Bulletin of the *Transilvania* University of Braşov
Series VII: Social Sciences • Law • Vol. 15(64) No. 2 – 2022
https://doi.org/10.31926/but.ssl.2022.15.64.2.13

THE SICK OFFSPRING OF SCIENCE: BAD SCIENCE AND PSEUDOSCIENCE

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Abstract: *The problem of demarcation between science and pseudoscience, although old, it was made central to debates about the nature of science in 1962 by Karl Popper. In this current climate of the pandemic, anti-vaccine theories and fake news, it is imperative that one distinguishes between science, bad science and pseudoscience. In this paper I analyse and discuss a number of arguments related to this debate mainly from Sven Ove Hansson's paper, `Science and Pseudo-Science` (2021). The Swedish thinker argues for the importance of identifying subtle differences between bad science, non-science, un-science and pseudoscience. I claim that in this debate the starting point is a careful analysis of well-known examples. I conclude that understanding the demarcation between those domains and the unmasking of pseudoscientific theories is vital for negotiating both the social and the scientific landscape.*

Key words: *science, pseudoscience, unscientific, non-scientific, creationism*

1. Introduction

The distinction between science and pseudoscience is an old distinction and it seems that in the current climate – the increasing decline in trust of governmental institutions, the pandemic, and the era of fake news and proliferation of conspiracy theories – understanding this distinction is an essential tool not only for the academic but also for the non-specialist. The importance of understanding the distinction is tackled through the well-known problem of demarcation between science and pseudoscience (Popper, 1962) in Sven Ove Hansson's paper, entitled `Science and Pseudo-Science` published in *Stanford Encyclopaedia of Philosophy* in 2008 with significant revisions in 2021. In this work, I present and discuss, mainly, ideas from Hansson's paper, in particular, the relation analysed by the Swedish thinker between the concepts of science, pseudoscience, non-science and un-science.

2. Setting the Stage – The Demarcation between Science and Pseudoscience

In his paper, Hansson discusses the "nature of pseudoscience in relation to other non-

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scientific doctrines and practices" (Hansson, 2021, section 1)[2] and his arguments touch upon the main issues regarding the demarcation between science and non-science. First, the author emphasises that the demarcation between science and pseudoscience is important for both theoretical and practical reasons; second, that the concept of pseudoscience can, of course, be understood by grasping the concept of sciences; third that there are problems of defining pseudo-science; fourth he makes a journey through the history of the problem of demarcation and in the last parts of his paper, he deals with different forms of pseudoscience and the related terminology to both science and pseudoscience. In what follows I discuss ideas from Hansson's first three sections of his paper, then turn my attention to examples of bad science and other activities characterised as unscientific or pseudoscientific and towards the end of the paper I propose heathy attitudes and practices with regard to recognising pseudoscience, with the caveat of mentioning David K. Hecht's warnings about mocking pseudoscience (2019).

2.1. Worries about practical applications with regard to the distinction science – bad science – pseudoscience

Hansson says "the demarcation issue is an illuminating perspective that contributes to the philosophy of science" (Hansson, 2021, s. 1) and one can add that understanding the demarcation has a much larger role – that of casting light upon different scientific areas of study and differentiating them from the pseudo-scientific ones. Also, the Swedish philosopher enumerates and briefly talks about a number of practical applications in which the demarcation issue is important – the most notable ones are: climate and environmental policies, healthcare, expert testimony, science education and journalism (Hansson, 2021, s. 1). Indeed, if one thinks of recent debates about climate change, vaccination, creationism, 5G technology, alternative medicine, GM crops, parapsychology, alternative medicine and the role of the scientific expert then, it is more imperative than ever, we understand the difference between science, bad science, non-science and pseudoscience. To take only one of those practical domains, like healthcare, one can argue that advancing and practicing pseudoscience can have a devastating effect on people's lives and the improvement of knowledge. Hansson mentions that `Medical science develops and evaluates treatments according to evidence of their effectiveness and safety` (Hansson, 2021, s. 1) and points out that any pseudoscientific approach in healthcare gives rise to "ineffective and sometimes dangerous interventions" (Hansson, 2021, s. 1). Here one can elaborate on other consequences of pseudoscientific activity in healthcare which are not only inappropriate but also threatening; for example: spread of diseases through ignoring scientific medical evidence; increased anxiety, stress and social dissent by supporting the so called 'experts'; endangered people's and scientists' lives through the fanaticism of science denialists; undermined trust in the medical profession and the health institutions and death of patients through refusal of verified and approved treatment.

