

Metaphysics: Inside or Outside of Science?

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For decades, the British philosopher of science Nicholas Maxwell has been promoting a new approach to science called aim-oriented empiricism. Maxwell's basic claim is that the regular way of doing science, called standard empiricism, is untenable because it does not account for the basic general assumptions that scientists actually adhere to without acknowledgment. Standard empiricism is unable to make sense of the progress of science as it is happening. The alternative approach that Maxwell advocates, aim-oriented empiricism, acknowledges some basic metaphysical assumptions, comprehensibility, unity and simplicity as inherent parts of science itself. By including these metaphysical assumptions into science, Maxwell is looking for ways to make sense of the progress of science from a philosophical perspective. This paper challenges Maxwell's claim with the help of another new approach to science, practical realism. While the founder of practical realism, Rein Vihalemm, claims that his approach is closely related to Maxwell's views, he does not acknowledge any need for metaphysics in science.

Keywords: Maxwell, standard empiricism, aim-oriented empiricism, metaphysical assumptions, Vihalemm, practical realism

1. Introduction

The article addresses the 'classical' problem of the relationship between science and metaphysics, introducing as a new angle the possibility of metaphysics as an inherent part of science and not as something committed to stay outside of its limits. In this respect, the issue is only partly classical. The article discusses metaphysics and science but combines them in a novel way.

It is common knowledge that, throughout the course of history, science has continuously taken over problems that have belonged to the realm of metaphysics. At the same time, it is not known whether this process will continue forever or at some point science will no longer need the 'guidance' of metaphysics. Some scientists, such as Stephen Hawking, believe that for

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us this is already the state of affairs, that not only metaphysics but also the whole philosophy is done. These scientists do not seem to understand that the possibility of the end of philosophy could mark the end of science as well.

Interestingly, there are also philosophers who believe that we do not really need metaphysics or even philosophy altogether in order to make sense of science, that there can be philosophy of science without philosophy. Traditionally, the latter has been the naturalist approach to science. Naturalists aim to study science by means of applying their own method for doing that. In that case we have science studies rather than the philosophy of science, even though we keep the philosophical stance to science. Recently, the late Estonian philosopher of science Rein Vihalemm added a new interesting development in this topic, gathering these kinds of approaches under a new approach in the philosophy of science, called practical realism. While the sudden tragic death of Rein Vihalemm in summer 2015 left his new approach in an underdeveloped stage, the core of practical realism is in place and open to discussions for philosophers of science and to possible developments as a new thread of realist thought in making sense of science.

The main task of this paper is to assess Nicholas Maxwell's claim concerning the need to acknowledge metaphysical assumptions in science. This acknowledgement is the core of Maxwell's conception of aim-oriented empiricism (AOE). It is important to understand that, according to Maxwell, the metaphysical assumptions have to be part and parcel of science itself, not anything supporting science from outside of its boundaries. The approach is a critical one, arguing that naturalism and practical realism with some of its sources provide an interesting frame of reference for the criticism. By all evidence, no conclusive proof on whether metaphysical assumptions are necessary or not will be presented to make sense of science and its progress. Rather it is the case that both approaches are possible: one in which metaphysical assumptions are required and the other where they are not, a kind of philosophy of science without philosophy.

2. Understanding science without metaphysics—the practical realism of Rein Vihalemm and its background

Less than a decade ago, the Estonian philosopher of science Rein Vihalemm began developing a new approach in the philosophy of science that he called practical realism (Vihalemm 2011). Vihalemm presented the core of practical realism according to the following five theses:

1. Science does not represent the world 'as it really is' from a god's eye point of view;

2. The fact that the world is not accessible independently of theories—or, to be more precise, paradigms (practices)—developed by scientists does not mean that Putnam's internal realism¹ (or social constructivism) is acceptable;
3. Science as a theoretical activity is only one aspect of it (of sciences) as a practical activity whose main form is scientific experiment which, in its turn, takes place in the real world, being a purposeful and critically theory-guided constructive, manipulative, material interference with nature;
4. Science as practice includes a normative aspect, too, and that means, in its turn, that the world as it is actually accessible to science is not free from norms either;
5. Although neither naive nor metaphysical, it is certainly realism as it claims that what is 'given' in the form of scientific practice is an aspect of the real world. (Vihalemm 2011, 48)

