based simply on the successful control of nature, is something we need to think about. Autonomy, in my view, should not be argued for by appealing to value-freedom, but by appealing to the necessity of free space where science can be critical of itself and of its role in society.

In the first part of this thesis, I will describe the idea of value-freedom. Value-freedom has to do with the notion of objectivity. An account of objectivity contains certain posits about what constitutes natural objects and how to study them, which is the scientific method. I will say something about the rules ensuring objectivity, and give some traditional arguments for autonomous science, which all more or less relate to value-freedom. In the following part, I will discuss the most recent criticism on value-free science, offered by the feminist philosophers of science. This is one example of the different interpretations of the problem of science and values that figure in contemporary discussions. Usually, each side in these discussions argues for or against the possibility of value-freedom in science. The feminists are useful here to understand how human values might intrude even in autonomous science. Yet, the attempt of the feminists to show that value-freedom is an unrealizable ideal, I think, misses the point. Value-freedom is a notion we should reject, at least where it touches on the border of fundamental and applied science, because it is socially undesirable as an ideal. I will explain this in the third part, where I discuss both Marcuse's arguments and an argument of Hugh Lacey. Both show that if science is to be socially progressive, it must be valorized, but it will be a very different valorization from what the contemporary science policy makers have in mind.

Part One: The idea of Value-freedom

Human values

As I mentioned, the claim that science should be separated from society rests on the claim that science is "value-free". We could also say that the autonomy of science is the autonomy from values. The following account serves to clarify the different aspects of that idea. I will start with what value-freedom means, and why science is considered to be value-free. First of all, it is important that we know what is meant by the word "value" in this context. Hugh Lacey gives a list of definitions of what he calls "personal values", as the word is used in ordinary (non-scientific) discourse. We can also call them social or human values. This list may be helpful in understanding some of the issues which will appear later:

1. A fundamental good that one pursues consistently over an extended period of one's life; an ultimate reason for one's actions.

2. A quality (or a practice) that gives worth, goodness, meaning or a fulfilling character to the life one is leading or aspiring to lead.

3. A quality (or a practice) that is partially constitutive of one's identity as a self-evaluating, self-interpreting and a partly self-making being.

4. A fundamental criterion for one to choose what is good among possible courses of action.

5. A fundamental standard to which one holds the behavior of self and others.

6. An "object of value", an appropriate relationship with which is partially constitutive both of a worthwhile life and of one's personal identity. Objects of value can include works of art, scientific theories, technological devices, sacred objects, cultures, traditions, institutions, other people and nature itself. Appropriate relations with objects of value, depending on the particular object, include the following:

production, reproduction, respect, nurturance, maintenance, preservation, worship, love, public recognition and personal possession.[6]

As will become clear, value-free means free from the kinds of values as stated above. When I use the terms *non-epistemic values, non-cognitive values, human values* etc. I refer to these kind of values. The definitions (1), (2), and especially (4) are important to keep in mind when reading the arguments of Marcuse and Lacey in Part Three.

Historical sources of the idea of value-freedom

According to the oldest idea about science and values, science is value-free, because the object of its study, nature, is value-free. This idea can be attributed to the Enlightenment, the historical period in which the old religiously informed worldview made room for the scientific worldview. Before the scientific revolution, the study of nature was grounded in metaphysics, the philosophy of the fundamental nature of all existence. Metaphysics is said not to be part of modern science anymore, since it provided itself with an empirical basis for its conception of nature, grounded in observation and experiment. However, its distinctive approach to the study of natural phenomena (as opposed to other possible approaches, as I will show later) is still based on certain metaphysical ideas about what underlies these phenomena. These ideas are usually attributed to Galileo Galilei and Rene Descartes. Both posited a certain core structure or basis of nature, in such a way that it could be studied without having to make reference to any final cause, in the sense of a Divine Creator.

According to Dupré (1993), Galileo's metaphysics were strongly influenced by Plato. Galileo held the Platonic idea that the essence of reality must be ideal. There is, however, a big difference between his view of reality and Plato's. According to the classical (not unchallenged) reading of Plato's metaphysics, Plato believed that the ideal, essential forms of things resided in another world, separated from their non-essential participation in the physical world. For Galileo, all the ideal forms were to be found in the physical world itself.

Galileo had observed that natural objects behave in a way that approximates mathematical regularities. He came to the idea that the structure of the world must be

[6] Lacey 1999, p. 23

mathematical in character. He postulated that all physical being has at its root a mathematical core. To understand a phenomenon, he believed, requires that we break it down into its quantifiable elements. What remains may be discarded as ontologically irrelevant. According to Dupré, Galileo's postulate should not be understood as an escape from the intractable irregularity of the physical world into an ideal mathematical order, but as a serious attempt to use that order to grasp the essence of the real world, of reality. [7]

The distinction between "objective reality" as opposed to "subjective reality" can be attributed to Rene Descartes. Descartes had postulated a strict separation between spirit (or mind) and matter, between *res cogitans* and *res extensa*. This is a conceptual detachment of man from the nature surrounding him, which facilitated the attempt to acquire a fundamental knowledge about nature. Nature could now be studied and described as an independent substance, without having to meet statements about God or man. [8]Further, building on thinkers like Galileo, Descartes devised a mechanistic philosophy, relating to a mechanical worldview. The idea of an independent nature with its own teleology makes room for a mechanical one, mathematically constructed and subject to human purposes.[9] Regarded this way, it was now possible to explore all the regularities of the *res extensa* with methods of mathematics and accurate natural sciences. Descartes' mechanical world consisted of particles of matter, which work in cause and effect relations, exerting influence on each other just like the parts of a big machine. All material particles are governed by certain rules, equally valid as the axioms of mathematics, which were once created by God. These are the laws of nature. All individual objects and their characteristics are explainable in terms of these laws[10].

Since the time of Galileo and Descartes, more and more emphasis has been put on the importance of direct experience in the study of nature. For Francis Bacon, philosophical reasoning about nature could not bring us fundamental knowledge about nature. Only through experience could we gain access to nature's secrets. Bacon's ideas about the

[7] Dupré 1993, p. 66-67

[8] Fürstenwerth, On morality and chemistry, p.54
[9] Dupré 1993, p. 66
[10] Vermij 2006, pp 78-79

importance of experience and method became the official philosophy of the Royal Society of London[11], which is the earliest example of an institutionalized science with rules and methods. Following the mechanistic philosophy, observation and experiment were used to test the theories about mechanistic nature. The tests had to be such that they could be replicated by anyone following the right methods. The outcomes were to be agreed upon by witnesses, so that the knowledge gained from an observation was not a matter of individual experience, but of a shared experience. In order to arrive at the conditions of objectivity, as described by the mechanical worldview, the methods of science were constructed such that human values (see Lacey's definition above) could not play any role in relating theories to the evidence gained through (experimental) observation. If the knowledge gained is to be objective, everybody should be able to make the same observations and to interpret them independently of personal interests, desires or value perspectives [12].

Extra support for the view that values should not figure in any objective account of the world is a certain logical view on facts and values, according to which they are logically distinct. The idea is called "Hume's Law". In the eighteenth century, the philosopher David Hume held that facts and values are logically separated. According to Hume, statements of "ought" cannot be derived from statements of "is". His argument was that a proposition containing the modal term "ought" cannot be derived from propositions which don't contain the same modal term. To claim to have rationally deduced obligations from factual premises, is to commit a logical blunder[13].

Value-free science

We now arrive at the two essential ideas which form the core of the idea that science is value-free; a metaphysical idea, which defines objectivity, and a methodological and epistemological idea, which provides the methods and epistemological rules to arrive at objectivity. According to the metaphysical idea, the facts of nature can be described in terms

[11] Craig, E. 1998a, p. 627-629

[12] Lacey 1999, p. 4

[13] Norton 1994, p. 169

of nature's underlying structures, processes and laws. All objects which belong to this underlying order can be fully characterized in quantitative terms. The objects interact with each other through laws, which are expressible in mathematical equations. The order and its objects are ontologically independent from human inquiry, perception or action. Construed as belonging to the underlying order, the objects in themselves have no natural ends, no developmental potentials and they are in their essence unrelated to human life and practices. They are free from any value, and only from their relationships to human experience, practice or social organization can values be derived. What remains is the world of pure "facts" and the aim of science is to represent this world of facts and its underlying order in theories. In order to be objective, these theories must only contain quantitative concepts, bearing no relation to human experience[14].

The scientific theories about the world of facts must be tested somehow. This is the epistemological/methodological part of value-freedom. According to this idea, only experience can provide evidence for a scientific theory. Observations, which are usually experimental observations, must be certified through agreement and replicability, in order to serve as evidence for a theory. Our interests, norms and values, be it on individual or societal level, cannot play any role in accepting or rejecting scientific theories.

Certain formal rules are followed in order to be able to accept or reject theories according to the empirical evidence. There is no collective agreement about what the rules are, and whether they are deductive, inductive or otherwise. Value judgments don't play a role in acceptance of theories, though they might play a role in their discovery[15]. In the philosophy of science, this is called the distinction between the context of discovery and the context of justification. For example, wanting to receive more funding for a physics department can be a motivation for research that leads to the discovery of a new and interesting theory. This is the context of discovery. However, the theory itself should not be accepted because it can generate more funding, but must be judged solely on scientific terms, which is the context of justification.

In modern natural science, the metaphysical idea is complemented with the epistemological/methodological idea. The latter aims to generate intersubjective knowledge

[14] Lacey 1999, p. 2-3
[15] Lacey 1999, p. 4-5

(which comes closest to the idea of objectivity), and is employed to test theories that meet the conditions of the former. The combination of the two ideas turned out very successfully, both in creating the current amount of knowledge and in its widespread applications in society[16].