[2] In the rest of the text when referencing Hansson's paper I write an "s." instead of the word "section" followed by the number of the section corresponding to that section in his paper

2.2. All the roads lead to how one defines science

Hansson's second section deals with the definition of science as a first step to defining and understanding pseudoscience. He mentions briefly the history of the word "pseudoscience" and then he analyses in detail the definition of science and its relation with pseudoscience. Thus we are told the word "pseudoscience" comes from the Latin `pseudoscientia` and this was used for the first time in the 17th century, and that the *Oxford English Dictionary* shows that the English word "pseudoscience" has been known since 1776. Here one could add that according to the *Etymology Dictionary,* the English word "science" appeared in mid-14th century and it means 'the state or fact of knowing; what is known, knowledge (of something) acquired by study; information' and also 'assurance of knowledge, certitude, certainty' and it was taken from Old French in 12th century where, of course, it came from the Latin 'scientia' which means knowledge. The word 'pseudoscience' is 'a pretended or mistaken science' and as Hansson points out, the term was related to alchemy and it appeared in 1776. His conclusion regarding the use of the word "pseudoscience" is that "Throughout its history the word has had a clearly defamatory meaning" which means the definition of the word "pseudoscience" is not value-free and this characteristic is what makes the definition of pseudoscience contentious (Hansson, 2021, s. 2). In other words, our use of the word "pseudoscience" is constrained by our own subjective values or our own standards which express our assumptions, outlook, beliefs, or opinions about ways of seeing and studying different subjects.

Although etymologies can be illuminating, one could argue that the most effective way of understanding a concept is through its accepted definition. Hansson discusses the definition of science and explains that the way we use the term 'science' is partly descriptive, partly normative: "the acknowledgement that [science as an activity] it has a positive role in our striving for knowledge' and this is, he says, the conventional part, meanwhile the highly normative part comes from the fact that the discipline of science is depended on its subject area, as well as, its epistemic qualities" (Hansson, 2021, s. 2). Therefore, anybody studying the problem of demarcation would have to take one of the two roots – the descriptive one or the normative one. According to Hansson focusing on the normative part is the preferred approach of philosophers and moreover, the author choses this perspective in discussing the definition of science, a perspective which is highly idealized in comparison with the common usage of the term. At this moment in Hansson's paper, it is clear that he prefers a philosophical approach to the demarcation problem but one could argue that it would also be interesting to call on the scientist to start a dialogue with the philosopher. The scientist naturally, will chose the descriptive element of the definition and he/she will focus on the concept of knowledge which is the result of an activity that studies the physical and natural world using the scientific method – observation and experiment.

If the focus is on the normative element of the definition of 'science' then, because of the historical process and contingencies of the concept, what we identify as science or not, depends upon (as mentioned before) the subject area of the discipline and its epistemic qualities. In order to clarify the demarcation between science and

pseudoscience Hansson discusses both the subject areas of science and the epistemological and metaphysical issues (Hansson, 2021, 1). He says that the word 'science' in English is used to refer to natural sciences and other disciplines related to those which indicates that the word has a more restrictive meaning than some other languages. I would like to point out that the meaning of the Romanian word for science, *știință*, is broader than its English counterpart and it is closer to its Latin root. In Romanian, one meaning of science is a rational and certain way of knowing the nature of things and their conditions of existence comprised into a body of truths about the object studied.[3] The broader meaning of the word 'science' is the reason why subjects as philosophy and history are considered by most Romanians, sciences – even though such subjects do not use the scientific method. Hansson's own example of a broader definition is linked to the German word for science, 'Wissenschaft', whose meaning includes the humanities. To sum up, Hansson's rationale for the normative aspect of the definition of science is more rewarding for a philosopher because one can tackle the fundamental meaning of the term – by this, I think, he means a term which denotes an activity which investigate the nature of things.

