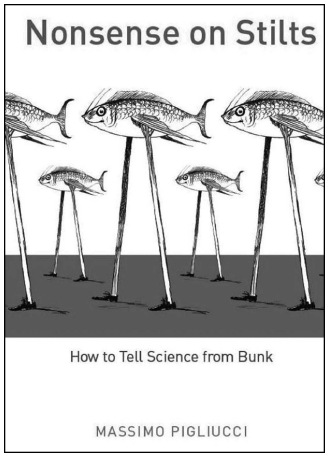

Nonsense on Stilts

Reviewed by Olle Häggström

Nonsense on Stilts: How to Tell Science from Bunk
Massimo Pigliucci
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The task that biologist-turned-philosopher of science Massimo Pigliucci sets himself in his book *Nonsense on Stilts: How to Tell Science from Bunk* is very ambitious. With a broad audience of interested laymen in mind, he aspires, as the subtitle indicates, to show how to tell science from bunk—the so-called demarcation problem. And he is not content with just a theoretical discussion (although the book offers some of that, too) but wants to equip the layman with the intellectual tools to tell one from the other in, for instance, media reports on scientific issues.

A straightforward "if and only if" criterion for what is science is too much to hope for, no matter how much some fans of Karl Popper may think otherwise. In his first chapter, Pigliucci discusses what he calls "hard" versus "soft" sciences and demonstrates the implausibility of formulating simple criteria that work across all fields. Hard sciences, in his view, are those whose objects under study are either simple (relatively speaking) or admit reductionist analysis via division into simple constituents; typical examples are physics and chemistry. At the soft science end of the spectrum, we find, e.g., sociology, in which the fundamental constituents of the systems under study are human beings—incomparably more complicated than the atoms or elementary particles of physics and chemistry. This difference alone makes it unreasonable to apply identical criteria to all sciences, but there is more. Pigliucci stresses, quite rightly, the need for a general philosophy of science to recognize that some sciences, notably history and parts of evolutionary biology, aim to map sequences of events in the past rather than to formulate general laws applicable today and in the future.

Nonsense on Stilts is reader-friendly and entertaining. Part of the reason for this is Pigliucci's preference for concrete examples as opposed to losing the reader in abstract theory. Many authors would probably have begun with a chapter or two on the history of science; Pigliucci instead postpones this deep into the book until the reader, motivated by examples, realizes the need for a historical perspective. Up to that point he has discussed not only sciences such as sociobiology, string theory, and the SETI search for extraterrestrial intelligence, which have all been the target of controversy of one kind or another, but also areas that fall squarely in the pseudoscience category, in which his two favorite examples are those that also attract the largest amount of attention in public debate: intelligent design and climate change denialism. In a later chapter he treats the postmodern current in the sociology of science and related areas, whose hollowness was so masterfully exposed by physicist Alan Sokal in his 1996 practical joke that has become known as the Sokal Hoax.[1]

A common theme (albeit with various twists) in Pigliucci's discussions about sociobiology, string theory, and SETI is the need to relax, at least in a short time perspective, the strict Popperian orthodoxy about falsifiability. In the first two cases I am happy to embrace his position, but as

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[1] *For Sokal's own reflections on the incident, see A. Sokal,* Beyond the Hoax: Science, Philosophy and Culture, *Oxford University Press, 2008.*

regards the third I disagree. Neutrally described, the purpose of SETI is to shed light on which of the two hypotheses

$$E = \{\text{extraterrestrial intelligence exists}\}$$

and

$$E^c = \{\text{extraterrestrial intelligence does not exist}\}$$

is actually true. To plug the project into falsificationist formalism, we need to break the symmetry and take either E or E^c to be the null hypothesis, i.e., the hypothesis we should then try to falsify. If, like Pigliucci, we take E to be the null hypothesis, then we would be hard pressed to think of a way (at least with current technology) that it might be falsified. But if instead we take E^c as the null hypothesis, then SETI will fit beautifully as a textbook example of falsificationism in practice.