If we consider metaphysical statements as positions that are not empirically testable, as Nicholas Maxwell does, then eliminating metaphysics is not emphasised here, although the wish to do so is apparent. Practical realism is not a metaphysical approach, nor is it even anything involving or accepting metaphysics in close relationship with science. Still, Vihalemm does not specifically aim to do away with metaphysics either. The task simply comes about as a natural part of practical realism so that nothing metaphysical in the above-mentioned sense is needed in order to make sense of science, to understand how science works. This is so even despite the emphasis on the normative essence of science. The normative aspect that Vihalemm has in mind is nothing metaphysical. It serves a practical purpose or, to put it differently, comes into the process of scientific research with the way how the researcher constructs the object of research. However, if a scientist doing research has metaphysical assumptions in her mind it opens a window for bringing these assumptions into science. Vihalemm seems to have overlooked this option or perhaps he did not consider metaphysical assumptions as anything normative.

Vihalemm's views concerning the role of metaphysics in science have evolved over several decades. Here it is important to explain in more detail how to understand naturalism as philosophy of science without philosophy.

¹ Hilary Putnam's internal realism involved rejecting the "God's Eye Point of View" that Putnam thought was characteristic of metaphysical realism. For Putnam, internal realism involved a commitment to the idea that truth is somehow epistemically constrained, and to some version of conceptual relativism.

The main claim of an interesting paper by Vihalemm (1993), published in *Estonian*, is simple—all scientific disciplines derive from natural philosophy. Therefore, the same should happen in science studies. A philosophy of science without philosophy claims that there is no philosophical foundation of science outside of science itself (Vihalemm 1993, 1800). This may be true but, as will be shown below, the lack of philosophical foundation of science outside of science does not necessarily mean that there is no need for metaphysical assumptions inside science. Obviously, this is not what Vihalemm had in mind at this point. It seems that Vihalemm's intention at this point was to get rid of any kind of philosophy in contemporary science. The same is perhaps not the case with his practical realism. In 1993, Vihalemm was advocating the naturalist approach to the philosophy of science. The term 'naturalist' points at something natural, something close to nature. Vihalemm argued, however, that the essence of the naturalist approach to science does not necessarily lie in its proximity to nature. Naturalism can be taken as nonphilosophical, as an attempt to study science using its own method.

As the naturalist philosophy of science aims to study science with its own methods, it seems that there must be a direct link to positivism. However, this is not necessarily the case. The naturalist approach is also against the positivist philosophy and epistemology of science. Positivism that evolved into logical empiricism did not achieve the status of empirical scientific research. It could be argued that logical empiricism aimed at discarding metaphysics, which it did not succeed in, though. It is difficult not to agree with Stephen Toulmin's observation that logical positivism simply rewrote Hume's and Mach's metaphysics into Russell's and Whitehead's symbolism (Toulmin 1969, 40).

The position of a follower of naturalism might be called 'historiographical positivism'. Her approach to the world is that of an empiricist describer. The points to consider here are the following:

1. Objects of scientific research have to be set by the a priori cognition in the sense of Kant;
2. There is the classifying-historical-descriptive type of science (from biology to the humanities) in which cognition has to be set in place after the object of research has been defined. (Vihalemm 1993, 1804)

The nonphilosophical (naturalist) philosophy of science can work with the latter type of science but it cannot work with the former. The type of cognition that corresponds to the first point is characteristic to physics-like sciences, i.e., physics and the part of chemistry that deals with the laws of nature. The researcher does not have a direct connection to reality here as it is

mediated by a construction created by the scientist herself. A philosophical account is needed in order to make sense of this type of science.

The nonphilosophical (scientific) theoretical knowledge of the second type presupposes the empirical experience, while preserving the latter presupposes the theoretical.

By all evidence, this is the difference between the two types of science that motivated Vihalemm to put a question mark at the end of the title of his paper, actually asking whether it is possible to have a philosophy of science without philosophy (Vihalemm 1993). The answer is that it is only partly so. Only the classifying-historical-descriptive type of science acknowledges the naturalist philosophical approach. No metaphysics is required here. Thus, it is quite different, from the first type of science that requires priority of cognition over the object.