Value-freedom and value-neutrality

Since Kuhn wrote *The Structure of Scientific Revolutions*, it became clear that the above account of science, which was adhered to and promoted by the logical positivist philosophers of science, did not explain why certain theories were favored over others. According to Kuhn, scientists didn't reach consensus over theory choice by following a clear methodology. Rather, theory choice was guided by certain values, such as explanatory power, consistency, accuracy, scope, predictive power etc. [17]

Although Kuhn's theory forced philosophers of science to reconsider many of their assumptions, the idea of value-free science was still maintained, although in a slightly modified form. The philosophers of science who accepted the standard view, admitted that some values do play an important role in science.[18] Not any values, however, but only those values which have to do with the first aim of science, as described above: to represent the world of facts and their underlying order in the form of theories. The values in question are referred to in the literature as "epistemic" or "cognitive values". They refer to scientific practice, and it is believed .. "that reliance on them tends to improve the chances that the judgments based on them are (at least approximately) true".[19]

Cognitive values help to distinguish science from pseudo-science and to choose among competing theories. They provide the criteria for theory acceptance. "Non-cognitive", or "non-epistemic" values are norms, preferences, beliefs and interests which have nothing to do with the fundamental goals of science. They diminish scientific objectivity. They should therefore play no role in scientific decision-making. In this sense,

[16] Lacey 1999, p. 5-6
[17] Craig, E. 1998b, p. 316

[18] Curd & Cover 1998, p. 213

[19] Mcmullin 1982, p. 557

science should be free from values. This view is called the "value-neutrality thesis". The proponents of this thesis believe that the cognitive values and the institutional mechanisms based on them prevent "good science" from being infected by any subjective values and that they can act as a cure for when an infection does happen.[20]

Scientific Autonomy

The neutrality thesis is also held at an institutional level. Science is practiced in institutions, and a part of the knowledge created there is transferred to society. The possibility of a value-free science rests on the distinction between science and society, or between fundamental and applied science. In order for scientific knowledge to be objective, it should be separated from any concerns other than scientific. And it can be separated by virtue of the epistemic rules or cognitive values which are said to govern scientific practice. This is called the autonomy of science.

Science needs to be autonomous to ensure its objectivity. It cannot be guided by values or interests from outside science. But what this autonomy exactly means is not always clear. Applied science, for instance, cannot be fully autonomous, for technology is always created for a specific practical purpose. But fundamental science partially depends on technological development, which in turn depends on developments in fundamental science. It is hard to draw a line between the two. In the literature, the meaning of autonomy is never fully explained, but usually shaped by instances in which it is threatened.[21]

Interestingly, the idea of a socially responsible science can be seen as threatening to the autonomy of science, since this would mean a serious societal interference with the aims of science. Indeed, the idea is traditionally met with reluctance. And this reluctance is usually justified in different ways: the first, already mentioned, is the epistemological justification, according to which science should be done by properly trained experts, free from societal control. The cognitive norms (or values) unique to science are institutionalized and ensure its

[20] M. Curd, J.A. Cover 1998, p. 212-213

[21] Lacey 1999, p. 10

advancement. The second, historical justification, points to the undesirable social and epistemic effects in cases were society did interfere, like in Stalinist Russia(Lysenko), Nazi Germany (Mengele) or renaissance Italy (Galileo).

Thirdly, an economic justification: science as it is, brings us socio-economic progress, so any interference would be unnecessary[22]. This has to do with the sort of self-evident connection between science and progress, mentioned in the introduction. Throughout the history of science, there was the idea that science will benefit mankind. The idea is that both science and society are best served if they are separate. Science can produce the most objective knowledge if society does not interfere with the scientific process, and society is best served by pure objective knowledge.

The latter idea seems to be derived from the Baconian idea that the range of practical possibilities to be discovered by science will be too narrow if science is guided by values[23]. Four: political justification, scientists have the right to research whatever they want, according to freedom of thought, freedom of speech etc.[24] So, according to the "standard account" of autonomous science, any ideologically informed, or value-laden science is "bad science", and "good science" is in this view free of (non-epistemic) values.

Conclusion

From the above account we learn that science works with a very specific idea of reality. According to this idea, human values are not real in any scientific sense. They cannot be measured and they cannot be universalized, and therefore they must belong to the realm of subjective experience, as opposed to objective reality. In order to present reality as objectively as possible, science makes use of certain "scientific" or "epistemic" values, in order to assess the validity of a theory, and to choose among competing theories.

If science is to be uninfluenced by non-scientific values, it cannot be tied to explicit social ends, like emancipation, social progress and the like. Does this mean that scientific knowledge therefore cannot be used to further such ends? If we follow the account above,

[22] Kourany, p. 79
[23] Lacey 1999, p. 4
[24] Kourany, p. 79

we can say that it can be used to further any social end in principle, good or bad. Science aims at the truth, and should not be restricted by social aims and values. What the knowledge it produces is used for, depends on society. Moreover, according to Kourany, proponents of the autonomy of science believe that science ensures socio-economic progress, so there is no reason to interfere with it.

However, currently, this account cannot be upheld anymore. Science is being directed by the profit motive, so much that many worry whether its integrity can still be upheld. Then there is the worry that since not all socially progressive purposes are profitable, science cannot be said to ensure social progress anymore. Then, in order to ensure scientific integrity, and to leave science open to any purpose, rather than only commercial ones, its autonomy should be restored. How society can ensure that the applications of science are in accordance with ideals of social progress is then a question of politics, not of science.

In the introduction I posed two questions. First I asked whether an autonomous science, in the sense described above, is methodologically possible, and if so, whether value-free science can really be used for socially progressive goals. The two strands of critique that follow in the next two parts of this thesis aim to answer these questions. The first, the most recent, comes from the feminist philosophers of science, while the second, much older, comes from one of the critical theorists of the Frankfurter Schule.

Both aim to show that science is fundamentally biased towards certain socio-political values. Both criticisms thus question the supposed separation of science from society, which autonomy demands. The feminist critique is aimed at the value-neutrality thesis. It asks whether scientific and non-scientific values can be separated at all in scientific research. The second critique is aimed at the value-free metaphysics of science as posited by Galileo and Descartes.

Part Two: A feminist critique of value-freedom

The feminist philosophy of science

When I searched for literature about science and values, I found that the most recent attacks on value-free science come from the feminist philosophers of science. The feminist philosophy of science is not monolithic. Its accounts of science and values may widely differ. What they all seem to agree upon, is that many instances of seemingly neutral research were in fact biased, that is, their results were influenced by non-epistemic values. Why, we may ask, are the feminists concerned with the natural sciences?

Well, feminists are engaged in a political struggle against any form of oppression of women, to make sure that men and women receive an equal treatment in society. What made science a target of their critique is probably the fact that it is traditionally a typically (white) male-dominated activity. More importantly, science has proposed many theories which attribute different characteristics to men and women, which could be (and many times have been) used to provide a scientific basis for their unequal treatment in society, in the same way as genetic theories were once used to justify unequal treatment of racial minorities. According to the feminist philosopher Kourany,

> *"Science can be a powerful ally in the struggle for equality for women. Science, after all, can expose society's prejudice against women for that what it is, and science can both justify the replacement of this prejudice with a more adequate perspective and move society to accept the replacement. All too frequently however, science has done more to perpetuate and add to the problems women confront than to solve them."*[25]

Others, like Sandra Harding, even go further and say that not only is science a male-dominated activity, but that its applications also function to serve typically male activities like warfare, pollution, and of course the suppression of women:

> *"Not only technologies and applied sciences but also scientific theories have been used to move control of women's lives to those who exercise power in the dominant class, race, and culture. Many egregiously sexist and androcentric misuses and abuses*

[25] Kourany 2010, p. 4

have been documented for workplace and domestic technologies. And gender relations more generally—not just those that take the form of male-supremacy—are implicated in the applications of science that result in ecological destruction and support militarism."[26]

Thus, the kind of "value-intrusion" in science that feminists are concerned with is a very specific one. It is the *androcentric* (male-centered) and sexist views which have found their way into science, thereby influencing observations and theories. This is the epistemological aspect of their critique of science. On the other hand, the problem for feminism as a social and political movement is that the biased results they are concerned with, are used to justify asymmetrical relationships of power in society. This is the social aspect of their critique, addressing the issue of the social responsibility of science.

Now, the feminists have offered many cases which show some sort of androcentric bias both in the posing of research questions and in the interpretation of phenomena.[27] The question which feminists ask is whether these were cases of "bad science" or whether science is itself intrinsically androcentric, and therefore not value-neutral.[28] Bad science means that methodological rules which lead to objective results are (partially) abandoned in favor of values or interests other than scientific.[29]

Like I mentioned, the feminist critiques of science differ widely, both in their analyses of the problems and the solutions they propose. Sarah Harding divided the diverse accounts of feminist writers on science into three different categories [30]:

1. *Feminist empiricism*, which criticizes science for not living up to its own standards. Male values are influencing scientific results, but if the methods are more rigorously applied, this can be prevented.

2. *Standpoint epistemologies*, which claim that bias is inevitable, but some kinds of bias are epistemologically superior to others. According to Harding, the point of view

[26] Harding, Whose Science? Whose Knowledge, p. 35
[27] For a collection of examples of the kind of patriarchic science feminists are concerned with, see Kourany 2010, p. 4-12

[28] Ohkruhlik 1994, p. 199
[29] Ohkruhlik 1994, p. 200
[30] Ohkruhlik 1994, pp. 199-200, Harding 1986 & Harding 1991

from minorities and suppressed peoples contains more knowledge than the mainstream point of view. Women, being suppressed for centuries, would know more than men, for they know the mainstream point of view but also their own point of view. Standpoint epistemologies have been criticized for the fact that there is not a single female or feminist standpoint. They all differ so there is no reason to favor one standpoint over the other.

3. *Feminist postmodernism*, which has abandoned all pretensions of rationality and objectivity. It accepts a plurality of different narratives about what the world is like, each appropriate to a specific place, time or culture, rather than using one universalized account.

The critique I chose to investigate comes from the feminist philosopher Helen Longino. This is because Longino is herself a philosopher of science and she addresses traditional issues of her field, making her work more challenging than that of "outsiders". Longino seems to belong mostly to the feminist empiricist category, although her philosophy exhibits features from all three. She argues for her position of "contextual empiricism", according to which the acceptance of theories is partially context-dependent, so we have to assess theories not only with traditional universalized scientific standards but also with appropriate criticism, depending on the context.[31]

Longino's critique of the value-neutrality thesis

The challenge offered by Longino is not that she denies that there are standards to assess the validity of scientific theories which are independent from particular interests and values. Rather she argues that "[…] satisfaction of these standards by a theory or hypothesis does not guarantee that the theory or hypothesis in question is value- or interest-free"[32] In other words, Longino tries to prove that science, contra the *value-neutrality thesis*, cannot protect itself from the influence of non-scientific values.

