

Scientism and Pseudoscience: A Philosophical Commentary

Massimo Pigliucci

Received: 6 January 2015 / Accepted: 2 June 2015
© Journal of Bioethical Inquiry Pty Ltd. 2015

Abstract The term “scientism” is used in a variety of ways with both negative and positive connotations. I suggest that some of these uses are inappropriate, as they aim simply at dismissing without argument an approach that a particular author does not like. However, there are legitimate negative uses of the term, which I explore by way of an analogy with the term “pseudoscience.” I discuss these issues by way of a recent specific example provided by a controversy in the field of bioethics concerning the value, or lack thereof, of homeopathy. I then frame the debate about scientism within the broader context of C.P. Snow’s famous essay on the “two cultures.”

Keywords Scientism · Pseudoscience · Two cultures · Homeopathy

There has been much talk about scientism of late, and I expect there to be quite a bit more in the foreseeable future.¹ This talk is generated and sustained by an ongoing phenomenon that C.P. Snow (1959) famously labelled “the two cultures,” i.e., the mutual incomprehension, and sometimes overt hostility, between the natural sciences and the humanities. Back in 1959, of course, the humanities held sway on university

campuses, and Snow famously chastised his colleagues in English departments for being proudly ignorant of the second principle of thermodynamics, at the same time that they were ridiculing their counterparts in the sciences for not being sufficiently acquainted with the works of Shakespeare. Nowadays, the situation is completely reversed, with the sciences riding high and pushing increasingly STEM-centred curricula while the humanities are constantly put in the uncomfortable situation of having to explain their worth to students, administrators, and the public at large (e.g., Nussbaum 2010).

The term “scientism” began as a denigratory label, used to point out instances of unwarranted aping of the natural sciences by the humanities (Sorell 1994) or of scientists attempting territorial advances into fields where they do not belong (e.g., Harris criticized in Blackford 2010) or else unfairly dismissing the contributions of humanistic fields to human understanding (e.g., Weinberg criticized in Pigliucci 2008). More recently, however, a number of authors—including several philosophers—have attempted to reclaim the label of scientism in a positive fashion, using it to flaunt their tight allegiance with the natural sciences, which they see as the only legitimate, all-encompassing source of worthwhile knowledge (e.g., Ladyman and Ross 2007; Rosenberg 2011).

It is not surprising, then, that scientism—both as a term of ridicule and as a badge of honour—also has begun appearing in the bioethical literature. Indeed, a recent classification of the “varieties of scientism,” so to speak, identified the following one: “[the idea that] no

M. Pigliucci (✉)
Department of Philosophy, The City College of New York, 160
Convent Avenue, New York, NY 10031, USA
e-mail: massimo@platofootnote.org

virtue, moral norm, or ethical principle has serious legitimacy unless it has been confirmed by, or derived from, scientific knowledge about humanity and reality” (Shook 2014, 28). In the following, I will attempt to parse the contrasting claims being made by different parties when they invoke the dreaded term “scientism”; I will then proceed to provide a brief example of discussions of scientism in bioethics; and I will conclude with some more general points about the ongoing war between the two cultures.

What Is Scientism, Approximately?

Scientism means (very) different things to different people, so much so that some of my colleagues have suggested abandoning the term altogether. That, I think, would be a mistake. Since scientism does pick out an interesting range of epistemic and cultural attitudes, phasing out the word would simply make room for an alternative one to emerge and fill the gap. Much better to try to be as clear as possible on what scientism is and is not.

Let us first examine the opposite extremes along the range of definitions of scientism—both of which I take to be indefensible in any serious intellectual fashion. After that, we should be able to arrive at a sensible Wittgenstein (1953) “family resemblance” conception²

² From §67 of the *Investigations* on the fuzziness of the concept of game: “I can think of no better expression to characterize these similarities than ‘family resemblances’; for the various resemblances between members of a family: build, features, colour of eyes, gait, temperament, etc. etc. overlap and criss-cross in the same way. And I shall say: ‘games’ form a family.” Wittgenstein here is rejecting the Platonic, essentialist approach to definitions of concepts, in favour of a more nuanced, organically construed one. It is the latter approach that I am using in analysing the idea of scientism.

³ A recent paper by Loughlin, Lewith, and Falkenberg attempts to define scientism more precisely as “the view that science, and only science, reveals the truth, such that all true claims are part of a true scientific theory, or are reducible to claims of this sort” (2013, 131). The authors point out that such a view is historically associated with logical positivism and interestingly argue that it comes with an (implicit) ontology: “This epistemological thesis is closely associated with an ontological thesis, about reality or ‘what really exists’, to the effect that science reveals the true nature or essence of the world” (2013, 132). There is much that I agree with in this paper, but I still think a less sharp, Wittgensteinian approach comes closer to do justice to the bewildering variety of not only epistemic and ontological claims surrounding scientism but also its broader psychological and sociological dimensions.

of scientism that can actually be useful for further discussion.³

At one end of the spectrum, then, there is the idea that any forays by natural scientists into the subject matters of the humanities constitute an unwarranted example of scientism, a form of gross cultural imperialism based on a naïvely reductionist conception of the world and of human nature. This, I hope is clear, will not do. Philosophers since David Hume (1748), and more recently of course Quine (Hylton 2014), have convincingly advocated a role in philosophical discussions for the sort of empirical knowledge about the world that science provides us with. Similarly, using “scientism” so broadly as a negative term would mean that there would be, for instance, no place in historical research for statistical analyses of large data sets (Turchin and Nefedov 2009) and there would be no talk of the “digital humanities,” either.⁴ I do not think, like Quine did, that epistemology can be reduced to a branch of psychology, nor do I entertain for a moment the notion that history and literature will cease to be independent disciplines and be absorbed into biology departments (Pigliucci 2012a). But it seems odd to assert that quantitative data analysis and the deployment of methods and concepts from the natural sciences have no place at all within humanistic scholarship.