There is a wish to study science by applying its own method, which is possible if we are interested merely in the statistical part of the sociology of science. If we need to understand what science is and how it works, however, we are back into philosophy in a quite traditional sense. There is a place for the science of science on the academic landscape but this does not mean that philosophy of science is finished. Science keeps developing. Therefore, we need to keep asking the question what is this thing called science and correcting or fine-tuning the answers.

3. Metaphysics or methodology?

The aim of this paper is not to prove conclusively that we do need metaphysics in order to make sense of science, to account for its success, but rather to assess the claim of Nicholas Maxwell that some metaphysical assumptions have to be part of science and to compare Maxwell's views to the practical realism of Rein Vihalemm. The latter himself believed that his approach is sufficient to account for the success of science at least as well. It is a claim of special interest, however, that Vihalemm considers Maxwell's understanding of science, his AOE, closer to practical realism, despite the different attitude to the need for the metaphysical assumptions in science. This issue will be addressed below in more detail.

According to Maxwell, AOE emerges as a solution of a dilemma. He spells it out as follows: In order to proceed in improving knowledge we must make some assumption about the ultimate nature of the universe. In order to proceed successfully we must make an assumption that is near enough correct. If our assumption is wrong then it would be difficult to discover the basic mistake (Maxwell 1998, 6). It may be not obvious to speak about a dilemma here but this is how Maxwell puts it.

AOE, according to Maxwell, emerges as follows: First, we need to make explicit the cosmological assumption that may be regarded as being implicit in our current methodology and then extract from here a hierarchy of increasingly attenuated metaphysical cosmological assumptions concerning the comprehensibility and knowability of the universe (Maxwell 1998, 6). Bringing in the idea of a hierarchy of assumptions justifies the term 'aim-oriented'. The goal is to arrive at assumptions which are such that doubting them cannot help the growth of knowledge (Maxwell 1998, 6). Thus, Maxwell is aiming at ideal assumptions, such that need no longer be corrected.

For several decades already, Maxwell has criticised the current approach to science that he calls standard empiricism (SE). Maxwell says that SE is untenable because of the requirement that nothing should be taken for granted in science if there is no empirical evidence for that. "The collapse of standard empiricism means that it is impossible to do science without some permanent assumption about the nature of the universe being made independently of empirical considerations" (Maxwell 1998, 4). According to Maxwell, this is the 'official' claim of scientists that does not hold true in reality. Maxwell believes that some metaphysical assumptions are always applied by scientists but not knowingly. Normally, scientists consider that the world is comprehensible and they prefer unified theories over disunified ones as well as simple theories over more complicated ones. Thus, metaphysical assumptions are argued to be present in science and they have to be given credit. Acknowledging the metaphysical assumptions in science is the core of Maxwell's AOE, his new understanding of science in which metaphysics has a 'natural' place as an inherent component of science itself, not outside of it.

Here a question could emerge whether the metaphysical assumption of comprehensibility precedes the goal of preferring unified theories or it derives from the desire to avoid disunity. This issue is not clarified in Maxwell's works. However, it looks as if the assumption of comprehensibility is prior to everything concerning scientific research. How to understand this difference seems to be a major challenge. How to make sense of the distinction that is very important to Maxwell, namely that the metaphysical assumptions he advocates are not outside of science but its immanent ingredients? Perhaps, analysing the few critiques of AOE that are available would help to determine that.

Somewhat surprisingly, Maxwell's AOE has not attracted too much attention among philosophers of science. Still, some critical approaches towards it are available. The most notable ones were presented by David Miller and F. A. Muller. Miller briefly addresses the question of the metaphysical assumptions, saying that neglecting the disunified theories has nothing to

do with presuming any kind of metaphysical assumptions, just like excluding God hypotheses does not mean that science makes a big assumption of atheism (Miller 2006, 92). Obviously, science does not make such an assumption and does not need to. At least this is the general perception. However, the validity of Miller's comparison can be challenged. One could claim that science does not aim at saying anything about God in any respect. However, it aims at making claims about reality. The latter appears in a different way depending on whether we consider the option that it can be adequately described by disunified theories or not. Thus, making assumptions about empirically testable reality becomes part and parcel of the activity called science. God hypotheses are and have to be out of science. Any assumptions that refer to the power of science to make sense of empirical reality, however, remain inside it.

