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PRESUPPOSITIONS OF (HUMAN MOVEMENT) SCIENCE[1]

LAS PRESUPOSICIONES DE LA CIENCIA (DEL MOVIMIENTO HUMANO)

AS PRESSUPOSIÇÕES DA CIÊNCIA (DO MOVIMENTO HUMANO)

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ABSTRACT

Van Woudenberg, R. (2017). Presuppositions of (human movement) science. **PENSAR EN MOVIMIENTO: Revista de Ciencias del Ejercicio y la Salud, 14**(2), 1-16. This paper argues that science, human movement science included, proceeds from many presuppositions. First, it explains what sorts of things presuppositions are. Next, it argues that science proceeds from metaphysical, epistemic, and normative presuppositions. The argument entails that neither scientism nor Naturalism is a presupposition of science.

Keywords: Philosophy; philosophy of science; epistemology; metaphysics; naturalism; scientism; philosophical analysis

RESUMEN

Van Woudenberg, R. (2017). Las presuposiciones de la ciencia (del movimiento humano). **PENSAR EN MOVIMIENTO: Revista de Ciencias del Ejercicio y la Salud, 14**(2), 1-16. Esta ponencia argumenta que la ciencia, incluyendo la ciencia del movimiento humano, procede a partir de muchas presuposiciones. Primero explica qué clase de cosa son las presuposiciones. Luego arguye que la ciencia procede a partir de presuposiciones metafísicas, epistémicas y normativas. Este argumento implica que ni el cientificismo ni el naturalismo son una presuposición de la ciencia.

[1] Original submission in English. Also available in the Spanish-translated version in this journal.

Palabras clave: filosofía; filosofía de la ciencia; epistemología; metafísica; valores; Naturalismo; cientificismo; análisis filosófico

RESUMO

Van Woudenberg, R. (2017). As pressuposições da ciência (do movimento humano). **PENSAR EN MOVIMIENTO: Revista de Ciencias del Ejercicio y la Salud, 14**(2), 1-16. Este artigo argumenta que a ciência, incluindo a ciência do movimento humano, procede a partir de muitas pressuposições. Em primeiro lugar, explica que classe de coisa são as pressuposições. Em seguida, alega que a ciência procede a partir de pressuposições metafísicas, epistêmicas e normativas. O argumento implica que o cientificismo e o naturalismo não são pressuposições da ciência.

Palavras-chave: filosofia; filosofia da ciência; epistemologia; metafísica; valores; Naturalismo; cientificismo; análise filosófica

Human Movement scientists borrow from a number of established, traditional sciences such as physics, chemistry, and physiology to do their work. In doing so, they go along with their colleague scientists in making important, though often unacknowledged or unrecognized, presuppositions. This can easily give rise to an inappropriate view of what science is, even to its very practitioners. The purpose of this paper is to make a start in explicating a number of these mostly unacknowledged and unrecognized presuppositions of science. The main point that I argue in this paper is that these presuppositions are not themselves products of scientific inquiry: we don't accept them *because* they are scientifically established. Rather, in order for us to be able to do scientific research at all, we have to make these presuppositions.

We can think about presuppositions in different ways, or perhaps it is better to say that different (though related) items have been baptized with the name 'presupposition'. In the interest of clarity it is important to distinguish these with precision. The most common accounts take a presupposition to be a relation between statements. Since scientific theories can be thought of as statements, this notion of presupposition is clearly relevant when we think about science. However, at least three *different* relations between statements have been named 'presupposition'. On a first account, statement P presupposes statement Q when the following is the case: if Q is false, then P is false as well. "John was at home this morning" presupposes that "Somebody was at home this morning". For if the latter statement is false, then so is the former. I call a presupposition of this sort an a-presupposition. On a second account, P presupposes Q when the following is the case: if Q is false, then belief in, or acceptance of, P would no longer be justified or warranted. If someone bases his belief that "Susan is an insecure person" on the basis of the outcome of a Rorschachtest, the statement that "the Rorschachtest is a reliable test for personality traits" is a presupposition of that person's belief. For if the latter proposition is false, belief in the former proposition is no longer justified or warranted—but it does not entail the falsity of the former proposition. I call a presupposition of this kind a b-presupposition. On a third account[2], P presupposes Q

[2] This is the way Strawson (1950) explains the notion.

when the following is the case: if Q is false, then P is neither true, nor false. To use a classic example: “The present king of France is bald” presupposes “Presently France has a king”. If the latter is false, then the former is neither true nor false. If the former is to be either true or false, the latter must be true. If “The present king of France is bald” is to be true or false at all, “Presently France has a king” *must* be true. And if “Presently France has a king” is false, “The present king of France is bald” is neither true nor false. I call a presupposition of this kind a c-presupposition.