As I mentioned earlier, the value-neutrality thesis assumes a strict separation of

[31] Longino 1996, p.39
[32] Longino 1990, p. 12

cognitive and non-cognitive values. Longino questions whether these different kinds of values can really be separated in scientific activity. She renamed these values *constitutive values* and *contextual values*. The former are the source of rules determining what constitutes acceptable practices and methods in science, while the latter belong to the social and cultural context in which science is done.[33] She thereby makes more clear what the issue is:

> *"The issue of the autonomy of scientific practice from values can then be reformulated as two questions—one having to do with the extent to which contextual values influence actual scientific practice; the other, with the relative independence or interaction of the constitutive and contextual values of scientific practice. "*[34]

In the value-free account of natural science, according to which the interaction between science and values is viewed as an *external* relation, values may influence the directions of research and its applications, but not the *internal* processes of scientific inquiry itself, which is thought to proceed according to its own rules. In contrast, Longino offers her contextual account of science, according to which contextual values influence and shape scientific results in several ways. From Longino (1990) I have taken three kinds of influences which I think are most relevant for her argument below[35]. I have reformulated them a bit, to make it more clear:

1. Contextual values influence which questions are investigated and which are ignored.
2. They influence which observational and experimental data are selected for study and the way those data are interpreted.
3. And finally, they influence which theory is chosen among competing theories, and which evidence is found relevant for this choice.

[33] Longino 1983, p. 8
[34] Longino 1983,p.8

[35] see Longino 1990 p.86 for a more detailed list of how values interact with science.

If these claims are correct, then the *value-neutrality thesis* would turn out to be false. Besides the supposed cognitive values, other values would play a role in scientific reasoning. Before we move to the arguments which support Longino's claim, let us first look at her proposed solution to the problem she identified.

If science cannot separate itself from the social and cultural context in which it is done, Longino asks, what prevents scientific theories from being completely subjective? The solution she proposes is the requirement of critical interactions among scientists with *different points of view*, which minimizes the influence of subjective preference on data interpretation and theory choice. These interactions "must not simply preserve and distribute one subjectivity over all others, but must constitute genuine and mutual checks."[36] To reach this aim requires a scientific community which possesses the following features:

1. There must be publicly recognized forums for the criticism of evidence, methods, background assumptions and reasoning.

2. There must be uptake of criticism

3. There must be publicly recognized standards by reference to which theories, hypotheses and observational practices are evaluated and by appeal to which criticism is made relevant to the goals of the inquiring community.

4. Communities must be characterized by equality of intellectual authority. Longino doesn't mean that both experts and laymen are allowed equal authority in the same field, but rather a criterion which ensures that all different views are included in reaching scientific consensus.

Interestingly, the public standards of condition (3) include not only cognitive values, but also " […] pragmatic values and substantive assumptions grounded in either the metaphysical commitments or the social and political commitments of a society, i.e. metaphysical or value-laden substantive assumptions."[37]

[36] Longino 1996, p. 40
[37] Longino 1996, p. 41

Longino proposes that we use shared values (also socio-political ones), open to democratic discussion, with which we not only critically assess the goals of scientific research, but also the theories and hypotheses themselves, on both their epistemic and their social merits. As I mentioned, feminist philosophers of science do not treat the problem of biased theories as only an epistemological problem but also as a social problem, since certain biased theories have been used to justify social inequality. The solution proposed by Longino is thus meant to address both problems.

Longino's solution is very controversial, because it could be taken to mean that in some cases, theories which are not in accordance with certain socio-political aspirations, would have to be rejected, although they might be true. This kind of political interference in scientific discourse is the reason, as Kourany mentioned (see: end of Part One), why science is traditionally not committed explicitly to social goals, however admirable. It would threaten the integrity of science. However, I think this is not what Longino intends. We must realize that Longino believes that there is no way that socio-political considerations can be kept out of scientific reasoning. Once this is so, she seems to mean, we might as well use explicit socio-political considerations on which we democratically agree, so that science can more adequately respond to both our cognitive and our social needs. Moreover, the critical interactions among scientists would insure that scientific theories would satisfy not only the social but also the *cognitive* aims of the scientific community. The difficulty of creating her ideal scientific community, is recognized by Longino[38], for it would need a social and a political change in society. But even if such a change would take place, Longino does not clarify what kind of socio-political commitments should figure in the publicly recognized standards she proposes with which to evaluate theories. She seems to believe that as long as these would be democratically established in critical discussions (made possible by the political change), they would already be better than the hidden commitments and values which she thinks cause a bias in current scientific research. I agree that it would be an improvement if the application of scientific theories would happen in a more transparent manner, but it does not automatically mean that these applications will be socially any better. Besides this problem (to which I will return later in Part Three), Longino's proposed solution would only be acceptable if she is right in her claim that there is no way to prevent

[38] Longino 1990, p. 214

the context from influencing scientific reasoning. To show that this is indeed the case, she proposed several arguments against the value-neutrality thesis. Let me take two examples offered by Longino. The first is a theory which is used to interpret data about human evolution. The question posed in these studies is how anatomical and behavioral development contributed to the evolution of *Homo sapiens* as a species, by the processes of natural selection.[39] There are two different approaches with which the data could be understood, and fitted into an account of human evolution. One is the "man-the-hunter" account, and the other, developed later and partially in response to the former[40], is the "woman-the gatherer" account. In the former, it is the changing behavior of the male that essentially contributed to the evolution of humans, and in the latter it is the changing behavior of the female that played the crucial role.[41]

According to the man-the hunter account, for example, tool use is explained with the development of hunting by males, while according to the second it is explained with the development of new gathering techniques by females, who also needed weapons for protection against predators while gathering. Longino says that none of the admissible data can favor one account above the other. How the data is read actually depends on the account one is working with.[42]

The second example is about neuroendocrinology, which in this case relates differences in hormonal distribution to differences in male and female behavior. In this case, certain hormones have been divided into male and female hormones, androgens and estrogens, and their effect on aggressive or sexual behavior has been investigated. The problem that Longino sees is that classification of hormones in male and female, and description of their effects on the brain in terms of "masculinization" and "feminization"[43], creates a bias in the interpretation of their effects. While the workings of these hormones are very complex and depend on a number of other physiological factors, "the creation of terms whose meaning is primarily behavioral for processes of neural development only hypothesized to exist leads researchers to highlight some aspects of the biochemical

[39] Longino 1990, p. 106
[40] Longino 1990, p. 111
[41] Longino 1990, p. 107-108
[42] Longino 1990, p. 109
[43] Longino 1990, p. 121-122

processes they can trace at the expense of others."[44] Longino points out that it is the background ideas about gender which have established a direct link between sex hormones and sexual differentiation, while other studies show that sexual differentiation is too complex to link it to male and female hormones, classified as such.[45] In the past, the results of such research have been used to explain homosexuality, or boyish behavior in girls. Research on the effects of androgen on mathematical test performance of boys and girls are another example. Longino's worry is of course the temptation to extrapolate the results of both fields to society, because then, " a picture of a biologically determined human universal emerges"[46], which can justify unequal treatment of the different sexes, and through which phenomena as homosexuality or boyish behavior come to be seen as due to hormonal or genetic pathology.[47]

Rather than dismissing these cases as "bad science", Longino argues that the problem is more complex. There might be nothing wrong with the testing procedures of the hypotheses in the cases mentioned. They could qualify as good science. But they contain a bias, since the hypotheses themselves are informed by contextual values, as is the description and interpretation of the data.

To show why such bias can even occur in "good science", Longino uses the "underdetermination argument". According to Longino, this argument shows that science cannot protect itself from bias, because the choice between two theories which both adequately explain the same phenomenon, depends in part on background assumptions. The underdetermination argument questions to what extent we can rationally choose among different theories which explain the same phenomenon. According to this argument, no amount of empirical data can uniquely determine theory choice, since the full content of any theory or hypothesis always overreaches the amount of available data which can support the theory. More importantly, says Longino, the content and language of data descriptions are different from that of explanatory hypotheses, and therefore, no formal relationships can be established between them. What makes data relevant as evidence, then, depends strongly on background assumptions. Consequently, the same data can serve

[44] Longino 1990, p. 123
[45] Longino 1990, p. 122-123
[46] Longino 1990, p. 129
[47] Longino 1990, p. 128-132

as evidence for different hypotheses, depending on the context. Remember that cognitive values function as criteria for determining what counts as a "good" scientific theory and what counts as evidence for accepting such a theory.

If Longino is right, it means that these values do not fully account for theory choice. There is room for all kinds of contextual values to influence the content of scientific knowledge.[48] The importance of this point is that it implies that scientific results cannot be value-free even if science is properly conducted. Practicing scientists will usually admit that value-free results are hard to obtain, but that value-freedom still remains the ideal, which they can approximate by following the epistemic standards.[49] Longino aims to show the theoretical impossibility of this ideal. The epistemic values are not sufficient to choose among theories, but need to be supplemented with background assumptions, which may be informed by all kinds of contextual values. If this is true, then value-freedom would be an unrealizable ideal.

Stephanie Ruphy (2006) noted that Longino's argument rests on the claim that background assumptions cannot be critically assessed on purely epistemic (constitutive) grounds. The author shows that Longino didn't establish this claim anywhere. Ruphy argues that (contextual)background assumptions can be tested on constitutive grounds. It is exactly what the feminists have done: by bringing different background assumptions to the assessment of theories than the dominant male-biased assumptions, they have shown the constitutive weaknesses of these theories. If the available evidence can both support the theory relying on a feminist background assumption and a theory relying on a androcentric assumption, it is inconclusive, so that one cannot be favored over the other.