Maxwell has his own response to Miller's criticism, of course. By giving it, Maxwell actually contradicts himself, countering David Miller's criticism with an example of a disunified theory which has been given attention in science—namely, a rival to the Newtonian theory presented by Maurice Levy in 1890 (Maxwell 2005, 188). Such a counterexample proves that some disunified theories are given attention by scientists and therefore there is no persistent metaphysical assumption that only unified theories fit in. Maxwell acknowledges this. This position contradicts his own view that a persistent claim for preferring only unified theories is permanently present in doing science. It is true that normally unified theories are preferred. However, the episode in the history of science concerning the theory of Maurice Levy shows that David Miller is quite erroneous in saying that disunified theories are totally excluded from science. Therefore, the comparison with God hypotheses does not quite hold.

F. A. Muller (2004; 2008) has given much more attention to Maxwell's idea of the necessity of metaphysics in science. As the title of the second, lengthier paper suggests, Muller's priority is defending constructive empiricism rather than criticising Maxwell's AOE. Muller's criticism is rich in analytic detail. Muller's final conclusion is that science really makes permanent assumptions about the universe but these do not belong to metaphysics as they are strongly dependent on the results of empirical research (Muller 2008, 155). Muller is ready to call the assumptions Maxwell has pointed out methodological and he is not alone in this observation. For instance, Kenneth Westphal shared this view during his open discussion with Maxwell at the 2013 conference in Tallinn that the author had the chance to witness.

In order to give an assessment here, it is worth reminding what is normally meant by methodology. The term applies to the basis or underpinnings of doing research. Sometimes, somewhat mistakenly, also to a set of

methods that are used to do research. Methodology can be understood as a philosophical discipline but it is also directly connected to empirical experience. This gives the understanding of methodology good justification to what F. A. Muller and Kenneth Westphal are attributing to Maxwell. Thus, Muller is actually claiming that the assumptions that Maxwell understands as nontestable can still be submitted to empirical control, although in a mediated way.

The latter may make sense if one asks whether it is possible to claim that any metaphysical statement ever has been immune to the impact of the results of empirical research. This can be done if one remains strictly inside the realm of theoretical philosophy not admitting any empirically testable statements. Science as a practical process, however, can hardly contain any elements that are not influenced by empirical experience. Does this mean that there cannot be any metaphysics in science in principle? This question will be revisited below when comparing Maxwell's views with practical realism. Given the assumptions that are at stake, namely, comprehensibility, unity and simplicity, is it not a little too abstract for methodology? Metaphysics looks a more appropriate term in this respect.

Recently, Maxwell himself has given a detailed overview of the criticisms together with his answers to the critics (Maxwell 2015). In the corresponding paper, he manages to single out altogether sixteen objections to the argument that persistent acceptance of unified theories means that physics makes a substantial metaphysical assumption about the universe (Maxwell 2015, 13–14). For obvious reasons, they all cannot be analysed in detail here. The most controversial point seems to be the one about there being endlessly many empirically more successful disunified rivals to the accepted unified theories that can be concocted. Maxwell may be right about the possibility of concocting (endlessly) many disunified rivals that are empirically more successful than the accepted unified theory. However, being unified is not the only and perhaps even not the most important reason for picking the theories that achieve prominence in science. Maxwell points out that we can concoct as many equally empirically successful but disunified rival theories as we please by modifying any accepted fundamental physical theory for some as still untested predictions only (Maxwell 2015, 14). This is true. However, the question remains whether not accounting for all these disunified rival theories means that scientists are making a metaphysical assumption in favour of unified theories. It may well be that they rather follow the principles of comprehensibility and simplicity simply for pragmatic reasons, i.e., to make the research process smoother and better comprehensible in itself. Actually, this seems to be exactly what Maxwell is pointing out. Only he calls these principles metaphysical assumptions. Some other philosophers, such as F. A.