However, the notion (or rather notions) of “presupposition” is used not only in relation to statements, but also in relation to *activities*. Activities can be said to have presuppositions as well. Since doing scientific research clearly is an activity, this notion of presupposition is relevant for present purposes as well. Some statement P is a presupposition of an activity provided one cannot sensibly engage in the activity and deny P. The statements that are the presuppositions of an activity needn’t be explicitly endorsed, or self-consciously believed. It may even be that those who engage in the activity have never so much as given those statements a thought. What makes it the case that a particular statement is a presupposition of a particular activity is this: one cannot sensibly engage or continue to engage in the activity that has statement P as its presupposition, while explicitly denying that P is true. It is, in some sense, *incoherent* for someone to knowingly engage in an activity that has P as its presupposition, and yet explicitly deny P. Some examples will clarify the point. The activity of playing tennis has as one of its presuppositions the statement that balls can be hit by means of rackets. What this means is that it is, somehow, incoherent to play tennis and yet explicitly deny that balls can be hit by rackets. The activity of making someone a promise presupposes the statement that promises ought to be kept. What this means is that it is, somehow, incoherent to make someone a promise and yet explicitly deny that promises ought to be kept. Likewise, the activity of doing science has a number of presuppositions; this means that we cannot coherently engage in scientific investigation and yet deny certain statements—the statements that are science’s presuppositions. I call presuppositions of this kind d-presuppositions.

The presuppositions of science fall in three broad categories. There are, first, metaphysical presuppositions, i.e. presuppositions *about the world*. There are, second, broadly epistemological presuppositions, i.e. presuppositions *about our abilities to investigate the world*. And thirdly there are normative presuppositions, i.e. presuppositions *about what ought and what ought not to be done and about what is good and what is bad while doing science*. For each of the items that I will argue are presuppositions of science I will indicate of what kind they are: a-, b-, or d-presuppositions (in the interest of space I will forego discussion of whether the items are also c-presuppositions.)

My discussion doesn’t claim completeness, as science has more presuppositions than I will be able to discuss or even to mention.

Metaphysical Presuppositions

Metaphysical presuppositions are presuppositions *about the world*. In this section I discuss two such presuppositions of science: (1) that the world displays

order, and (2) that truths about the world exist independently of their being known or believed by humans.

1. Our world is an orderly world. When we do science, we must presuppose that the world that we study is an orderly world, that it displays patterns of regularity and constancy. The world here and now, we presuppose, behaves in ways that are identical to the ways it behaves at other places as well as in the past. This presupposition lies at the basis of the many inductive procedures that we use in science. Of course, prior to investigation, we don't know *what* is regular and constant in nature. But we do and must presuppose *that* nature (or at least much of it—we must leave space for randomness) is regular and constant if we are to do science.[3]

To see this, suppose we didn't make this assumption. Suppose, for instance, that we didn't assume that human muscles, in similar conditions and similar contexts would behave similarly. Then we could not arrive at general conclusions about the behavior of human muscles. But we *do* arrive at such general conclusions. And we arrive at them through induction: we generalize over a limited number of observations of muscular behavior, such as noticing that repetitive, unaccustomed eccentric contractions damage muscle fibers causing inflammation and delayed-onset muscle soreness, and conclude to something that holds for all muscles. But this inductive step can only be made because we presuppose that the world, muscles included, is regular and constant.

A world without regularity or constancy is a world that would change from moment to moment without there being any patterns to discern in the series of changes. It is a world that would surprise us constantly. It is a world without natural laws—and laws are, of course, the icons of regularity and constancy. It is also a world in which prediction, for example the prediction that any skeletal muscle will generate tension when stimulated by a sufficiently large electric stimulus, would be impossible. But it is part and parcel of many sciences that they make predictions. In order for this to be possible, however, scientists must presuppose that the world displays regularity and constancy.

Many theists have argued that the patterns of regularity and constancy can best be understood against the backdrop of, or best be explained by reference to, God's constancy and faithfulness to his creation.[4] But whether or not one adopts a theistic account of the patterns of regularity and constancy, the belief that these patterns exist, or are real, is a presupposition of science—it is a thesis that itself is not the product of scientific investigation.