Moreover, Longino herself keeps pointing to alternative research which contradicts the sex-difference theories in question, with which she shows that their acceptance must be based on specific background assumptions. But by doing this, she proves not only that background assumptions can be revealed, but that they can be tested against other background assumptions, by comparing both sets of assumptions with the available evidence. She made this especially clear in the example of human evolution studies. She

[48] Longino 1996 , p. 39-40
[49] Ruphy 2006, p. 192

uses epistemic arguments to reveal the bias, while claiming that it is not possible to reveal the bias with epistemic means. This makes her account self-defeating.[50]

In another paper, Longino presents cases from less controversial areas than behavioral research, in which contextual values have influenced scientific conclusions, for example in biological risk assessment. One of the cases is about Gregory Pincus, a scientist who helped to develop the oral contraceptive Enovid. During his research on the effects of this contraceptive, Pincus emphasized its prophylactic and therapeutic properties, while downplaying the potential damaging effects. There was, however, sufficient data available which showed relation between the estrogens that Enovid contains, and reproductive tract cancers and blood coagulability. Not only was Pincus employed by the pharmaceutical company that made Enovid, but Pincus was himself preoccupied with worries about population growth, and it is suggested that especially the latter influenced his research in a way that he tended to look for positive effects, rather than negative effects.[51]

Longino claims that she has shown cases in which "[…] non-epistemological, personal, social or cultural values have affected scientific practice internally rather than externally"[52]. But what does she mean with "internally rather than externally"? Longino writes: "I have not attended to whether, in any given case, overt or covert pressure, internalization of values, or some other factor has been involved, but have instead presented a series of interactions in which contextual values and scientific practice have become progressively more entwined."[53]

Longino said that when the stakes for decisive outcomes of research are high, then in absence of any decisive data, the outcomes are influenced by these stakes. She asks to what extent the constitutive values can protect science from the interests involved in the context in which science is done, and to what extent the constitutive values and contextual values can be separated at all. Although Longino doesn't make the same strong claim that science cannot protect itself from intrusion of values, she does suggest that this could become very difficult when the two sorts of values "become more progressively entwined". In all these

[50] Ruphy 2006, p. 194-197

[51] longino 1983, p. 10
[52] Longino 1983, p.13
[53] Longino 1983, p. 13

cases presented, contextual values influenced scientific conclusions, while they shouldn't have. In other words, these are cases of "bad science", and not of "good science". Again, Longino's account is self-defeating, since she herself proves that the kind of bias in question can be revealed by showing scientific facts which contradict the theory, thereby making it inconclusive, and in the case of risk assessment, provide an unsound basis for any policy dealing with biological risks.

Conclusion

Longino has shown that the influence of contextual values doesn't only happen at the level of determining areas of research and the posing of research questions, which is a problem of today's commercialized science, but also within the research itself. This shows that it is at least hard to keep society out of science, so to speak. Longino's findings are similar to those of sociological and historical research of science, which point to countless examples in which social factors played in important role in the establishment of scientific facts, and in the promotion of certain theories at the expense of others.[54]

The account of Longino is very valuable because it shows the usefulness of employing alternative (feminist) perspectives to lay bare any kind of bias. However, Longino's claim that science cannot rid itself of this bias by purely epistemological means, turns out to be too strong. All the examples offered by Longino point simply to "bad science", as scientists themselves would call it. These are examples of scientifically unsound conclusions: unfounded cultural assumptions about sexuality and gender guided the research and colored its outcome. No sound argument is offered why this could not be evaded within the common framework of scientific research, and it can be shown that such value-intrusion can be evaded in principle.

As Ruphy pointed out, Longino defeats her own argument by doing exactly what she claimed to be impossible. Background assumptions which result in biased theories can be made explicit by confronting a theory with alternative background assumptions fitting the same evidence. And a theory can be shown to be inconclusive in the light of alternative data. Longino has proven this herself. She made a clever argument, but as it turns out, science can

[54] See for instance: Shapin & Schaffer 1985

correct its own biases with purely constitutive means. To come back to the question posed in the introduction, namely, whether science can be value-free, the answer is that value-free science can be maintained as an ideal.

However, does this mean that science can in fact be separated from society and its politics? One claim uttered by the feminists which is interesting in this respect, is that the value-neutrality ideal, or objectivity itself, is being used to present highly politically-laden activities based on scientific research as "neutral" or "objective" in the political sense[55]. Neutrality would be an ideological veil, hiding the political interests served by science. Longino's alternative science, her contextual empiricism, seems to respond to this. As long as the context remains hidden, science seems value-free, but is in effect serving certain political interests. By making the context explicit and part of a knowledge production open to critical discussion, the knowledge produced will be more in accordance with social values, shared by a larger community, which according to Longino, will result in more socially responsible applications.

But we have just seen that the kind of bias feminists are concerned with can be corrected, without an appeal to alternative political interests from those "hidden" by science. As the problem is formulated by Longino herself, the emphasis lies with the problem of value-intrusion. If this problem can be solved without taking recourse to non-scientific values, there is no reason why Longino's alternative would be better than contemporary science. Having discussed all this, the second question posed in the introduction remains unanswered, namely, whether a science kept free from values can be socially responsible.

There is a different kind of criticism about the problem of science and values, which suggests that the answer to this question is a negative one. According to the philosopher Herbert Marcuse, science is value-free, but it is precisely the value-freedom which makes science serve certain political interests and not others. These political interests are hidden, not because the context influences science in spite of its ideal of value-freedom, but because value-freedom requires science to abstract from the social context, making it fundamentally tied to an interest in (social) control. In the discussion about commercialized versus autonomous science , this problem is left unrecognized, while it helps to grasp the role of

[55] Harding 1992, p. 568-569

science in society and what should be done to make this a socially responsible role.

In the light of Marcuse's analysis which will follow, it seems that Longino's position, that is, the solution she proposed, might be very worthy of consideration after all. At the end of this thesis, I will consider Longino's solution in combination with the insights from Marcuse and Hugh Lacey, and discuss the possibilities for an alternative science.

Part Three: The critical theory of science

One-dimensional science

I mentioned that critical perspectives like of the feminists are a valuable tool for scrutinizing science. For the same reason, I think that critical theory is useful here: it provides, even more than the feminists, a truly critical perspective. The reason I like to discuss Marcuse, and in particular his book *'One Dimensional Man'*, rather than works of other critical theorists, is that he treats the issue of *natural* science and values more extensively than the others. Another reason is that Marcuse, just like Longino, argues for valorizing the sciences, which is relevant for the contemporary discussion about valorized science in the commercial sense.

Longino's argument for the necessity of a democratically valorized science was not sufficiently acceptable, (since science can in principle check itself for any bias), leaving the restoration of scientific autonomy, in the value-neutral sense, as the only available solution to the problem. Marcuse provides a stronger argument for valorization than Longino. He argues that science is inherently biased, precisely because of its value-freedom. Because of this bias, scientific applications tend to become instruments for social domination, rather than liberation. What constitutes the bias what Marcuse calls a "one-dimensional" manner in which science studies natural objects and presents the possibilities for application of these studies. The range of possibilities presented by science is restricted to the current social circumstances in society.

A "multi-dimensional", or what Marcuse calls a "dialectical" method, would take the social context in which natural objects are situated into account, and such a method would do justice to the acknowledgement that in order for some possibilities to be realized, the social circumstances in society would have to change, and vice versa. Such an acknowledgement of the dialectical relationship between understanding nature and the society for which such understanding is created, is seen by modern science as a value-consideration, which should not belong to an objective study of nature. According to Marcuse, value-free science and its applications are so constituted that they cannot be used to change society for the better.

If this is correct, then I propose that the contemporary discussion about the commercialization of science should not be about how to keep science purified from human

interests, but rather, as Longino proposed, how to tie science to human interests which are based on shared values. Longino thinks that open critical discussion will suffice to come to these values. But will these shared values be about social progress and emancipation, or in any way "better" than the hidden contextual values which she found to have intruded science? This all depends on the consciousness of the community in which the science is done, and Longino herself noted that "the problem of developing a new science is the problem of creating a new social and political reality".[56] According to Marcuse, science itself has a static conservative function with respect to the current social and political reality, thus making such a change more difficult. So another reason why I discuss *One Dimensional Man*, is because Marcuse pays more attention to the dialectical relationship between science and society then Longino has done.

In *One Dimensional Man*, Marcuse tries to explain why large social movements demanding socialism, or any other alternative to capitalism, are virtually absent in advanced industrial societies. Marcuse sees that these societies are still characterized by social domination, in the form of coercive power, social hierarchy and exploitation, typical of the capitalist mode of production. Moreover, he sees this domination growing more and more effective as it is carried out increasingly with the help of scientific knowledge and applications.

According to his thesis he outlined in One Dimensional Man, society becomes increasingly *one-dimensional*, when what is considered rational in society comes to depend on scientific-technological conceptions of reality. His explanation for the absence of genuine resistance is that social domination is now also internalized by the individual, who conforms to his situation because he understands the benefits of the increasing efficiency of the productive system to satisfy his needs as a consumer as "progress", and who sees his freedom and independence from society as a technological impossibility, as irrational.

This requires some further explanation. Neutral, value-free concepts, used in scientific-technical reasoning, belong to what Marcuse calls one dimensional thought. According to Douglas Kellner, the term "one-dimensional",

> "[…] *describes practices that conform to pre-existing structures, norms, and behavior, in contrast to multidimensional discourse, which focuses on possibilities that*

[56] Longino 1990, p. 214

transcend the established state of affairs. This epistemological distinction presupposes antagonism between subject and object so that the subject is free to perceive possibilities in the world that do not yet exist but which can be realized. In the one-dimensional society, the subject is assimilated into the object and follows the dictates of external, objective norms and structures, thus losing the ability to discover more liberating possibilities and to engage in transformative practices to realize them." [57]

Marcuse calls the scientific conception of reality one-dimensional, in the sense that its concepts only relate to the empirical present, to which the current society also belongs. The concepts needed to think of other possibilities than the given, to change reality for the better, are considered unscientific and therefore less real. They belong to the realm of values and other personal preferences.

Marcuse believes that the current social and material circumstances of society are historically relative, and open to radical transformation. The way a society develops and organizes the life of its people "involves a choice between historical alternatives, which are determined by the inherited level of material and intellectual culture"[58]. The choice is made according to the dominant interests of society, which benefit from specific modes of transforming and utilizing nature (and man) and accordingly, aim to realize one "project" and reject others. This historical project, says Marcuse, is about the "experience, transformation and organization of nature as the mere stuff of domination".[59] The beginnings of this project originated in the human struggle with nature. Out of necessity, man had learned to control nature to some extent in order to survive. But now, the project is no more dictated by necessity, but by capitalist interests, which seek to maintain the status quo and exploit human and natural resources for short term profits.