Pigliucci's language is quite relaxed. Every now and then, he falls into sarcasm when describing work that needs to be categorized as either weak science or even pseudoscience. Here's a typical example: in a discussion (page 159) about the (lack of) credibility of the conservative think-tank American Enterprise Institute on issues of climate change, he asks, after mentioning some compromising facts, whether he "needs to say more to push your baloney detector all the way up to red alert". Such passages add to the entertainment value of the book, but also have the potential downside of not putting the reader in the optimal state of sharpened senses for digestion of new thoughts and subtle distinctions. Rather, it tends to produce a cozy feeling: think how clever we are, the author and I, especially compared to these simpletons! A related quality of the book is Pigliucci's straightforward, sometimes blunt, way of expressing his opinion on controversial issues. Again, this makes for enjoyable and interesting reading, although it is not always trivial to distinguish matters of fact from the author's personal opinions.

How, then, does Pigliucci succeed in his ambition to solve the demarcation problem? He does shed some useful light on it, but the problem of how a nonexpert should go about distinguishing science from bunk seems to be simply too difficult to admit a clear-cut answer. When Pigliucci summarizes his advice toward the end of the book, it is striking how much emphasis he puts on judging the credibility of the purported scientist or the messenger, as opposed to judging the quality of the arguments themselves. In other words, he advocates a large element of appeal to authority, which may seem unsatisfactory. This, however, is probably unavoidable, especially in complex issues such as climate change. On one hand, it is obviously important that citizens have an idea about where science stands concerning the link between greenhouse gas emissions and global warming. On the other hand, it is unrealistic that the man-on-the-street (or even the typical mathematics professor) should be acquainted with the entire chain of scientific arguments behind the conclusions, all the way down to the quantum physics of the absorption spectrum of a CO_2 molecule. So in practice there's no way around the problem of judging whom to trust. On the other hand we certainly do not want to stop thinking for ourselves. It's a tricky balance.

The broad range of the contents of *Nonsense on Stilts* is impressive but also tends to make the book somewhat patchy (a patchiness that is inherited by the present review). Another consequence of the broad scope is that the author needs to have done a vast amount of homework. As far as I can tell, Pigliucci has mostly succeeded in this—with the occasional exception. Since I share his know-it-all disposition, I cannot resist listing some of the cases in which he apparently doesn't quite know what he is talking about or where his arguments fail to convince. (If nothing else, I hope in this way to instill the reader with the aforementioned cozy feeling.)

• In his chapter on hard versus soft sciences, Pigliucci takes a classical paper by Platt[2] as a starting point for a discussion about why the hard science of physics has shown greater and more manifest advances than the comparatively softer ecology. He rejects, somewhat indignantly, the idea that physicists might be more gifted than ecologists (page 9). Shortly afterward, he considers as perfectly plausible the idea that part of the explanation may lie in the fact that physics enjoys higher prestige than ecology among American high school nerds, giving it a comparative advantage in the recruitment of the best young talents. Viewed separately, each of these judgments by Pigliucci makes some sense, but his failure to note how they contradict each other is a strange lapse.

• In a discussion about statistical hypothesis testing, Pigliucci writes (page 79) that "one way to understand what a p-value says is to think of it as the probability (given certain assumptions) that the observed data are due to chance, as opposed to being the results of a nonrandom phenomenon." Here he commits the well-known fallacy of the transposed conditional, i.e., he confuses the probability of the data given the null hypothesis with the probability of the null hypothesis given the data.[3]

[2] *J. Platt, Strong Inference,* Science ***146*** *(1964), Oct. 16, 347–353,* `http://ecoplexity.org/files/Platt.pdf`.

[3] *See, for instance, Cohen, J., The Earth is round (p. 5),* American Psychologist ***49*** *(1994), no. 12, 997–1003,* `http://www.ics.uci.edu/~sternh/courses/210/cohen94_pval.pdf`.