The statement that "the world is an ordered world" is a d-presupposition of science. For it is somehow incoherent to engage in research and explicitly deny that

[3] No one, to my mind, has formulated the presuppositional nature of the statement that our world is an orderly world (and hence behaves uniformly) better than the 18th century philosopher David Hume: "It is impossible, therefore, that any arguments from experience can prove this resemblance of the past to the future, since all these arguments are founded on the supposition of that resemblance. Let the course of things be allowed hitherto ever so regular, that alone, without some new argument or inference, proves not that for the future it will continue so. In vain do you pretend to have learned the nature of bodies from your past experience. Their secret nature, and consequently all their effects and influence, may change in their sensible qualities. This happens sometimes, and with regard to some objects. Why may it not happen always, and with regard to all objects?" (Hume 1748 [1965]: 51-2.

[4] Plantinga (2011), pp. 271-4.

statement. But it is also an a-presupposition of many scientific statements, especially of statements concerning what will happen in the future. The scientific statement that "next year water will freeze when the temperature sinks below 0 degrees Celsius and the air pressure is 1 atmosphere", for example, presupposes that "the world is an ordered world". For if the latter statement is false, then so is the former. That "the world is an ordered world" is, of course, also a b-presupposition of the scientific statement. For if it is false, acceptance of the scientific statement is no longer warranted or justified.

2. Truths as exist independently of any human being believing them, knowing them, affirming them, or entertaining them. Truths exist mind-independently. The truths we seek in science are truths that already exist 'out there' prior to our getting to know them through scientific investigation.[5] A statement S is true if and only if the world is the way S says it to be. The statement that "Lemons are sour" is true if and only if lemons are sour; nothing more is needed, and nothing less will suffice.[6] Of course, in order for us to *know* truths, we must exist. But in order for the truths to *exist*, our existence isn't needed.

To see this, let us engage in a little thought experiment. Suppose that through some unhappy course of events in the year 2020 no human beings exist anymore. Perhaps an atomic rain has extinguished all human life on earth. Now concentrate on the world in 2020, and ask yourself "Would there still be truths in the year 2020?" Then the correct answer would seem to be: "yes, of course! It would still be true that water evaporates in an open container, and that two heavy objects attract each other with a force that is directly proportional to the product of their masses, and inversely proportional to the square of the distance between them, etc. etc." Of course, in 2020 none of these truths would be known by anybody (excepting God and other possibly non-human intelligent beings). But this fact doesn't rob these truths of their very existence. The annihilation of humans doesn't bring with it the annihilation of all truths.

One influential way of thinking about this topic is Platonism.[7] On this view, the primary items that are true or false (or as philosophers say: the primary bearers of truth value) are *propositions*. And propositions have the following characteristics: (a) they are non-linguistic items, (b) capable of being expressed by linguistic items such as sentences, that (c) stand in logical relations to one another, and (d) are the possible objects of propositional attitudes such as belief, hope and fear. Let me explain. Propositions are non-linguistic items. They aren't, for example, written or spoken sentences. But they are capable of being expressed by sentences. By way of illustration of (a) and (b): suppose I say "I know that the earth has one moon", and

[5] It must be noted that there are also truths that, in some way, depend for their very existence on the human beings believing them. I am thinking here of social artifacts such as money and marriage. If no one would believe that certain pieces of paper, bank notes, are legal tender, those pieces of paper would not be legal tender—it would not be true that they are legal tender. If no one would believe that X and Y are married (not even X and Y themselves) they would not be married—it would not be true that they are. Searle (1995) is a landmark essay on this phenomenon.

[6] This is the classical Aristotelian conception of truth. A full development and defense of it, the realist conception of truth, is Alston (1996).

[7] See Loux & Crisp (2017): ch. 4.

that my friend says in Dutch “Ik weet dat de aarde een maan heeft”. Then my friend and I know the same thing, the same proposition, the same truth, even though the sentences we use to express what we know are entirely different. My sentence is an English sentence, his is a Dutch one. There are English and Dutch sentences; but there aren’t English and Dutch truths or propositions! That is why we can say that truths are non-linguistic items. As (c) says: propositions stand in logical relations to each other. The proposition that can be expressed by the sentence “Elisabeth has a son named John” stands in the relation of logical entailment with the proposition that can be expressed by the sentence “Elisabeth is a mother”. And it stands in the logical relation of negation with the proposition that can be expressed by the sentence “Elisabeth has no children”. Finally, as (d) says, propositions are the sorts of things vis-à-vis which we can have such attitudes as believing them, doubting them, hoping them to be true, etc. I can (and do) believe that the earth has one moon, you may hope that the sun will shine tomorrow, one may doubt that dark matter exists.