At the end of section two, Hansson points out two interesting things: one is that the conflict between science and pseudo-science is best understood using the extended sense of science and the second one is that, one should think eventually of the ultimate goal of the human practice that is science. On the first point, the author mentions that the broader or extended sense of science includes accepting the interdependence between the natural and social sciences and the humanities, which means that different disciplines which have been developed since mid-20th century like astrophysics, evolutionary biology, biochemistry, ecology, quantum chemistry, the neurosciences, and game theory are linking unconnected disciples and form a '*community of knowledge disciplines*'. He says that this community of disciplines are characterized by: "…systematic and critical investigations aimed at acquiring the best possible understanding of the workings of nature, people, and human society" (Hansson, 2021, s. 2)

The second point, looks at our deeper need to know 'how things really are'; in other words, demarcating the practices we call science from the practices we call pseudoscience through identifying what kind of *fact-finding practices* are the scientific ones. Here we can go back to Hansson's earlier claim about the normative aspect of the definition of science which holds that epistemic qualities are important in the definition of science. The conclusion is that these qualities are, in the special case of science, as Hansson says accurate fact-finding practices and the emphasis is here on accurate. There are other human practices that are fact-finding practices like journalism and criminal investigations and all are distinguished form the pseudoscientific practices through the demand for accuracy (Hansson, 2021, s. 2). I will come back to this issue of accuracy when I discuss bad science.

2.3. Conceptual entanglements: bad science, un-science and pseudoscience

[3] This is my own translation of the definition of science from the entry of the authoritative Romanian dictionary: *Dicționarul Explicativ al Limbii Române (2016)*

In the third section of his paper Hansson, focuses on the difficulties of defining pseudoscience. The author initially distinguishing between, what I call the sick offspring of science: bad science and pseudoscience, as well as, the terms 'non-scientific', 'unscientific' and he tries to explain why the boundaries of these are unclear. For examples, he says that not all non-science is pseudo-science, and that science has important delimitations with non-scientific activities such as metaphysics, religion and other non-scientific practices (Hansson, 2021, s. 3). In the same manner but with more details about the scope of non-science, Pamela Irving Lazorok in her article 'Science and Non-Science' (2013) claims that:

> 'Non-science' means more than that which is antithetical to science. As sources of human knowledge, non-scientific approaches such as philosophy, theology, and art have usefully guided visions of the 'why' of our existence, our interactions with one another, or defined morality/ethics. (Lazorok, 2013)

Lazorok points out the usefulness of such 'visions' and the fact that these approaches are not only about trying to find out the role of our existence but also the importance of human interactions and the development of morality. In order to illustrate what is considered non-science and which fits with the above account, I propose a disparate list of examples of non-scientific theories, ideas or studies; for example: Plato's theory, Aquinas' arguments for existence of God, the theory of Edward Bullough about *psychic distance* in explaining aesthetic experience, Marxism, feminism, Freud's dream analysis, Hegel's theory of history, the theory of intuitive knowledge, metaethics, phenomenology, etc. These enumerated theories are not bad science, or unscientific, or pseudo-scientific. It will become clearer why this is the case once I discuss each concept in detail.

Hansson briefly defines 'bad science' as the activity of those scientists who fail to produce good science. It would have been illuminating to concentrate more on the concept of bad science, but Hansson does not discuss this in detail because the focus of his paper is the demarcation between science and pseudoscience. However, one can think of many ways in which bad science happens: from the main flaw which is a bad experimental design to the misinterpretation or extrapolation of the results, the eschewal of an experiment's limitations and the misapprehension of a study to fit the agenda of the scientist. With these characteristics in mind, one can move forward and think of the relation between the concepts of bad science, unscientific and pseudoscience.