In order to change the current project, man needs to look beyond the possibilities realizable under current conditions. This involves a different notion of reality, that is, a

[57] Marcuse 1991, p. xxvii

[58] Marcuse 1991, p. xlvi

[59] Marcuse 1991, p. xlvi

dialectical notion. Remember the fourth point of Lacey's list: *values are criteria with which we choose what is right among possible courses of action*. It is in this sense that values are part of reality for Marcuse. The creation of a better reality, a society with improved social conditions, is mediated by values, for they provide the criterion for choosing among "historical alternatives". If science would study nature using a dialectical method, it would mean that it would consider the historical alternatives, and it would involve value-considerations in its reasoning, at least where applications are concerned. In the following sections, I will outline Marcuse's arguments concerning the role of science in one-dimensional society. This is important for considering the possibilities for an alternatively *valorized* science which can truly be said to be linked to social progress, rather than the valorized science we have today.

Marcuse's critique of value-free science

In chapter six of "One Dimensional Man", titled "From Negative to Positive Thinking: Technological Rationality and the Logic of Domination", Marcuse attempts to explain how science and technology are not really neutral, but essentially linked to society in a biased manner, so that all scientific applications tend to be used for purposes of technological control, diminishing individual freedom. In the following quote he states his position:

> *"It is my purpose to demonstrate the internal instrumentalist character of this scientific rationality by virtue of which it is a priori technology, and the a priori of a specific technology—namely, technology as form of social control and domination. Modern scientific thought, inasmuch as it is pure, does not project particular practical goals nor particular forms of domination. However, there is no such thing as domination per se. As theory proceeds, it abstracts from, or rejects, a factual teleological context—that of the given universe of discourse and action. It is in this universe that the scientific project occurs or does not occur, that theory conceives or*

does not conceive the possible alternatives, that its hypothesis extend or subvert the pre-established reality."[60]

When Marcuse characterizes science as "instrumental", he does not refer to the antirealist position of instrumentalism, which is about the epistemological status of theoretical entities, like electrons. The term instrumental refers to the nature of science itself, to the character of its knowledge. For critical theorists, like Marcuse, science doesn't produce what they would call understanding. It rather produces information, that is, technically utilizable information.[61] Marcuse does not really believe in the possibility of gaining knowledge from a detached, disinterested position. Scientists may pretend to be able to occupy such a position, but in reality, his conceptual framework with which he understands the world, will always be related to the society that he finds himself in:

"Observation and experiment, the methodical organization and coordination of data, propositions, and conclusions never proceed in an unstructured, neutral, theoretical space. The project of cognition involves operation on objects, or abstractions from objects which occur in a given universe of discourse and action. Science observes, calculates, and theorizes from a position in this universe. The stars which Galileo observed were the same in classical antiquity, but the different universe of discourse and action—in short, the different social reality—opened the new direction and range of observation, and the possibilities of ordering the observed data."[62]

This is very different from the common view of science, which carries the traditional conception of truth as abstracted from human interests. According to this view, scientific theories may result in successful technological applications, for the simple reason that they are true. In other words, first was the theory invented, and then we discovered how to use it to gain power over nature. For the critical theorist, however, the most basic aspects of science, like formal classification under laws, cause-effect reasoning and quantification are not disinterested notions, but "epistemological expressions of an interest in instrumental

[60] Marcuse 1991, p. 161-162

[61] Alford 1985, p. 10-11

[62] Marcuse 1991, p. 161

control".[63] Marcuse argues that the concepts science works refer to human practical action and purposes, at least before they became abstract. Marcuse borrowed this conception of science from the phenomenologist Edmund Husserl, who showed that geometry, for instance, is an idealized version of the practice of measuring land (*feldmesskunst)*, and algebra is the abstracted version of geometry. But because of these abstractions, science forgot that its concepts actually refer to the practices and purposes of the world of common sense, which he calls the life-world. "The result was the illusion that the mathematization of nature created an "autonomous (*eigenständige*) absolute truth" [..], while in reality, it remained a specific technique for the *Lebenswelt*. The ideational *veil* (*Ideeenkleid*) of mathematical science is thus a veil of *symbols* which represents and at the same time masks (*vertritt* and *verkleidet*) the world of practice [..]."[64]

In chapter six of One Dimensional Man, Marcuse is concerned with two things. First to show how science is inherently instrumental, and second, that this instrumentality binds it essentially to practices of social domination. If Marcuse is right in his first claim, then science cannot be autonomous on the grounds that it is supposed to be detached from direct human interests. Scientific knowledge would be essentially an instrument of power over nature, to be utilized for human practical purposes.

But not only the detachment of science is questioned by Marcuse, he also questions the neutrality of science with respect to its applications in society, since he connects instrumentality with social domination. This second claim is regarded to be more problematic, even by the most sympathetic critics of Marcuse, like William Leiss, who disagrees that there is such a necessary connection between science and domination. However, I will show that Marcuse provided good arguments for both claims.

The instrumental character of scientific knowledge

Remember the "Galilean" metaphysics, positing a mathematical, value-free structure of the world. Marcuse aims to show that regarding the world as value-free leads to a certain kind

[63] Feenberg 1988, p. 240-241
[64] Marcuse 1991, p. 166

of understanding, which is inherently practical, or instrumentalist, as he calls it. Marcuse writes:

> *"The quantification of nature, which led to its explication in terms of mathematical structures, separated reality from all inherent ends and, consequently, separated the true from the good, science from ethics. No matter how science may now define the objectivity of nature and the interrelations among its parts, it cannot scientifically conceive it in terms of "final causes"."*[65]

If nature is regarded as value-free, and its "ontologically relevant" part is fully understandable in quantifiable relationships and structures, then "what nature (including man) may be striving for is scientifically rational only in terms of the general laws of motion—physical, chemical or biological. Outside of this rationality, one lives in a world of values, and values separated out of the objective reality become subjective."[66]

But without reference to final causes, the kind of questions about nature which can be answered by science are not of the metaphysical "What is. . . ?(τί εστίν)" but of the functional "How. . . ?"[67]. Whatever reality is, science rejects the metaphysics of final causes, which actually means that it no longer concerns itself with what existence is, but with how it works. This "… establishes a practical (though by no means absolute) certainty which, in its operations with matter, is with good conscience free from commitment to any substance outside the operational context."[68]

Consequently, the validity of scientific theories and the entities they posit, can only be judged in instrumental terms. Indeed, theories about the inner *working* of nature are tested through our intervening in that working, in trying to isolate the working parts, by performing operations on matter, as in measurement and experimental manipulation. The expected reaction we get from nature as a result of these operations constitutes what counts as empirically adequate proof for our theories.

This idea, that we have understood something if we have successfully manipulated it,

[65] Marcuse 1991, p. 150

[66] Marcuse 1991, p. 150-151
[67] Marcuse 1991, p. 155
[68] Marcuse 1991, p. 155

has been attributed to Francis Bacon, because of his metaphors he used to promote the experimental method. He was talking about "vexing" nature, probe her to learn her inner secrets, "to twist the lion's tail". More recently, in the realism-antirealism debate, it has been used in an argument made by Ian Hacking for his experimental realism. According to Hacking, realism about entities is justified only because we can successfully manipulate these entities in experiment.[69] Hacking writes:

> *"Discussions about scientific realism or anti-realism usually talk about theories, explanation and prediction. Debates at that level are necessarily inconclusive. Only at the level of experimental practice is scientific realism unavoidable. But this realism is not about theories and truth. The experimentalist need only be realist about the entities used as tools."*[70]

> *"The experimenter is convinced of the reality of entities some of whose causal properties are sufficiently well understood that they can be used to interfere elsewhere in nature ." "Interference and intervention are the stuff of reality."*[71]

Hacking's realism is about unobservable entities, like electrons. But the same applies to observable objects, says Hacking, "for why else are we (non-sceptics) sure of the reality of even macroscopic objects, but because of what we do with them, what we do to them, and what they do to us?"[72] What we know of them, is form and function, because of what we can do with them; how they respond to our actions. But besides experimental testing, Marcuse sees also an instrumental character in scientific theories, because they contain terms which represent matter in idealized quantifiable forms, which can be calculated and operated on.[73] So, Marcuse's thesis about the instrumentality of science can be understood as follows: The idea of value-free nature, combined with mathematical formalization, leads

[69] Hacking 1982, p. 1153
[70] Hacking 1982, p. 1153
[71] Hacking 1982, p. 1157
[72] Hacking 1982, p. 1157
[73] Marcuse 1991, p. 166-168

to the idea that we can only understand nature by manipulating it. And this approach is confirmed in its truth by the practical success of technological manipulation.[74]
In this sense, in the scientific representation of nature, all being is at the same time a potential instrument.[75] Moreover, because this being is regarded as value-free, "…theoretically, the transformation of man and nature has no other objective limits than those offered by the brute factuality of matter, its still unmastered resistance to knowledge and control."[76]

It is remarkable that Hacking expresses the very instrumental attitude to nature Marcuse suspects in science, although Hacking of course sees successful experimentation as a proof for the truth of theoretical entities, rather than an expression of the interest in power over nature. Marcuse does see the latter at work. He identified scientific knowledge as instrumental knowledge. It projects nature as "a (hypothetical) system of instrumentalities" (Marcuse, p.155), as pure means, to further ends. But the ends are not defined by science, for science does not concern itself with values.