When doing science, it must be assumed that truths, i.e. true propositions, exist independent of our believing or knowing them. Unless we assume that there is a truth about what causes small pox, scientific research into the causes of small pox has no clear aim. Unless we assume that there is a truth about whether a physically active lifestyle is healthy or not, scientific investigation into the health effects of regular physical activity is pointless. Of course, prior to scientific inquiry we don’t know what the truth about these things is. But we do and must assume that these truths exist.[8]

That truths exist is, therefore, a *presupposition* of science, not a result thereof. It is a d-presupposition, for you cannot coherently engage in scientific research and at the same time deny that truth exists. It is, moreover, a b-presupposition, for if truth doesn’t exist, belief in or acceptance of no scientific proposition is justified or warranted. The reason for this is that *to believe a proposition* just is *to believe the proposition to be true*. For it just doesn’t make sense to say “I believe proposition P to be true, but truth doesn’t exist.”

Epistemological presuppositions

Epistemological presuppositions concern human knowers. I present and discuss the following two epistemological presuppositions of science: (1) that human beings are capable of knowing things, and (2) that the faculties we use in doing science are reliable.

1. We human beings are capable of acquiring knowledge. We cannot do science, unless we presuppose that we are capable of acquiring knowledge of the objects of our study. To know something, for example, to know that human hearts are partly composed of striated muscles, means to have true beliefs about the composition of human hearts that are well-founded. So, in order to do science, we must presuppose that we are capable of acquiring well-founded true beliefs about the objects that we

[8] It should be noted that in Philosophy various forms of relativism regarding truth have been proposed. In Van Woudenberg (2014) I have criticized a number of such proposals.

study.[9] In science, the way to acquire well-founded beliefs about the objects that we study is to engage in scientific investigation, observation, experimentation, etc.

Now it is theoretically possible that we are *not* capable of knowing things—*not* capable of acquiring well-founded beliefs about the objects that we study. It may be that although we form many beliefs, none of them are true or well-established. Some skeptics, for example, have argued that truth is an illusion and hence that none of our beliefs can be true. We like to claim that we have true beliefs, but these claims are no more than somewhat hidden exertions of power. When you claim that what you believe is true, what you are in fact doing is trying to force others to adopt your point of view. Unenlightened people may naively think that what they do when they claim that what they believe is true, is to say it like it is. But they are mistaken. What they are in fact doing is engaging in a battle in which what counts is not the way the world is, but how effective they are in manipulating and convincing others. I call it the Nietzschean denial of knowledge; it can also be found in the works of Michel Foucault.

Other skeptics have argued not that truth is nonexistent, but rather that none of our beliefs, even if they happen to be true, are well-founded, not even the scientific ones. The argument offered is this: it is theoretically possible that we are constantly being deluded by an evil demon who 'feeds' us with experiences of the sort that we are so thoroughly familiar with: you, reader, now have the experience of looking at a white page on which words are printed; also, you have the experience of now hearing various sounds in your environment, etc. But all of these experiences could be fake. They could be 'given' to you by an evil demon, while, in fact, there is no white page in front of you, and there are no sounds to be heard in your environment. You could be trapped in a Matrix-scenario! Now you can never exclude the possibility that you are the victim of an evil demon, or trapped in a Matrix scenario. After all, what is your evidence for thinking that these possibilities do not occur? Experiences cannot help you here—for *all* of your experiences may be 'fed' to you by an evil demon, *all* of your experiences may be included in the Matrix scenario. Science cannot help you here either. For apart from experiences we have no other sorts of evidence that can help us to decide whether or not our experiences are genuine, or not. And science is based on the experiences that humans have; there can be no science without humans who have experiences. But if we cannot exclude the possibility that we are deluded, then it follows that we don't really know anything. For then none of our beliefs is safe or certain. And it is somehow contradictory or strange to say that we know that the earth has one moon, but that we might be wrong, as we cannot exclude certain skeptical scenarios.

Now we must acknowledge that although the skeptical arguments may not compel us, they are certainly not trivial. And what we can learn from the history of philosophy is that certain kinds of skeptical arguments are well-nigh irrefutable. What this means is that we cannot establish that we are capable of knowing the objects that we investigate by doing science—we cannot scientifically establish that we are capable of knowledge! That is why I say that it is a *presupposition* of science that we are capable of acquiring knowledge. It is not something we can scientifically establish—or establish in any other way.

[9] This was acknowledged by Kuyper (1898).