Muller and Kenneth Westphal call them methodological assumptions. Is the solution to the problem of how to call them simply a matter of taste? It looks as it really is, to some extent. However, the methodological approach to any practical research can be altered. Different bases to develop research may be tried. The principles Maxwell is addressing, however, are to stay forever as inherent components in the appropriate type of science—aim-oriented empiricism. There is no way to get rid of them.

According to Maxwell, in SE scientists do not recognise the presence of metaphysics in science, although it is there. However, calling these assumptions methodological does not turn things around. If Maxwell's critique of SE hits the target then it appears that the methodological principles of unity or simplicity are not recognised by scientists either. Calling the phenomenon by another name would not eliminate the problem.

Thus, there is still a need for the change from SE to AOE even if we do not acknowledge the presence of metaphysics in science, of hypotheses that cannot be tested by the scientific method in principle or even the need for them. It is important to acknowledge that metaphysical or methodological assumptions have to be present in science as an inherent component, not as a foundation holding it or a guiding light attracting it forward. In that respect, Nicholas Maxwell has come forward with an interesting new interpretation of the essence of science even if he cannot conclusively prove the need for precisely metaphysical assumptions in science.

4. AOE and practical realism

The founder of practical realism, Rein Vihalemm, has claimed that Nicholas Maxwell's approach to science is close to his own. The issue has to be clarified in detail because there are at least two instances in which practical realism and AOE do not come close at all, at least not until quite recently.

This is how Vihalemm explains in the most basic terms the similarity of Maxwell's approach to his own: "Maxwell proceeds from science as practice in the sense that he intends to make explicit presuppositions, aims and methods which are implicit in scientific practice and thanks to which its—as an aim-oriented rational action—progress has actually been achieved" (Vihalemm 2011, 56). Vihalemm compares Maxwell's approach to science with his own practical realism-based view and observes that items 1, 2, 4 and 5 (see above) of his main theses of practical realism are all important to Maxwell. It is just the third thesis, the one addressing the essence of scientific experiment that traditionally has been not interesting to Maxwell. One can claim, of course, that four out of five would not save the day if it is the most focal one from the practical point of view that is missing.

Vihalemm, however, chooses a more general approach. In this context, neglecting to mention the experiment by Maxwell does not matter that much. Vihalemm observes that Maxwell's criticism of SE meets with approval in practical realism. Still, in practical realism the question concerning metaphysics does not come up as a dilemma between SE and a viewpoint that involves metaphysical assumptions. According to Vihalemm, this dilemma is due to Maxwell's traditional approach that is based on the Popperian distinction between scientific and metaphysical statements, the former ones being empirically testable and the latter ones being out of reach of empirical research by definition (Vihalemm 2011, 57–58). Practical realism, however, rather adheres to Joseph Rouse's understanding of how scientific cognition works:

We are already engaged with the world in practical activity, and the world simply is what we are involved with. The question of access to the world, to which the appeal to observation was a response, never arises. The important categories for characterizing the ways the world becomes manifest to us are therefore not the observable and unobservable. We must ask instead about what is available to be used, what we have to take account of in using it, and what we are aiming toward as a goal. (Rouse 1987, 143)

In practical realism, as well as in Rouse's approach, science is not construed abstractly as a system of knowledge. It is understood as a practical activity (Vihalemm 2011, 58). Maxwell, however, adheres to the traditional distribution of the world into observables and unobservables. As the unobservables are out of reach of empirical testing, without this distinction, our current question about metaphysical assumptions can never arise.

As metaphysics is about the nontestable, the unobservables are important for our current analysis. They are important from the point of view of Maxwell's AOE. Rein Vihalemm, on the other hand, did not see the need for metaphysics in science. He believed that there is no need for accounting for metaphysics while trying to make sense of science in any respect, neither something that lies outside of the limits of science nor as its inherent part. As indicated, the understanding of Joseph Rouse is the same in this respect. The positions of Rouse and Vihalemm are well argued. However, the big question remains. How to account for the nonempirical beliefs a scientist encounters while doing research? From Vihalemm's point of view, this is perhaps the normative part of science. But even if so, the unobservables are still there.