Husserl, who wrote about "The crisis of the European sciences" has shown the paradox of this conceptual separation of means and ends, where the former belongs to science and the latter to the life-world (*lebenswelt*), the world of common sense. He wrote that the relation between experience in the objective scientific world and the experience in the life-world remains always unclear. This is because the lifeworld is permanently "devalued" by science as the realm of subjective experience. Yet science is directly related to purposes in the lifeworld by showing possibilities which can be realized through its technological application. It can, however, never transcend the technical level, it cannot formulate an objective basis for judgments, decisions and valuations with respect to the human purposes of scientific application.[77]

But if normative reasoning in our common experience is devalued as non-objective, matters of personal preference, what informs the purpose of scientific application? "With respect to the control of both men and nature we find ourselves in possession of ever more

[74] Alford 1985, p. 54
[75] Marcuse 1991, p. 155
[76] Marcuse 1991, p. 155
[77] Leiss 1974, p. 131 ; also: Marcuse 1964

efficient means for the accomplishment of ever more obscure ends."[78] In this sense, science would be irrational, since it lets society decide about its ends, while denying the validity of values that inform these ends. But showing that science is irrational is not enough for Marcuse. He intends to show that the means of science are means for domination:

> *Pure science is not applied science; it retains its validity apart from its utilization. Moreover, this notion of the essential neutrality of science is extended to technics. The machine is indifferent towards the social uses to which it is put, provided those uses remain within its technical capabilities. In view of the internal instrumentalist character of scientific method, this interpretation appears inadequate. A closer relationship seems to prevail between scientific thought and its application, between the universe of scientific discourse and that of ordinary discourse and behavior—a relationship in which both move under the same logic and rationality of domination."*[79]

Although it can be shown that science shows an interest in instrumental control, there is no necessary connection to the social practice of domination, since instrumental control can in principle serve any particular human interest in the totality of possible interests.[80] Leiss admits that Marcuse succeeds in showing that scientific rationality is inherently instrumentalist, but he says that the second point, the link between instrumentalism and social domination, "is not really defended at all"[81]. According to him, the existing connection between scientific rationality and political domination is to be found in the "absolutization" of a particular scientific method as the *only* valid source of objective knowledge." The fact that the predominant methodology used by science produces better control techniques both for nature and men, is a social phenomenon, and "can be explained only with reference to a particular constellation of social interests, and *not* with reference to the instrumentalist character of scientific methodology". This is also because Marcuse himself has argued elsewhere that this instrumentalism might, in changed social conditions, be an instrument of

[78] Leiss 1974, p. 132
[79] Marcuse 1991, p. 158
[80] Feenberg 1988, p. 241

[81] Leiss 1974, p.207

liberation rather than domination.[82]

I agree that the adoption of only one method as the only valid source of knowledge can only be explained by reference to social interests (I will return to this point later), but on the other hand, it is precisely the value-free method (by virtue of which science assumes an instrumentalist character), which demands this absolutization. This is precisely Marcuse's point in One Dimensional Man: that dialectical ways of knowing are refuted by science as speculative and irrational.

The contradiction in Marcuse's writing noted by Leiss, that instrumentalism can be both used for domination and for liberation, is not a contradiction for Marcuse. Marcuse sees society as not only dominated by powerful groups using science for their purposes, but also as dominated by the value-free logic of science itself. As Husserl pointed out, long before Marcuse, this results in an ethical crisis. The ends of science cannot be defined, while the means it produces are about instrumental control. This is why Marcuse criticizes science, for it is the scientific denial of values which he believes promotes what is wrong inside society:

> *"The point which I'm trying to make is that science, by virtue of its own method and concepts, has projected and promoted a universe in which the domination of nature has remained linked to the domination of man—a link which tends to be fatal to this universe as a whole."* [83]

Science and Domination

Marcuse has made an argument, scattered through a couple of chapters of One Dimensional Man[84], which shows that, contra the value-neutrality thesis, instrumental control over nature cannot serve all particular interests in principle. This is because the instrumentalism is, as Marcuse argued, implied by the value-free metaphysics of science.

What connects the *means* of science to the *ends* of (social) control is precisely these

[82] Leiss 1974, p. 209
[83] Marcuse 1991, p. 170
[84] See: Marcuse 1991 *One Dimensional Man*, Ch. 1 (p. 4-6, 10, 11, 18, 19), Ch. 5-6, Ch. 8 (pp 222-226), Ch. 9 (pp 234-239), Ch. 10 (pp 258-259)

value-free metaphysics. Remember that I mentioned in Part One that there was an important difference between Plato and Galileo in their ideas about being. In the metaphysics of Galileo, the essence of reality is part of the natural world, in the form of a mathematical core structure which constitutes all being. For Plato, the essence of things resided in the ideal world. The reason that Marcuse criticizes the "Galilean" metaphysics of science is because it has abandoned the Platonic concept of essential potentiality.

In the scientific notion, reality is empirically verifiable, and what is not empirically verifiable is not real in any objective sense. But for the ancient Greeks, especially Plato, reality had a different nature. It consisted of a tension between being and becoming, essence and appearance, potentiality and actuality. In this view, reality is not limited to what is currently empirically available, but also contains possibilities of becoming something else. "Essential potentiality" does not involve the kind of potentiality which can be actualized under the given social and material conditions, it is of "a very different order [and] it's realization involves the subversion of the established order"[85]. This view of reality acknowledges that material possibilities do not stand apart from social possibilities, and realizing a material potential involves realizing a social potential. Indeed, an object can contain different potentials, for different ways of making and using it, every potential belonging to a different way of life and social organization.

Marcuse maintains that the formal logical view of reality, according to which statements about reality may not contain value judgments, (I believe Marcuse referred to Hume's dictum, according to which *is* and *ought* statements are *logically* separated, see Part One) does not do justice to the dialectical nature of reality. If all things, including material objects, contain potentials which, once realized, make human life qualitatively better, then thinking about "is" may involve a judgment on the established reality; we can judge reality in terms of its unrealized potentials. Sometimes, the "is" implies an "ought". Let me explain what Marcuse means with an example: There is a society where everyone continually dies of starvation, while at the same time it contains a potential, in terms of material and social resources, to ensure that there is plenty of food for everyone. Realizing the potential in this situation cannot happen apart from having made a value judgment on the actual situation.

[85] Marcuse 1991, p. 136

This dialectical view of perceiving reality as a tension between actuality and potentiality is rejected by empirical science. What remains is actuality, describing all objects as they immediately appear in empirical reality. Identifying suppressed potential is seen as an act of fantasy, as a value-consideration and thus a matter of personal preference, having no ontological grounds at all.[86] The abstraction from social context prior to any application, by virtue of which science is called value-free, suppresses the potential for different ways of understanding and using an object in accordance with social circumstances, which may be more desirable than those of the actual society. As soon as this abstracted knowledge is applied, it is already biased towards practices of domination, because it is biased towards the existing social structures of society. This is what Marcuse means, when he says:

"The hypothetical system of forms and functions becomes dependent on another system—a pre-established universe of ends, in which and for which it develops. What appeared extraneous, foreign to the theoretical project, shows forth as part of its very structure (methods and concepts); pure objectivity reveals itself as object for a subjectivity which provides the Telos, the ends .In the construction of the technological reality, there is no such thing as a purely rational scientific order; the process of technological rationality is a political process. Only in the medium of technology, man and nature become fungible objects of organization."[87]

Now it becomes clear why science is inherently biased towards practices of social domination, rather than emancipation. By abstraction of nature from the social context, science remains tied to practices of domination, because it instrumentalizes objects and at the same time denying the validity of emancipatory ends to this instrumentalization. However, these ends can be realized if science would create the means to do so. It could create technology which is makes a more free society possible, where, for example, everyone's basic needs are satisfied, where people are not continually exposed to polluting agents, where labor is reduced so everyone can enjoy more free time, and where people would have the opportunity to develop their own personal potentials, to have more control over their own lives, without even having the need to control others. However speculative,

[86] Feenberg 1988, p.246
[87] Marcuse 1991, p. 172

such utopian visions are equally valid now as they were in the time of Marcuse, who already saw modern technology becomes increasingly sophisticated and creates evermore possibilities for different ways of life. The technological developments which dominate our society is also the source of Marcuse's utopian hopes, for he says: "Thus, the speculations about the Good Life, the Good Society, Permanent Peace obtain increasingly realistic content; on technological grounds, the metaphysical tends to become physical."[88] But these hopes will not be realized, as long as science rejects considerations of potentiality as value-considerations, and so the means it discovers remain tied to "the current universe of ends", which lie within the current societal framework of creating economical growth through effective technological control and exploitation of human and natural resources.

Utopian visions like those above are out of fashion. Even the possibilities for creating sustainable technologies that we hear so much of nowadays, like clean energy, clean cars, clean factories etcetera will be applied according to the capitalist norms of productive growth, efficiency, division of labor and hierarchical power structures. Before I move to Marcuse's solution to this problem, I will move to some insights of Hugh Lacey (1999), which might shed more light on the problem of science and values.

The approach of Science

Lacey labels the approach which characterizes modern science as the "materialist" approach. In the materialist approach, all data and theories are expressed in materialist terms: "the kind of terms that apply to phenomena considered as generated from underlying structure, processes and laws rather than considered as an integral part of daily life and social practice."[89] Science uses particular strategies which determine the kind of theories which may be entertained and the kind of data which are to be selected to bear upon a theory. The strategies used in science vary in each discipline, but because they all produce data expressed in materialist terms, Lacey subsumes them all under the term "materialist

[88] Marcuse, 1991, p. 234
[89] Lacey 1999, p. 68

strategies". Materialist strategies are used to bring theories into contact with data in such a way that the degree to which the evidence supports a theory can be measured.[90]

Lacey notes that modern natural science is characterized by "the almost exclusive adoption of materialist strategies", while materialist strategies are just one, among in principle many approaches.[91] For the sake of argument, Lacey defines an approach as "scientific", when it constitutes a form of "systematic empirical enquiry", which aims to grasp phenomena intersubjectively, and that its theories amount to a "systematic empirical body of posits"[92] Other approaches, says Lacey, could be teleological, phenomenological or intentional, for example. Which approach is chosen for research depends on what we regard as the objective of scientific inquiry. He argues that the materialist approach, or the "Galilean/Baconian" approach, may be pursued if one considers the objective of science to be the following:

O1: The objective of science is to represent phenomena as generated from underlying structure, process and law.(p. 102)

To be sure, this approach is based on the idea of value-freedom, as outlined in the first part of this thesis. For the sake of his argument, Lacey proposes an alternative objective, "O", to show that pursuing O1 results in range of applications which is more restricted than when an alternative objective would be pursued, namely:

O: The objective of science is to gain understanding of phenomena. This includes to encapsulate (reliably in rationally acceptable theories) possibilities that are open to a domain of objects, and to discover means to realize some of the hitherto unrealized possibilities.[93]

O is more general and more encompassing than O1, leaving open a multiplicity of possible approaches to investigate phenomena. O can be reduced to O1, only when human agency is not considered a relevant causal factor in the phenomena under investigation. The emphasis on "possibilities" in "O", recognizes that scientific knowledge can be applied and inform

[90] Lacey 1999, P. 68
[91] Lacey 1999, p. 88
[92] Lacey 1999, p. 100
[93] Lacey 1999, p. 102

human cognitive and practical projects, and that different projects might need different approaches, rather than only the materialist approach.