That we are capable of knowledge, then, is a presupposition of science. It is clearly a d-presupposition, for it is incoherent to engage in scientific research and yet deny that we are capable of knowing anything. But it is also a b-presupposition, for if we are incapable of knowing things, belief in or acceptance of scientific theories is no longer justified or warranted.

2. A related presupposition that we have to make if we are to take science seriously, is that the faculties we use to do science, such as perception, memory, and reasoning are in the main reliable. A faculty is reliable when it gives us mostly true beliefs in those conditions in which it is meant to function. A faculty whose operation gives us beliefs, 50% of which are false, is thoroughly unreliable. If a person speaks the truth only half of the time, we would likewise deem him unreliable. How high must the percentage of true beliefs be, if the faculty that produces them is to qualify as reliable? Should that be 60% or 90% or 98%? That is very hard to say. But for present purposes we can forego this thorny issue.

There is an analogy here with the reliability of instruments that we use in research. If we are accepting the outcomes of the instruments by means of which we measure, say, blood pressure or cholesterol levels, then we are assuming that these instruments are reliable. (But there is also a disanalogy, as I will indicate in a moment).

It is a presupposition of science, I say, that the faculties we use to do science are reliable. It is a presupposition, for that our faculties are reliable is not something we can establish, not even scientifically. Any argument we can think of for the conclusion that, say, our sense perception is reliable (i.e. gives us mostly true beliefs), will somehow have to assume, somewhere down the line, that sense perception is reliable. To see this, consider the following track-record argument for the conclusion that sense perception is reliable:

P1 I perceived an ape, and there was an ape.
P2 I perceived a bear, and there was a bear.
P3 I perceived a cheetah, and there was one.
P4 I perceive a dove, and there was one.
(…).
C Therefore, perception is reliable.

This argument only establishes the conclusion when I have implicitly adopted the conclusion. After all, how can I accept the premises of the argument (esp. the second conjuncts: “there was an ape”, “there was a bear”, etc.) without in fact relying on the reliability of perception? I can only know that there was an ape, bear, cheetah, dove etc. either (i) through perception, or (ii) on the basis of the testimony of others. If I accept the premises on the basis of (i), then it is blatantly obvious that I am, in fact, relying on the reliability of sense perception—my own. But if I accept them on the basis of (ii), it is only slightly less obvious. For those who testify that “there was indeed and ape”, “there was indeed a bear”, etc. will either have to rely on sense perception—their own, or they will have to rely on the testimony of yet others who have to rely on sense perception—*theirs*.

Or consider an argument for the conclusion that the faculty of reasoning is reliable, so the faculty that enables us make inferences of the following kinds:

- John won the match, so someone won the match.
- 2176-1387=789
- if something is real, then it is also possible.
- if A finished the race before B, and B finished before C, then A finished before C.
- all humans are mortal, and Michael Jordan is a human being; hence Michael Jordan is mortal.

The argument runs as follows:

> P1 From “John won the match”, I deduce “Someone won the match”; and rightly so.
> P2 From “2176 reduced by 1387”, I deduce “789”; and rightly so.
> P3 From “This is real”, I deduce “It is possible”; and rightly so.
> (…)
> Hence, the faculty of reasoning is reliable.

However, this argument only establishes its conclusion when I presuppose that my reasoning faculty is reliable. Unless I presuppose so much, I can never derive the conclusion from the premises! Moreover, I can only accept the premises when I already trust my reasoning faculty, so prior to drawing the conclusion.

The point to make about these arguments is not that they are logically invalid. They are not! Nor is the point that they are logically circular. For an argument is logically circular provided the conclusion is already among the premises. And that is not the case here. No, the point to make about these arguments is that they are circular in another sense. They are what philosophers have called *epistemically circular*.[10] An argument is epistemically circular provided one can only accept the premises of the argument if one has already assumed the correctness of the conclusion. The two arguments I just gave display this feature. One can only accept their premises when one presupposes that the conclusion is true!

Since we cannot do science without assuming that our belief forming faculties are reliable; and since we cannot establish by a non-epistemically circular argument that our faculties are reliable, it follows that it is a presupposition of science that our faculties are reliable.