Connecting to practical realism an approach that disregards the scientific experiment may seem unusual. The latter is obviously central in the practical realist approach. Scientific experiment was out of Maxwell's focus until 2015. Ever since, Maxwell has suddenly started to use the example

of the experiment to give more ground to his position concerning the empirical justification of physical theories. After all, it is not possible to avoid addressing the experiment in the context of our main problem. Maxwell is certainly right in claiming that experiments in physics are often difficult to perform correctly (Maxwell 2015, 15). The initial results of the experiments often clash with the predictions of accepted theory. In other words, the initial results sometimes refute accepted theories. The theories, however, are rarely questioned. These are normally the results of the experiments that are rejected. Something in the setup of the experiment will be adjusted until the outcome fits the theory. Of course, scientists do not always operate in this manner but the pattern is visible. It is hard to counter Maxwell's statement "If physics gave equal weight to unified and disunified theories, experiments would persistently favour the latter" (Maxwell 2015, 16). Therefore, according to Maxwell, even the analysis of the experiment supports the idea of the presence of permanent metaphysical assumptions in science that are not noticed in SE but will be acknowledged in AOE.

We must also consider that the role of experiment has been changing for quite a while already (Mürsepp 2012). Today, we cannot adhere strictly to the repeatability requirement. We still manipulate nature while experimenting but we have started to recognise the difficulty concerning obtaining the same or sometimes even similar results for several times. These changes do not diminish the role of the experiment in practical research. We just need to correct our understanding of the experiment.

The situation concerning empirical research can be interpreted as nature telling the physicists that it is more complicated than their theories claim. Maxwell claims that the physicists refuse to listen to this call (Maxwell 2015, 15). This, however, is just partly true. Quite obviously, most of the physicists are very well aware of the situation, i.e., of the limited power of physical theories. The theories rather just form a limiting and guiding framework that help to develop the experimental dialogue with nature. It is worth reminding what Rein Vihalemm lists as the third point of the practical realist 'manifesto'. The experiment is theory-guided but at the same time it is a constructive and manipulative interference with nature. The experiment takes place in the real world. The theory is born in the head of the scientist. It can have only a remote connection to the real world. Does this mean that there are no theories in physics, that the latter is a practical activity by definition and the theories belong to metaphysics altogether? In reality, however, it is not the case that there is no theoretical physics and everything nonexperimental is called metaphysics. Also, physical theories can hardly be classified under methodology as they are more narrowly limited to specific subfields of research.

This brings us back to the question of what is the real meaning of Maxwell's advocating the need to introduce metaphysics into science. The theories are in science anyway and there is no obvious need to call them metaphysical because, at least ideally, they can be empirically tested. However, this is clearly not enough for Maxwell. The question is about giving preference to some type of theories over the others. As scientists themselves are doing this this process obviously takes place in science. However, giving preference to unified theories over disunified ones and simple theories over more complicated ones is not necessarily anything metaphysical. It can well be understood as a practical principle along the lines of the approach of Joseph Rouse (see above). The activity could be even called following a certain methodology, if we wish. This seems to be F. A. Muller's perspective to the issue.

It seems that we have managed to narrow down the question of difference between the methodological perspective of F. A. Muller (and Kenneth Westphal) and the metaphysical perspective of Maxwell. The former relies on the connection between the most general assumptions and empirical research. If the assumptions are methodological then they are, at least to some degree, remotely testable. Maxwell's metaphysical assumptions, however, are not testable by definition in the classical Popperian sense. Still, they are something that are carried along with science unknowingly in SE but knowingly in AOE. Thus, recognising the methodological (but not metaphysical) general assumptions in science does not enable us to leave SE behind and accomplish the decisive turn to AOE. According to Maxwell, acknowledging the need for metaphysical (nontestable) components in science is crucial for this important change.