The Swedish thinker shows that 'unscientific' is a narrower concept than "non-scientific" because 'unscientific' points out a contradiction or a conflict with science. One can easily get out of the way the discussion about research which is not scientific: this is the research that does not follow the scientific method. Although, we take the understanding of the scientific method for granted, I will describe it in a few words, only as a reminder: careful observation, formulating an hypothesis, data collection, testing the hypothesis and dealing with variables, analysing the results, accepting or rejecting the hypothesis, proposing a theory, evaluating the research and as a consequence of the

contemporary demands on the scientist, maybe preparing the research for publication. As already mentioned theories or ideas should be based upon accuracy, this means an appropriate use of the scientific method. In contrast, an inaccurate use of the method or biased interpretation of its results erode the scientific standards, and we end up with bad scientific research.

One still needs to answer the question about unscientific theories; until now we have only discussed bad science. Hansson distinguishes between bad scientific research and unscientific studies or theories. The only thing that Hansson says about an unscientific theory is that 'unscientific' points out to a contradiction or conflict with science. Hansson's distinction between all these terms: non-scientific, unscientific and pseudoscience is a nuanced distinction and requires careful attention when used. Many people from both the scientific and non-scientific background are confusing these terms. One could address this by thinking of theories, ideas or studies that are in an obvious, clear conflict or contradiction with science and analyse their similarities. A small number of examples of such theories or ideas are: there was a (biblical) devastating flood, creationism, dialects are separate languages, the earth is flat, the Moon landing never happened, there are different pure human races, etc.

3. The Essential Aspect of Pseudoscience: Its Claim to Truthfulness

Going back to Hansson's arguments we arrived at the crux of his paper: the definition of pseudoscience. For Hansson the term 'pseudoscience' is even narrower than the term 'unscientific' because pseudoscience is not about 'mismeasurements and miscalculations' or about bad science, but it is:

> A pretended or spurious science; a collection of related beliefs about the world mistakenly regarded as being based on scientific method or as having the status that scientific truths now have. (Hansson, 2021, s. 3)

This definition is one of the best, I think, to cast light upon the main characteristics of pseudoscience: the pretence or the shamming of such an activity. Here are a number of other definitions and claims about pseudoscience: '[w]hat is objectionable about these beliefs is that they are masquerading as genuinely scientific ones' (Baigrie,1988, p.438, quoted in Hansson s.3), "a pseudoscience is a fake science that makes claims based on faulty or non-existent scientific evidence" (Kendra, 2019), or "…a non-empirical or a pseudo-empirical method – that is to say, a method which, although it appeals to observation and experiment, nevertheless does not come up with scientific standards." (Popper, 1962, p.33).

The British writer and psychiatrist, Ben Goldacre published a book in 2008 entitled *Bad Science*, which has excellent examples from healthcare discussed in detail. He analyses the role of misconceptions, misinterpretations, mismeasurements and reductive views which are the hallmarks of bad science. One of his examples is about detox and argues that the theory of detox: "Like the best pseudoscientific inventions, it deliberately blends useful common sense with outlandish, medicalised fantasy." (Goldacre, 2009, p. 10).

The emphasis here is again on the fact that pseudoscience 'deliberately blends'. The element of pretence is clearly involved in such practice. Goldacre thinks that pseudoscience "systematically undermines the public understanding of the very nature of evidence" (Goldacre, 2009, p. xi). The one thing which a more demanding reader could reproach to Goldacre is that when he describes bad experiments or bad theories he often uses the term pseudoscience which means that the two terms are used interchangeably. Thus, a more nuanced delineation of the two terms is needed, in particular, when talking about famous examples from different domains.

I think the main difference between pseudoscience and science consists in the intention to perform that kind of activity or in the scope of that kind of activity. One possible way to explain further my emphasis on pretence when talking about pseudoscience, is to enumerate theories or ideas that are considered pseudoscientific and identify the element of pretence in those theories.