Now I come back to the announced *disanalogy* between our faculties and the instruments we use when we do tests. It *is* possible to measure the reliability of the measuring instruments we use in tests. We can *calibrate* such instruments, which means that there are ways to verify whether or not they are reliable—*ways that do not involve the instruments that are subject to calibration itself*. For instance, we can scientifically verify the test-retest reliability of the Wingate anaerobic power results, and find it to be = 0.91 (1.00 would be perfect reliability)—and we can verify this by means of results obtained *not* by the Wingate test. And here the disanalogy shows

[10] Alston (1993): ch. 1.

up. For while it is possible to calibrate (verify the reliability of) the measuring instruments we use in science *in ways that do not depend on the use of those instruments themselves*, something analogous is *im*possible with respect to our faculties. For as I have indicated in this section, every argument for the conclusion that (one of) our faculties are reliable, is epistemically circular. We can*not* calibrate (verify the reliability of) our faculties in ways that do not depend on the use of these faculties themselves.

All of this entails that while the reliability of our measuring instruments, such as the Wingate test, is *not* a presupposition of science, the reliability of our faculties *is*. It is a d-presupposition, because it is somehow incoherent to engage in scientific research and yet deny that our faculties are by and large reliable. It is also a b-presupposition of many scientific statements and theories; for if the statement that "our faculties are by and large reliable" would be false, belief in scientific statements and theories would no longer be justified or warranted.

3. Science presupposes that there are multiple sources of knowledge or multiple modes of rational belief acquisition. These sources cannot be reduced to each other, they work differently, and they give us handles on different properties of the world. Here is a (non exhaustive) list[11]: Perception (the five senses, through which we come to know facts about our direct physical environment); proprioception (by which we come to know the position of our bodily parts without visually or tactically observing them); consciousness (by which we know what we think, and know that we have a headache if we have one), memory (by which we know facts about our own pasts), reasoning (by which we know that if all men are mortal, and Michael Jordan is a man, that Michael Jordan is mortal) or rational intuition (by which we know that *Modus Ponens* is valid), and testimony (by which we know such things as that Jesus Christ was crucified, and that Costa Rica is south of Nicaragua).

It has been argued that in addition to these sources that we work with in science, there are other sources that give us knowledge of other subject matters, such as morals and religion. It has been argued that there is a source for moral knowledge: a moral sense[12], or a moral intuition, or conscience through which we know such things as that promises ought to be kept, that honesty is much better that dishonesty, that you cannot be blamed for what was not in your power to prevent. Also, it has been argued there are sources of knowledge of God: a *sensus divinitatis*[13], mystical perception[14] and divine revelation[15] by which we can know that there is a God, that God loves us, and that God will judge people in a righteous way.

These sources 'work' differently. Proprioception works by and large without us being conscious of it. Reasoning, by contrast, is often a very conscious affair. In many cases the formation of moral beliefs requires some form of reflection, but perception, in the main, does not. Knowledge of historical and geographical truths involves trust in persons (the testifiers), but reasoning does not.

[11] For a discussion of some of the sources, see Audi (1998): chaps 1-5.
[12] Reid 1969 [1785].
[13] Plantinga (2000).
[14] Alston (1991).
[15] Swinburne (1992), Mavrodes (1988), Wolterstorff (1995).

These sources, moreover, cannot be reduced to one another. What we are able to know via one source often cannot be known via another source. Moral knowledge just cannot be obtained through visual or tactile perception, nor through proprioception. Mathematical knowledge just cannot be got through the senses either. And knowledge of the whereabouts of one's limbs just cannot be got through moral or rational intuition. This is not to deny that it is possible to know something by perception, and also know the very same thing by testimony—e.g. that Jack is in town. Nor is this to deny that what can be known by visual perception can sometimes also be known by touch—e.g. that the object is a ball. But it is to deny that reasoning is a form of sense perception, or can be reduced thereto; it is to deny that moral perception is a form of visual perception, or reducible thereto; it is to deny that proprioception is a form of moral perception, etc.

These sources, moreover, give us knowledge of different aspects or properties of things. Visual perception informs us about the shape and color properties of material objects in our direct environment. But reasoning doesn't give us such knowledge, nor does moral perception or the *sensus divinitatis*. Moral intuition informs us about general moral maxims, such as that promises ought to be kept, or about the moral worth of a particular act, such as that what David did to Bathseba was utterly wrong. But perception is never going to inform us about these things.

These considerations bear on the issue of the epistemological presuppositions of science in two related ways. First, science, as we now know it, draws on all of the sources mentioned, except for the moral and religious ones. This constellation is sometimes called 'methodological naturalism'.[16] Under the aegis of methodological naturalism when doing science we refrain from making references to substantive moral values, as well as to God or to religious beliefs.[17] Methodological naturalism is, in a way, a form of self-limitation. It is the policy not to draw on moral and religious sources when doing science. There may be good pragmatic reasons for proceeding this way. However! Often people go on and draw far-reaching metaphysical conclusions from the self-imposed limitations; or they forget that they are self-imposed limitations. For they go on to argue that since science doesn't tell us about morals, nor about God, and since science is the most successful cognitive project in human history, we should conclude that morality is an illusion, that God doesn't exist and that religious belief is anti-scientific and irrational. What these people in fact are saying is that Naturalism (not just methodological naturalism, but also metaphysical naturalism) is a presupposition of science. And the alleged presupposition is that "the only things that exist are the things that science can tell us about."