It may look as we are left with just one very general assumption that is not science and perhaps not methodology as well—namely, the belief that the universe is comprehensible. It is really something that any researcher has to believe in. Otherwise, what is the point of doing research if we are not able to make any sense of the results? This is really something that every researcher presumes, either consciously or not. In this sense, we can agree that metaphysics is always present in science. However, this idea has little depth as it would mean something like 'metaphysics is always with us anywhere,' a tautology. But the claim is definitely not a tautology for Maxwell as the whole practical usefulness of empirical scientific research depends on recognising the claim of comprehensibility. In the latter sense, acknowledging the comprehensibility of science plays the role of a guiding light for science but in a still different way compared to the traditional understanding of the role of metaphysical claims. Among the latter, there are such that have become empirically testable over time. Comprehensibility of the universe can never be

testable in principle. However, it makes a difference whether the researcher has to presume the comprehensibility of the universe before starting to come forward with research hypotheses or she does so in the course of practical research. For Maxwell, the latter is the case. The researcher has to have the confidence of the universe being comprehensible while she is engaged in practical research. Maxwell argues that this means acknowledging metaphysical assumptions in science. Rein Vihalemm, who seconds to Joseph Rouse, claims that we cannot engage in practical research at all if we do not presume the possibility to interact with the real world (Vihalemm 2011, 58). There is no reason for the researcher to presume anything. The possibility to interact is simply there, in the way metaphysical assumptions are present in SE but are not acknowledged by the researcher. But, according to Maxwell, they have to be accounted for, i.e., the researcher has to move over to AOE.

After all, there is a need to specify what it means to have metaphysics in science. It may well be that the only way to understand the position is to recognise the practice of science in the sense of Joseph Rouse. We engage in problem-solving by applying the scientific method and, while experiencing a dialogue with nature, recognise the constant need to believe in the comprehensibility of the universe. Is it metaphysics or methodology? Possibly neither. It may be simply a practical principle that enables practical realism to rule.

Now, it may seem that the difference between AOE and SE as characterized by Nicholas Maxwell is indeed very small. Science as SE works and includes a small amount of metaphysics but the scientists themselves do not notice that. Science as AOE involves scientists who acknowledge that they have some (at least one) metaphysical assumption that does not really influence their work, as they would conduct their research in the same way anyway. After all, this single principle perhaps need not be called a metaphysical assumption at all.

However, as might be expected, Maxwell has more to offer. Giving preference to unified theories can be connected to the quest for explanatory theories. Such quest need not presume anything metaphysical (Vicente 2010). In his response to this observation, Maxwell suddenly introduces the issue of physics seeking truth. If so, then it is really legitimate to claim that disunified theories are considered false by physicists. Still, Maxwell recognises that in some contexts that he calls purely theoretical, physics might aim at explanation and not put truth to the foreground (Maxwell 2015, 17). Obviously, it is easier to explain the world based on unity than disunity. Under such circumstances, however, it is not necessary to call disunified theories false.

Maxwell claims that unified theories and also laws are accepted in preference to more empirically successful disunified rivals in contexts where truth does matter, such as building bridges or designing aeroplanes (Maxwell 2015, 17). Truth does matter here to the extent that empirical predictions have to be true.

This is a position that practical realism would not accept, at least not in the terms of some kind of general theoretical truth. However, the example of bridges and aeroplanes could be accepted by practical realists from the point of view of explanatory truth. Still, this is not the truth that practical realism is after but rather practice as such from the perspective of solutions that work but also facilitate our connections to the world. This view is very close to the Marxist understanding of practice. This resemblance has been fully recognised by Vihalemm but is perhaps not important to Maxwell.

While introducing practical realism, Vihalemm gives real credit to Marx's understanding of practice. Interestingly, there is also a connection to Maxwell's view, although a somewhat remote one. According to Vihalemm, Marx has been interpreted too superficially in this respect. Karl Marx's understanding of practice is not a trivial notion adhering to the everyday activity of humans. It is a reference to human interaction with reality and therefore very important from the point of view of making sense of scientific research. For example, in the very first thesis about Ludwig Feuerbach Marx writes:

The main defect of all hitherto-existing materialism—that of Feuerbach included—is that the Object [*der Gegenstand*], actuality, sensuousness, are conceived only in the form of the object [*Objekts*], or of contemplation [*Anschauung*], but not as human sensuous activity, practice [*Praxis*], not subjectively. Hence it happened that the active side, in opposition to materialism, was developed by idealism—but only abstractly, since, of course, idealism does not know real, sensuous activity as such. Feuerbach wants sensuous objects [*Objekte*], differentiated from thought-objects, but he does not conceive human activity itself as objective [*gegenständliche*] activity. In *The Essence of Christianity* [*Das Wesen des Christenthums*], he therefore regards the theoretical attitude as the only genuinely human attitude, while practice is conceived and defined only in its dirty-Jewish form of appearance [*Erscheinungsform*] ... (Marx 1845)