For instance, research into socially and environmentally sustainable agriculture cannot be the same as research into modern capital-intensive agriculture (which is, to be sure, still socially and environmentally exploitative[94]). Knowledge which is relevant for capital-intensive agricultural applications will contain materialist terms, like genes, growth rates, water and chemicals, weight, with can be used to measure the efficiency of the food production process.

Socially and environmentally sustainable agriculture, on the other hand, must be designed to improve the quality of life of the farmers and the quality of the environment. This means that all agricultural objects must be studied in their social and ecological context to gain an understanding of how such an improvement can be made. It also means that norms other than efficiency will be used to assess the success of the research. This is because efficiency refers only to the food production itself, and not to the environment in which it takes place. What is efficient for the former may be destructive for the latter. The two kinds of agriculture need different kinds of technology, based on different kinds of research, using different kinds of standards and concepts. The different applications cannot result from the same research strategy. Thus, different applications demand different approaches.

Lacey emphasizes that objective O is motivated by the recognition that the real is not exhausted by the actual; "it includes also the genuinely, as distinct from merely logically or imaginatively, possible".[95] He is concerned with the idea of "unrealized possibilities". He argues that if science want to encapsulate the full range of possibilities inherent to objects, thus creating *full understanding*[96], it should not restrict itself to only the materialist approach. He argues that if science aims at gaining a full understanding of phenomena and their inherent possibilities for human purposes, it is important that theories at least aim to cover the complete range of possibilities inherent to an object, including ones that may be realized under different social conditions than the present, thus remaining only *potential*.

But, says Lacey, it is often impossible to identify all the possibilities of the objects we

[94] Shiva 1989
[95] Lacey 1999, p. 102
[96] Lacey 1999, p. 99

research. This is because each different set of possibilities open to investigation might require different social and material conditions, so that the investigation of one set of possibilities may, contextually, preclude the investigation of another. And the same goes for actually realizing these possibilities. Not all the possibilities of an object can be realized simultaneously, and realizing some of them may prevent the realization of others.

For example, realizing the exploitation of a rainforest prevents realization of agriculture techniques which depend on sustaining the rainforest. And research into the chemical possibilities for standardizing and labeling biological research material (like DNA-samples) precludes any research which depends on autonomous and cheap production of these materials, since through the former, all the basic material is branded and sold by companies which now own the rights of production.

Despite this, says Lacey, consideration of widest range of possibilities possible should still the remain the aim of science. Lacey argues that in cases where different kinds of research cannot happen it once, a choice is made as to which class of possibilities to investigate, and the pursuit of materialist strategies represents such a choice.[97] From this argument, it becomes clear that science conducted exclusively with one approach provides limited understanding and a limited range of practical possibilities, in the case of the materialist, only those possibilities which are generated from the underlying order, leaving out those possibilities which we can only describe *when we don't abstract objects from their social and ecological contexts*.[98]

Now, since different approaches can be taken to investigate nature's objects, how can science account for its almost exclusive adoption of the materialist strategies? According to Lacey, there is no established argument for not adopting alternative approaches which gain sound understanding of empirical phenomena. If other approaches aren't *possible* to pursue, this is because the necessary social and material conditions for their development are not present at the time. Restricting scientific investigation to only those possibilities realizable under current conditions, says lacey, is due to adherence to certain *values* and not others.[99] Settling on a particular strategy, Lacey argues, "is linked with its mutually reinforcing interactions with particular social values, and that the conditions of realizability

[97] Lacey 1999, p. 99
[98] Lacey 1999, p. 103
[99] Lacey 1999, p. 106-107

of the possibilities identified under the strategy include social (institutional) structures that embody these values."[100] In this sense, modern science is not value-neutral, but serves certain values and not others.

Science and Values

According to Lacey, each possible approach to science can identify different kinds of possibilities, which serve different *value-complexes*. He suggests that the virtually exclusive adoption of the so-called materialist strategies in favor of many possible alternatives can only be explained by the fact that these strategies are in 'mutually reinforcing relationships with specific value-complexes, which contain what he calls *the modern values of control*.

Lacey says that modern value complexes include a set of distinct values about control, in which expanding the capability to control material objects is the most important.[101] Exercising control over objects is valued in all human cultures[102]. Lacey points out that what is characteristic in the modern Western attitude towards exercising control over things, is that it isn't subordinated to other social values related to our relationship with nature. Another value might be to live in harmony with nature, in which control over the environment is balanced with caring for it, to ensure its preservation so that the relationships that humans have with it can be both stable and permanent.[103]

Despite this, control remains very highly rated in modern societies, says Lacey, and many times, other values are subordinated to it. It became a central organizing principle of modern society, reflected in the fact that technology (which functions to exercise control over a part of nature) rather than social relations under which it is applied, is seen as the key to enhancing human well-being, and that consequently, most practical and social problems of society are seen as requiring a technological solution.[104]

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[100] Lacey 1999, p. 109
[101] Lacey 1999, p. 114
[102] Habermas also made this point. He argued that the instrumental orientation towards nature, the attempt to gain mastery over the environment, is part of the human condition. It must be accepted as given (Alford 1985, p. 76).
[103] Lacey 1999, p. 112
[104] Lacey 1999 p. 113-114

The problem is that exercising control has negative effects on human practical life and social arrangements if it happens without limits. These limits cannot be explicated solely in materialist terms, because they concern the richer social reality in which technology is implemented. Science, using the materialist strategies, finds evermore possibilities to control natural objects, while abstracting these from their connection to social reality. It therefore clearly serves the interest in control, at the expense of other interests.[105]

What is interesting in Lacey's account is that he argues, independently of Marcuse, that science denies the notion of potentiality in its research through abstraction of social contexts. He also made the point that the value-neutrality thesis cannot be upheld with respect to contemporary science. This is because science has chosen only one approach, resulting in specific kinds of applications, which are not designed to be socially desirable and responsible, for in order to achieve such socially informed applications, they would need to incorporate different kind of methods and concepts. This problem remains as long as materialist understanding is regarded is the only appropriate way of grasping the world.[106] I think that the most interesting points, however, are in Lacey's discussion of the possible scientific strategies. I have summarized them below:

1. Multiple approaches are possible, while science only uses one particular approach. Whether one or multiple approaches are taken, depends on the objective of research.

2. Pursuing a particular strategy is the result of a choice, and this choice is related to the expected results coming from a particular approach, which is related to particular values. This relates to Lacey's list in Part One, according to which a choice of action among different possible actions essentially depends on values. The importance of this point is that Lacey shows that science cannot be literally value-free.

3. It is not obvious that the pursuit of one kind of strategies is the result of a choice, since pursuing one kind of research may eventually make it difficult or even impossible to pursue another kind.

[105] Lacey 1999, p. 115

[106] Lacey 1999, p. 127

Despite the third point, Lacey maintains that gaining "full understanding" remains a realistic aim for science, for it could always consider a wider range of possibilities than it is currently considering under the materialist strategies. Considering more possibilities, says Lacey, would mean considering a multiplicity of approaches. This means that there is a form of value-neutrality *possible* for science, which is I think the most valuable insight. Science could at least aim to present all the different approaches with their corresponding value-complexes and leave them open to choice.

Marcuse's new science

At the end of One Dimensional Man, Marcuse makes some suggestions for a new emancipatory science. Marcuse sees science as increasingly capable of creating the conditions for the realization of human freedom. However, these capabilities are used for the opposite, namely for domination. Despite this, Marcuse sees the possibility of a qualitative change, a "[…] transition to a higher stage of civilization if technics were designed and utilized for the pacification of the struggle for existence."[107] I already mentioned what possible liberating goals for science would look like, and why Marcuse believes that science can realize them. His hopes are inspired by the actual technological developments within contemporary societies. So Marcuse does not propose a return to nature, that we go back to more primitive ways of life, but rather that we progress into this higher stage, where science will be used for liberation rather than domination. In envisioning this utopian possibility for science, Marcuse breaks with the conception of science and technology held by his fellow critical theorists of the Frankfurter Schule, especially Horkheimer and Adorno, who emphasized only the dominative aspects of science.[108]

To be sure, Marcuse admits that liberation presupposes some mastery (control) over nature, but he emphasizes that there are two sorts of mastery: a repressive and a liberating one.[109] This seems a contradiction, for Marcuse said earlier that the instrumentalist character of scientific knowledge makes it linked to domination. The difference is made by subordinating control over nature (instrumentalization) to the goal of liberation of man.

[107] Marcuse 1991, p. 232
[108] For some of their critical remarks on science, see: Adorno & Horkheimer 2001, p. 17 and especially p. 66
[109] Marcuse 1991, p. 240

Marcuse argues that the precondition for human freedom is first of all a materialistic one.[110] This precondition is "the satisfaction of needs and the reduction of toil"[111]. Here lies the true "end" of scientific and technological progress for Marcuse. Just like Longino, Marcuse argues for science to become political by linking its cognitive and practical means to human values, so that metaphysical ideas about liberation would no longer be separated from science, left to subjective personal preference, but finally become "the proper object of science"[112].

This would mean that science would itself become a *political enterprise*, rather than, because of its value-freedom, be *subjected* to politics.[113] In other words, science would make it possible to pursue the goal of liberation, which goes against the interests of domination, belonging to the status quo in capitalist societies. By creating this possibility, scientific knowledge would have a political implications, for it would be linked to the purpose of changing the status quo, to create a radically different society.