However, Naturalism is certainly not a d-presupposition of science. For it is not incoherent to engage in scientific research and yet deny Naturalism, so deny that "the only things that exist are the things that science tells us about." For it is entirely possible to engage in science and to believe in morality and in God. Not only is it possible, it is real. Many of the most illustrious scientists have been devoted Christians—for example Isaac Newton, Robert Boyle, Michael Faraday.[18] And also today, a significant portion of scientists (and philosophers!) reject Naturalism as well.

[16] For discussion of this view see Plantinga (2011) pp. 168-173.
[17] Unless as phenomena that are up for scientific explanation.
[18] See for example Brooke & Cantor (1998).

Nor is Naturalism an a- or b-presupposition of scientific theories. If Naturalism is false, this doesn't entail the falsity of each and every scientific statement, nor does it undermine whatever warrant or justification they may have.

Second, and related, a number of philosophers and scientists favor the idea that *only* science can give us knowledge or rational belief.[19] This idea goes by the name of Scientism. Friends of scientism suggest that one doesn't really take science seriously unless one embraces Scientism. They sometimes treat Scientism as a presupposition of science. However, this cannot be right. Scientism is *not* a presupposition of science. It is not a d-presupposition, it is not incoherent to do science and deny Scientism. In fact, most scientists are no friends of Scientism! They seriously engage in scientific investigation but simply don't hold that only science can give us knowledge or rational belief. Ordinary visual perception, for example, can give us knowledge, but it isn't science.[20] Nor is Scientism an a- or b-presupposition of scientific theories and statements, for reasons that will by now be familiar to the reader.

Normative presuppositions

Apart from metaphysical and epistemological presuppositions, science has *normative* presuppositions. That is to say: in order to 'do' science, its practitioners will have to presuppose certain normative ideas and ideals—ideas and ideals that aren't the *results* of scientific inquiry. There is discussion about what these normative presuppositions are. But there should be no discussion about whether such presuppositions are in fact made. I single out the following normative presuppositions: (1) that in doing science we ought to seek the significant, not the trivial; (2) that we ought to comply to a number of ethical rules of scientific conduct; (3) that theorizing itself is and ought to be guided by certain norms.

1. Science aims to give us, among other things, knowledge. But not all scientific knowledge is equally valuable. We can investigate matters scientifically and the outcome of the investigation can have less value than the outcome of other investigations. For instance, it is interesting to find out that coconut water has good rehydration properties which may even surpass those of bottled spring water, but it is not at all as valuable as understanding the water, carbohydrate and sodium absorption dynamics that underlie the formulation of oral rehydration solutions, which have saved the lives of thousands of acutely dehydrated individuals. This obliges us to pursue science that will give us knowledge that is most valuable.

Now knowledge may be valuable in different dimensions and for different reasons. It may be valuable for instrumental reasons, i.e. because of its technological or medical applications—applications that improve performance or the quality of life. But it may also be instrumentally valueless. Knowledge may also be intrinsically valuable, i.e. certain things are worth knowing for their own sake. But it may also be intrinsically valueless. It is clear that if we are to do science that leads to results that

[19] For example Rosenberg (2011).

[20] For discussion of scientism see De Ridder, Peels & Van Woudenberg (2017). For a detailed critique of one variety of scientism, see Van Woudenberg & van der Steen (2016).

have value in some dimension, we must wield a standard for what has value and what has not. The point to see is that science or scientific research cannot bring to light what these standards are. Yet these standards are needed in order to select from the multitude of possible investigations those that we actually want to pursue.