Even more importantly, Marx emphasises in the second thesis:

The question whether objective truth can be attributed to human thinking is not a question of theory but is a practical question. Man must prove the truth, i.e. the reality and power; the this-sidedness [*Diesseitigkeit*] of this thinking, in practice. The dispute over the reality or non-reality of thinking which is isolated from practice is a purely scholastic question. Marx (1845)

Obviously, the Marxist understanding of practice is an important source of practical realism. What is the connection to AOE, one may wonder. It would perhaps be difficult to track down a close connection, although the emphasis on practice is definitely important in the thinking of Maxwell. In the last thesis of Marx about Feuerbach, however, we find the same aim in Marxism and in Maxwell's approach that develops upon AOE. It is the idea that describing the world is not enough. The world has to be changed (Marx 1845). Unfortunately, the attempts to change the world according to the Marxist principles did not produce favourable results in the long run.

Does this mean that following Maxwell's call for a revolution in the academia is doomed as well? Obviously, it is too early to say. Maxwell has been calling for a revolution in the academia or wisdom revolution in several of his works. A successful wisdom revolution presumes AOE that has to be developed into aim-oriented rationality (Maxwell 2010). After all, Maxwell's revolution would be much smaller than the Marxist one, as it applies only to a segment of society, the academia. In the end, however, Maxwell calls for changing the whole world as the result of a better, more reasonable organisation of the academia that should produce results of scientific research that really help in resolving the real problems that humanity is facing. In that respect, both Marx and Maxwell share the idealist dream of contributing to the wellbeing of humankind by means of introducing a new proper philosophy.

Rein Vihalemm is looking for a new proper philosophy as well, but only as far as making sense of science is at stake. There is no idealist hope of changing the whole world to the better here. However, we cannot deny the influence of proper understanding of science to making sense of research results that may benefit our everyday life.

It seems that we have lost sight of metaphysics for quite a while. To some extent, this is perhaps really so. However, we have not lost sight of practice. After all, on the one hand, Maxwell's AOE is an attempt to reconcile metaphysics with the practical approach to science. On the other hand, the practical approach to science needs some inner framework to hold it together. The idea of Maxwell is that this cannot be done from the outside. Science as a practice has to be glued together from inside.

The practical approach to science brings together AOE and practical realism. The latter leaves any kind of metaphysics out of the picture. Vihalemm kept adhering to his naturalist attitude to the study of science and while it may be enough for making sense of science, it is not enough for guiding it further. According to Maxwell, metaphysics is necessary for fulfilling the latter role. To be more precise, there have to be nontestable assumptions in

science that guide it further. The traditional role of metaphysics is preserved but it is positioned differently.

5. Conclusion

Nicholas Maxwell and Rein Vihalemm share a similar approach to science. Science is a practical activity that enables us humans to have an ongoing dialogue with reality that yields quite special results. Knowledge that we obtain as the result of scientific research into nature or society is the most reliable information about the world out there. Still, we cannot be content with obtaining just knowledge. This knowledge has to be useful. It has to help us in solving real problems of living, as Maxwell calls them.

The article's focus has been on assessing the need for metaphysical assumptions in science. According to Maxwell, we need them for the purpose of making sense of the progress that science is making. According to the practical realist approach of Rein Vihalemm, however, nothing metaphysical is needed in science. We can make perfect sense of the progress of science if we understand the practical nature of science properly and account for its normative essence.

In conclusion, we have good reasons to believe that nontestable claims are present in science and have to be accounted for. Therefore, we cannot do away with metaphysics completely. Science does include metaphysical assumptions and it is better to acknowledge them. AOE is nothing magical but it is a more adequate approach to making sense of science than SE is. The difference with practical realism remains. However, as the latter is not a fully developed view, nothing conclusive can be said about it at this point. Recognising the normative component in science may lead to the recognition of the metaphysical component of science after all. Still, this is a topic of future research into the matter.

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