Let's take an example of a domain that has a perceived controversial status by a number of people and try to identify if this domain is scientific, unscientific or pseudoscientific – the example I choose is creationism. One would like to start with the definition of creationism but immediately it transpires that there are controversies about the accepted definition of this term. What I mean is that, supporters of creationism do not accept what a scientific or a more scientific oriented community considers an accepted definition. As a general good reference for definitions, most people including the scientific community, use the *Oxford English Dictionary*. However, when it comes to terms like 'creationism' a number of people who are supporters of creationism do not accept the authoritative source of a dictionary like the OED. Here is the catch: those supporters use the OED for most of their other searches but not a few terms, like 'creationism'. I find this selective attitude inconsistent. Then what kind of theory is that which advances creationism as an explanation about the universe and life? I would dare to start (against supporters!) with the definition of creationism from an accepted and respectable dictionary. For example, the *Advanced Learner's Dictionary* online defines creationism as: "the belief that the universe was made by God exactly as described in the Bible", or "the belief that the universe and the various forms of life were created by God out of nothing (*ex nihilo)"* from the *Encyclopaedia Britannica*. None of these definitions indicate that creationism is a scientific theory but the supporter of creationism could reply to this in two ways: the first is that newer versions of creationism like creation science or intelligent design are aspiring to a scientific status and the second is that, the broader perspective on science, the one that integrates natural and social sciences and the humanities, should include creationism as a scientific theory. But let us reiterate what Hansson says about the human endeavours that form *the community of knowledge disciplines: "*systematic and critical investigations aimed at acquiring the best possible understanding of the workings of nature, people" (Hansson, 2021, s3). Is creationism such a knowledge discipline? My first reaction hangs on the characteristic 'systematic and critical investigations'. When supporters of creationism claim that intelligent design is empirically testable and it can make predictions, or in particular, that there are no transitional fossils, or there is irreducible complexity of organic structures which is proof of intelligent design, or that our dating methods are

flawed, they are going against what the scientific community and many laymen consider critical investigations of nature. The scope of this paper does not allow a more in depth analysis of the accusations against creationists. However, one aspect of this theory is under no doubt – as so called 'scientific' theory, creationism is the result of a reaction against the theory of evolution. One of the authors I mentioned earlier, Pamela Irving Lazorko thinks that creation science is pseudo-science, however, I claim that creationism is not a scientific theory, or for that matter a pseudoscientific theory, but an unscientific theory ('unscientific' in Hansson's sense).

To come back to third section of Hansson's paper, I want to point out that he makes compelling arguments about the conflict between science and pseudoscience. His main argument for an activity or a teaching to be pseudoscientific is that it must satisfy two criteria:

1) it is not scientific, and
2) its major proponents try to create the impression that it is scientific (Hansson, 2021, s. 3)

The Swedish philosopher applies the criteria for pseudoscience to interesting hypothetical cases of bad science and pseudoscience. His initial conclusions are: pseudoscience is confused sometimes with fraud in science (with bad science), there are different aspects to be considered when comparing pseudoscience with science (looking at both the method of inquiry used and the doctrine followed) and pseudoscience also has a wider sense "…and is assumed to include not only *doctrines contrary to science proclaimed to be scientific* but *doctrines contrary to science* tout court" (Hansson, 2021, s. 3.4)

Again, here the element of deceitfulness appears to be central to the description of pseudoscientific activity as opposed to science whose function is "to provide the most reliable information about its subject-matter" (Hansson, 2021, s. 3.4). Furthermore, towards the end of his third section, the philosopher comprises a list from different authors with the most important elements that should be used as a criterion of demarcation between science and pseudoscience; those are: a research program, an epistemic field or cognitive discipline, a group of people with common knowledge aims and their practices, a theory, a practice, a scientific problem or question, a particular inquiry (Hansson, 2021, s. 3.4). I would argue that each of these elements are important and anybody faced with the question of demarcation would have thought of some of those elements. In addition, Hansson highlights two authors' criteria of identifying pseudoscience: that of Settle, who in 1971 argued that the institutional factor (the rationality and critical attitude of an institution) is important in determining sciences form non-sciences and that of Derksen, who argued in 1993 that the individual person conducting the pseudoscientific research should be the main criterion for identifying a pseudoscientific activity. Again, most scientists and science oriented people would recognise Derksen's advice because often we start an inquiry into a piece of research by finding out about its author. The last feature of pseudoscience one needs to consider from Hansson's section three is that we should not, he says, agree with the idea that 'the demarcation between science and pseudoscience must be timeless'. Scientific theories are constantly revised and retested as part of the scientific process of involvement, thus science is not timeless. (Hansson, 2021, s. 3.4).