• On the topic of global warming, Pigliucci discusses natural climate variations in the past (page 136). Among climate change denialists, these are sometimes viewed as a decisive argument against the idea of an ongoing anthropogenic global warming. Pigliucci notes, correctly, that the existence of natural climate variation is well known and uncontroversial in climate science. But when he writes that "Greenland—which today is largely covered by ice—was given that name because it was a lush land during the so-called Medieval Warming Period", he is mistaken in his implication that the Greenland ice cover was absent during the MWP (which, according to most definitions, took place between AD 950 and 1250). The (relatively) hospitable climate that is sometimes referred to concerns parts of Greenland's coastal areas—its inland was, like today, covered by ice.

• Again on the topic of global warming, Pigliucci explains the greenhouse effect by first outlining how a greenhouse works and then stating that the greenhouse effect of atmospheric carbon dioxide is "the exact same phenomenon at the scale of the whole planet" (page 136). But here he is confused about how an actual greenhouse works. Its ceiling serves primarily to prevent not outgoing radiation but convection. The term "greenhouse effect" is thus a bit of a misnomer (and Pigliucci is not the first to be confused by it), but it is so established that we should simply get used to it, just like how we accept without complaints the term "sunrise" despite the phenomenon being caused by the Earth's movement, not the sun's.

• Before Galileo, it was generally held that gravity works in such a way that heavy objects fall faster than lighter ones. Galileo realized the untenability of this view using the following thought experiment. Imagine two rocks, one heavier than the other. Now join the two rocks by a rope, and drop them. The pair of rocks will now (i) fall faster than the light rock would have done on its own, because the latter will be pulled downward, via the rope, by the heavy rock. Similarly, the pair will (ii) fall slower than the heavy rock on its own, because the heavy rock will be pulled upwards, via the rope, by the light rock. On the other hand, the pair is obviously heavier than the heavy rock on its own, so by the old theory it will (iii) fall faster than the heavy rock on its own. Conclusions (ii) and (iii) contradict each other, so the old theory must be wrong. So far according to Galileo. Pigliucci tries to recount this argument (page 220), but fails to mention (iii), and claims incorrectly that (i) and (ii) contradict each other.

• One issue that is sometimes discussed in the philosophy of science is what we mean by truth. According to the so-called correspondence theory of truth, a statement P is true if and only if P. For instance, the statement "it is raining" is true if and only if it is raining. Simple but irreproachable—or so it may seem. After having explained the correspondence theory (pages 236–237), Pigliucci declares it untenable. What, then, is the alternative? I do not doubt for one second that Pigliucci is a better philosopher of science than I am, but precisely for this reason he should have been able to do better than merely declaring that "in philosophical circles, the correspondence theory of truth has been largely superseded by more sophisticated epistemological positions".

I am in fact a bit confused by Pigliucci's argument for declaring the correspondence theory bankrupt. He holds that since science will never provide definite answers about what the world is like, we can never be sure about the truth that the correspondence theory speaks of. Well, yes, but if we agree that we can never know for sure whether it is raining (for instance, we might be hallucinating), why is it so much worse that we can never know whether it is *true* that it is raining? But apparently it is, to the extent that the correspondence theory must be abandoned.

Furthermore, since Pigliucci neglects telling us what the "more sophisticated epistemological positions" are, the reader is left wondering how these may come to grips with the problem that makes the correspondence theory so unacceptable. I would think (perhaps naively) that a theory of truth that allows us to conclude that it is *true* that it is raining, without knowing that it is actually raining, violates the very notion of truth. These are questions that call for answers, but Pigliucci doesn't even offer a hint.

Apart from these lapses and a few more, I find *Nonsense on Stilts* to be a fairly convincing book. I would expect the average reader of the *Notices* to be about equally convinced (and I do think that even the purest of pure mathematicians who rarely or never interacts professionally with any applied researchers still has a lot to gain from occasionally paying some attention to the philosophy of science). On the other hand, the book does have a marked tendency toward preaching to the choir. It is doubtful whether it would do much to convince a reader who doesn't already share the author's proscience stance on issues such as global warming or the evolution-creationism struggle.