"I have stressed that this does not mean the revival of "values", spiritual or other, which are to supplement the scientific and technological transformation of man and nature. On the contrary, the historical achievement of science and technology has rendered possible the translation of values into technical tasks—the materialization of values."[114]

The new ends, defined in technical terms would not only operate in a reconstructed technology but would also figure in the construction of scientific hypotheses. Science would have to quantify values:

"For example, what is calculable is the minimum labor with which, and to the extent which, the vital needs of all members of a society could be satisfied—provided the available resources were used for this end, without being restricted by other interests […]. In other words: quantifiable is the available range of freedom from want. Or calculable is the degree to which, under the same conditions, care could be provided for the ill, the infirm, and the

[110] Marcuse 1991, p. 242
[111] Marcuse 1991, p. 236
[112] Marcuse 1991, p. 237
[113] Marcuse 1991, p. 238
[114] Marcuse 1991, p. 236

aged—that is, quantifiable is the possible reduction of anxiety, the possible freedom from fear."[115]

Feenberg remarked about the above example of quantifiying how much food is necessary to fulfill everyone's need, that its "significance escapes him", because "such quantification might serve besiegers starving out a city just as well as humanitarians fending off world hunger."[116] But this is besides the point. The point is to incorporate social context into science, rather than abstracting from it, so that science can create improved technological solutions for improved social circumstances. Lacey's definition of "appropriate technology", I think, provides a good formulation of what Marcuse means:

"It responds to questions like: "How can we produce food so that all the people in a given region will gain access to a well-balanced diet?" rather than to: "How can we maximize food production under 'optimal' material conditions?""[117]

Both questions respond to the world food problem, says Lacey, but the difference between the former and the latter is that the latter leaves out the social context to which it is going to be applied. Shiva (1989) has shown the devastating consequences of applications made according to the latter kind of questions.[118]

Feenberg does have a point when he says that Marcuse's passage can be interpreted as arguing that the new science should itself determine the values for the better society, which is confusing, "for surely Marcuse would have rejected the technocratic implications of such a proposal."[119] I agree that this cannot be Marcuse's intention. I prefer to read him as simply meaning that once science links explicit ends (values) to its own research, it automatically

[115] Marcuse 1991, p. 236-237
[116] Feenberg 1988, p. 249
[117] Lacey 1999, p. 188
[118] Farmers in India, who received the "help" from green revolution scientists solving their problem by optimizing the material conditions, had to change their whole way of life to adapt to the new conditions. Eventually their soil was depleted, their water was polluted by artificial fertilizers, and they became completely dependent on the world's major agricultural corporations. Shiva shows very convincingly that what she terms "reductionist science" has led to such disastrous applications of biological knowledge. For the details, see Shiva 1989.

[119] Feenberg 1988, p. 249

becomes political. He did not say anywhere that science should define these ends by itself.

Marcuse's solution can be read simply as a proposal to counter the "one-dimensional" application of science, by incorporating the notion of potentiality into its investigations, so that science is not separated from values, but finally shows society that it is possible to translate social values into technology, rather than denying the validity of value-considerations all together. It remains up to society to decide what those values are. Marcuse didn't offer much more suggestions on how the society will accomplish this.

Conclusion

Marcuse's critical theory of science provided a different answer than Longino with respect to both my questions I asked in the introduction. While Longino has argued that science cannot live up to its own standards in principle, leaving room for socially irresponsible theories and applications, Marcuse's arguments have shown that if science strictly follows its own standards, it cannot be socially responsible. Even more, he argues that science, by virtue of its own value-free concepts and methods, is an instrument for social domination.

The dialectical approach to reality, combined with the actual achievements of science and technology, provide for Marcuse the hope that the potential of a liberated society can once be realized. Science could translate values into technical tasks, so that science and technology is finally linked to ends of human liberation rather than domination. Unfortunately, Marcuse's account did not provide any further clues as how to realize these hopes.

Marcuse's notion of potentiality is what Lacey describes as "unrealized possibilities". I found his link of science and the "modern values of control" much more vague than Marcuse's link of science and social domination, and I think that formulating the problem in terms of different values ignores the ethical crisis Husserl and Marcuse pointed to. Nonetheless, Lacey made some very important points. He argued that in principle multiple approaches are possible, resulting in different kinds of applications, which can serve different kinds of social interests. Which approach is chosen must therefore depend on values, for they provide the criterion for what will be the best choice. Such values cannot be only scientific or cognitive

values, since applications of science are always related to a social context. With respect to my questions, Lacey would say that science is value-free in the sense that its methods and concepts are value-free, but that human values must play a role in scientific research. As to the social responsibility question, Lacey shows that value-free methods do allow for applications which are socially irresponsible, since other approaches than the materialist approach, which take social life and environment into account, are not even considered. The interesting conclusion we can draw from Lacey is that there is a possibility for science to be autonomous in the value-neutral sense. This is because it could adopt as many different approaches as possible in its repertoire, each linked to different value complexes.

Part Four: Conclusion

Remember the three problems associated with commercializing the sciences, mentioned by Kunneman, namely that it becomes difficult to maintain:

1. The epistemic autonomy of science (scientific integrity).
2. Academic culture (academic freedom, the freedom to criticize and engage in public issues).
3. The social responsibility of science (to which we may add the popular idea that scientific progress causes social progress).

To solve these problem, it has been proposed that scientific autonomy needs to be restored. My question was whether this should be an autonomy based on the value-free ideal, for it seemed questionable whether value-freedom can coincide with social responsibility and social progress. Indeed, at the end of Part One, we have seen that the traditional institutional autonomy of science, based on value-freedom, is designed to protect (1) and (2), but not (3). Social responsibility might be a goal in scientific applications, but autonomy demands that it cannot be an explicit goal of scientific institutes, for it would threaten (1) and (2). However, this does not give any definitive answer. I therefore posed two further questions, namely, whether science can be at all value-free, and whether it can be socially responsible as such.

To answer these questions, I investigated two kinds of critique of value-freedom. They each address different aspects of the idea of value-freedom, as it was outlined in Part One. The first critique I presented came from the feminist philosopher Helen Longino. She criticized the value-neutrality thesis on the ground that epistemological and social values cannot be kept strictly separated. The position of Longino, which she called “contextual empiricism”, addresses all three issues mentioned by Kunneman.

With respect to my questions, Longino tried to show that science cannot be value-free, but as long as we maintain that it is, it may go unnoticed that socially irresponsible goals can seep into scientific research. Longino’s positions depends on the argument that background assumptions of scientists remain implicit, while they influence theory acceptance,

sometimes to a large extent. She argues that we should therefore valorize science in a way that it can still produce reliable knowledge of nature, and be socially responsible. This can be done by improving and protecting what Kunneman termed *academic culture*, creating a free space where the goals and values of science can be critically discussed and agreed upon by both the public and the scientific community. In the way that Longino herself formulated the problem, her claim is too strong. Science seems capable of keeping its integrity by following its own standards, so Longino's proposal for valorization would seem unnecessary. However, considering the insights of Marcuse and Lacey, Longino's proposal for valorization becomes very reasonable if we want to consider a socially desirable alternative for commercialized science.

The second critique I presented, comes from the critical theorist Herbert Marcuse. His critique is on a deeper level of abstraction than Longino's analysis. Marcuse is, much more than Longino, radically skeptical about traditional conceptions of truth and science. He criticizes the nature of scientific knowledge on the ground that it is not really detached, disinterested knowledge, but rather instrumental knowledge. Marcuse means that the possibilities for practical action in the form of manipulation and control, are already implicated in the concepts and methods of science. This knowledge is revealed by Marcuse as pure *means*, which are not only tied to the ends set by society, but tied to the specific ends of social control.

Marcuse's insights provide an answer to both my questions. He accepts that science is value-free, but by being value-free, science cannot fulfill the social role which those who adhere to the modern idea of *scientific progress* attribute to science (see: Introduction). According to Marcuse, scientific knowledge is essentially about instrumental control over nature, which can be used either for social liberation or domination. Science is mainly used for the latter, because, by virtue of its value-free metaphysics and epistemology (see: Part One). The latter two require that science abstracts from the social context in which it is done and suppresses the notion of *potentiality*, which it sees as belonging to the realm of subjective values. Potentiality, as it is explained by Marcuse, and also by Lacey, is a notion which does justice to the dialectical relationship between material properties of natural objects and the social circumstances in which, (and by virtue of which) those properties are used for human

practical purposes. Marcuse's notion of potentiality is what Lacey describes as "unrealized possibilities", which can only be discovered and realized when we don't abstract objects from their social and ecological contexts. These are possibilities which refer to human practice under desirable social conditions. They can be *actualized* under different social circumstances than those of the current society, and are more in agreement with socially responsible and progressive aims. By separating itself from values, science can only identify possibilities related to the interests of the status quo. These interests aim at producing material wealth by exploiting human and natural resources through effective technological control, at the expense of other social goals which aim at transcending the status quo.

The importance of Marcuse's arguments is that they show that with respect to the issue of socially progressive aims, it doesn't matter whether we have a commercially valorized science or an autonomous science in the traditional sense. In order for science to be socially responsible, let alone socially progressive, it cannot remain value-free, but must be valorized at some point. But it must be valorized with human values relating to emancipatory goals, and not with the value of money.

Lacey provides a more nuanced answer to my questions than Marcuse. He would say that science is value-free in the sense that its methods and concepts are value-free. This does not mean that values play no role whatsoever in scientific research. As to the social responsibility question, Lacey shows that value-free methods do allow for applications which are socially irresponsible. He made the very important point that in principle multiple approaches are possible, resulting in different kinds of applications, which can serve different kinds of interests. Choosing one approach is depending on adherence to particular values, which provide the criterion to choose.

Interestingly, Lacey has shown that it would be in principle possible for science to maintain its autonomy with respect to society. If multiple approaches are possible, science could present all approaches it can think of, and the different kinds of practical possibilities which relate to different values, among which the emancipatory values proposed by Marcuse. In this way science could be value-neutral, at least on some theoretical level. Since some kinds of approaches cannot coincide in the same research, a choice needs to be made at some point in research, depending on the desired kind of application. So values need to play an

explicit role in scientific research, since they function as criteria for which approach needs to be pursued for which kind of application.

To conclude, science cannot be value-free and at the same time be used to pursue socially progressive aims. If a new science is to be developed to address social issues “irrespective of commercial gain”, then obviously, some amount of autonomy for science from our capitalist society and its politics is needed. Scientific autonomy should thus receive a new meaning, for it should ensure academic freedom, rather than value-freedom, at least where applied research is concerned. The line between fundamental and applied is hard, perhaps impossible to draw, but to be sure, I did not intend to argue for the absurd idea of a valorized astrophysics, or a social quantum-mechanics.

All three writers gave similar proposals for solving the problem, namely linking science explicitly to values. Marcuse’s proposal to translate values into technical tasks does not necessarily contradict Lacey, ‘s proposal for science keeping open a multiplicity of approaches, linked with different value-complexes. Marcuse would find this solution unsatisfying, for he would like science to be only busy with emancipatory goals. But the difficulty of articulating and assessing these goals, or value- complexes, are discussed neither by Marcuse, Lacey or Longino. However, showing possibilities, even if they remain theoretical, which go beyond the established ways of life, and invoking these in critical discussions would be a huge improvement. The eventual choice would be that of both the scientists and the public. That is where Longino’s proposal for critical interactions between science and the public may come to be implemented.

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