What are other ways of identifying and separating pseudoscience from science except those criterial elements mentioned by Hansson? What is the justification that activities or theories like homeopathy, drowsing, astrology, climate change denialism, some forms of creationism, alchemy, phrenology, parapsychology, anti-vaccine views, etc., are pseudoscientific? There are many ways of answering this but I am going to mention what I think are the most important ones. 'Pseudoscientists' appear to have most of the time a doctrinal agenda, pseudoscientific views are untestable – pseudoscience is not falsifiable, the researcher is in disrepute on strong scientific grounds, in general pseudoscientists do not like to be challenged, are uncritical and do not like self-correction, pseudoscientists are selective and reductive in choosing evidence, pseudoscience is in general not improving itself, being very static and pseudoscience wears a deceitful masque.

The last point I want to mention is that the scientific community or the critical thinker are not immune to the allure and traps of unscientific or pseudoscientific research or theories. However, David. K Hecht in Chapter 1, 'Pseudoscience and the Pursuit of Truth', argues that we should not dismiss pseudoscience right away because it is a historical phenomenon which needs to be understood and from which we can learn

– as it was the case with alchemy, phrenology or homeopathy. Hecht does not deny that 'outright error', 'fraud' and 'wild speculation' are the main characteristics of pseudoscience (Heck, 2019, p.4), nevertheless he argues that we need to consider the following: the fragility of science; the fact that science and pseudoscience are linked and their boundaries are blurred; pseudoscience cannot be eradicated; and that pseudoscience helps us to understand that in science we need 'warranted belief" instead of objective truth.

4. Conclusion

In this work, I argued that Hansson's demarcation between bad science, non-science, un-science and pseudoscience is a nuanced endeavour which can be supported through the use of examples and the discussion about those examples. Like Goldacre, the author of *Bad Science* and many others, I claim that unmasking pseudoscientific theories and research is necessary more than ever in the context of denial and fact-resisting world.

References

Academia Română Institutul de Lingvistică „Iorgu Iordan – Al. Rosetti", (2016). *Dicționarul Explicativ al Limbii Române* [Explanatory Dictionary of the Romanian Language], Universul Enciclopedic, București, p. 1207

Britannica, T. Editors of Encyclopaedia (2022, September 20). Creationism. *Encyclopedia Britannica*. Retrieved from https://www.britannica.com/topic/creationism

Derksen, A.A. (1993). The seven sins of pseudoscience. *Journal for General Philosophy of Science*, 24: 17–42.

Goldacre, B. (2008). *Bad Science*. London: Fourth Estate.

Hansson, S.O. (2021). Science and Pseudo-Science. *The Stanford Encyclopaedia of Philosophy (Summer 2021 Edition)*, Edward N. Zalta (ed.), Retrieved from_URL = <https://plato.stanford.edu/archives/sum2021/entries/pseudo-science/>.

Harper, D. (2021-2022), science, *Online Etymology Dictionary,* Retrieved from https://www.etymonline.com/search?q=science

Hecht K. D. (2019). Pseudoscience and the Pursuit of Truth. *Pseudoscience – The Conspiracy Against Science*, eds. Allison B. Kaufman, James C. Kaufman, MIT Press.

Kendra, C. (2020). How to Identify a Pseudoscience. *ThoughtCo*, Retrieved from https://www.thoughtco.com/what-is-a-pseudoscience-2795470

Lazorko, I. P. (2013). Science and Non-Science. *Philosophy Now.* Retrieved from https://philosophynow.org/issues/96/Science_and_Non-Science

Oxford University Press, (2022). *Oxford Advanced Learner's Dictionary*, creationism, Retrieved from https://www.oxfordlearnersdictionaries.com/definition/english/creationism

Popper, Karl. (1962). *Conjecture and Refutation, the Growth of Scientific Knowledge*. New York: Basic Books.