Any answer to the question why science and its outcomes are or aren't valuable will have to wield some standard of value. But science, or scientific research will not tell us *which* standards we ought to wield. Science just gives us no guidance on this. So, in evaluating the value of science we will have to presuppose a standard of evaluation (SoE) that science itself cannot give us. In a strict sense, this entails that a SoE cannot be an a- or b- presupposition of science. After all, a SoE is not the sort of thing that can be true or false. But in a somewhat lose sense, any SoE will be a d-presupposition. For it seems that it is near inconsistent to engage in some form of scientific investigation and yet deny that what one is doing, or hoping to achieve, has some value as measured by some SoE. Without *some* view as to why scientific inquiry is valuable, it seems impossible to engage in research. That is why I say that statements of the sort "this inquiry has value, measured by this SoE" is a presupposition of science—*whatever the SoE may be!*

2. The presuppositions just mentioned are in a way rather 'external' to the actual scientific investigations. They are needed to get started. The presuppositions I am now going to mention concern the agents that on a day to day basis are actually 'doing' the research—ones that are much more 'internal' to the practice of doing research. These presuppositions concern what is required for integrity in research. We may call this an 'ethics of science' (just as there is an ethics of medicine, an ethics of journalism and other forms of professional ethics). This ethics may be formulated in terms of injunctions that researchers must heed and that are such that if they don't do that, their work, and the practice of science as a whole, will lose credibility, authority and prestige. Here are some examples: (1) don't fabricate data; (2) don't hide data that don't support the theory that you are developing; (3) be open-minded, careful, thorough, rigorous, integrative, even-handed in the handling of evidence; (4) be cooperative, communicative, able to engage in genteel discussion, able to deal with objections, able to foresee possible objections; (5) don't suggest in public that your results are stronger than they in fact are; (6) don't plagiarize; (7) acknowledge the possibility that you might be wrong as the results are mostly preliminary, etc. There are also (8) ethical codes for and restrictions on what sorts of experiments with animals and human beings can be allowed. For science to be credible, authoritative and to have the right sort of prestige, scientists must acknowledge these norms for responsible research behavior.

The point to see now is that scientific inquiry itself isn't going to tell us what these norms for research integrity are. That is why I call them presuppositions of science. The presuppositions in this rubric aren't a- or b-presuppositions, but they are some kind of d-presuppositions: for it is, in a way that I won't try to specify in any detail, incoherent to engage in scientific research and yet deny that these norms must be heeded, or deny that these are the norms for good research conduct, i.e. norms the observance of which will lead to the most reliable outcomes.

3. There are normative presuppositions of science in addition to the ones just mentioned. These presuppositions are, in a way, even more 'internal' to the scientific enterprise. What I mean is this: in science, we give reasons for and reasons against hypotheses and theories. Some reasons for a particular theory are *good*, *sound*, or *valid*, whereas others are not. In order to devise and evaluate scientific hypotheses and theories, we hence must be aware of norms that distinguish good and bad reasonhood. It is no small task to specify these norms. For present purposes it will suffice to just mention 'simplicity'.[21] That theory A is simpler than theory B, while both explain the data equally well, is a good reason to prefer A over B. One theory is 'simpler' than another in the relevant sense, when the one poses fewer entities, or fewer kinds of entities, or fewer relations, or fewer kinds of relations than the other. A theory that explains all the evidence but refers to only one killer is to be preferred over another that explains the evidence equally well, but refers to a gang of killers. We presuppose that, *ceteris paribus*, simpler theories are to be preferred over more complex ones.

The point to see here, again, is that this, or any other, norm for good reasonhood is a presupposition of science, not something that has been established by science. It is, again, not an a- or b-presupposition, but it is a d-proposition. For it is incoherent to engage in scientific research and yet deny simplicity or any other norm for good reasonhood. Science is impossible without views on good reasonhood.

CONCLUSION

Is it important to state, as I have done, that science has presuppositions? I think it is—for the following reasons. (1) It gives us a more realistic picture of what is involved in doing science: it certainly isn't the presuppositionless enterprise that it is often held to be. It is a more realistic picture in that it brings to full view the fact that it is humans that do science—humans that must make certain scientifically unproven metaphysical, epistemological and normative assumptions. (2) It indicates rather clearly that scientism is an unhealthy and, in fact, untenable position. To adopt scientism really is to abandon science! For to declare not to accept anything unless science has established it, means not to accept the presuppositions of science—i.e. presuppositions that make science possible in the first place. (3) It indicates that not all disagreements in science arise from one party having done science as it ought to be done, whereas the other party did *not* what it ought to have done. Disagreements may arise from disagreement about what are held to be the presuppositions of science.

Finally, all this is especially relevant for human movement scientists. For by being removed from training in the mature natural sciences, they may have little awareness of the existence of these presuppositions. They, too, must be aware of what is involved in doing science, of the dangers and limitations of scientism, and of the fact that some disagreements in science may arise from disagreement on its presuppositions.

[21] For discussion of this, see Swinburne (1997). For a discussion of other theoretical virtues seen Laudan (1984).

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