Moving to the opposite end of the range of attitudes about scientism, we find a number of authors who simply do not think that there is any problem at all with what they often characterize as “alleged” scientism. These typically include scholars who have themselves been accused of acting scientifically, such as physicist Lawrence Krauss (Pigliucci 2012b) and biologist Jerry Coyne, but also colleagues who think the term is useless because it is deployed only as a derogatory and dismissive label for whatever the user dislikes about science. While there certainly is some truth to the latter point, to outright deny that there is a substantive issue surrounding scientism seems to me to deny an important and fairly plain fact of modern academic and public intellectual life: there really are plenty of questions, issues, and problems where science plays a marginal role at best.

Indeed, my collaborator, Maarten Boudry, and I have drawn a parallel between scientism (both the concept and its usage) and another loaded term commonly used

⁴ See, for instance, *Digital Humanities Now*, <http://digitalhumanitiesnow.org> (accessed December 22, 2014).

by both scientists and philosophers: pseudoscience (Pigliucci and Boudry 2013). The parallel is enlightening, we think: on the one hand, some scientists and self-professed “sceptics” truly seem to apply the “pseudoscience” label to anything they do not like, quite regardless of whether there may be good reasons to suspend judgement or to await further investigations. Dislike the sort of claims about gender differences made by evolutionary psychologists or neurobiologists? Just dismiss them as pseudoscience, no need for additional analyses. Think the search for extraterrestrial intelligence is a waste of taxpayers’ money? Ditto. However, there are also philosophers like Larry Laudan (1983) who simply think that the whole project of demarcating (as Popper [1962] famously put it) science from pseudoscience is hopeless and misguided and should therefore be abandoned. The truth, I think, lies somewhere in the middle: some claims made by evolutionary psychologists and neurobiologists may be questionable, and if so they need to be scrutinized and may end up being rejected, without this necessarily leading to impugning the whole discipline as pseudoscientific. But, contra Laudan, there are actual, well-identifiable pseudosciences out there including, but not limited to, astrology, homeopathy (see below), ufology, parapsychology, and the like. To reject the whole idea of a demarcation problem would fail to make important distinctions that are both of theoretical interest (to epistemologists and philosophers of science) and of sometimes great practical import (e.g., in public policy discussions about vaccines, climate change, so-called “alternative” medicine, and many others).

Since the situation is, I maintain, analogous for the idea of scientism, what might a reasonable solution look like in the latter case? The answer is not going to be clear-cut and certainly not uncontroversial, which is typical of the kind of Wittgensteinian fuzzy concepts I think both pseudoscience and scientism are. Again building on the analogy with pseudoscience: the latter can be thought of as an aping of actual science (i.e., deploying the trappings of conferences, dedicated journals, experts, etc.) without its substance or well past the point where the alleged substance has been investigated and found wanting (e.g., parapsychology, but also, for example, cold fusion). Analogously, we can think of scientism not simply as *any* injection of the natural (or social) sciences into the humanities but as the *unwarranted* (or *as yet unwarranted*) subset of such injections.

Take, for instance, the oft-repeated claim that science can answer moral questions (e.g., Harris 2010; Shermer

2015). It cannot be dismissed simply, as it is often done in philosophical circles, by invoking Hume’s famous distinction between *is* and *ought* as if it were a universal trump card. For one thing, Hume’s principle needs to be defended in turn, on penalty of simply making an argument from authority. But also it is somewhat ironic, given the context, to call on precisely one of the philosophers who has done the most to move morality into the realm of psychology. At the same time, however, one reads books like the ones cited above, compares them with equivalent treatments written by moral philosophers (e.g., Sandel 2009, 2012), and cannot help but find the former ones obviously wanting: while Sandel is recognizably doing the kind of moral philosophy that actually helps us think more clearly about ethical dilemmas, the reader will go through the whole of Harris’ and Shermer’s books without finding a single actual example of how (by itself) science solves moral problems. Not one. If so, then authors like Harris and Shermer are engaging in scientism not because what they are proposing is impossible a priori (few things are) but simply because they are making extraordinary claims on behalf of science and delivering little or nothing to support them. Scientism is like pseudoscience, then, for similar reasons: it is not that parapsychology is wrong a priori, it is just that parapsychologists insist on making extraordinary claims backed up by proportionally little or no evidence. In other words, just like in the case of pseudoscience, there may be some notions that are clearly scientific, as well as cases of unwarranted use of the label “scientism” to dismiss undesirable notions without argument; but the interesting cases will find themselves located in a complex, and far from clear-cut, middle territory.

Scientism and Bioethics

In order to crystallize the ideas sketched above, let me briefly comment on a series of articles published in 2012 in the journal *Bioethics*, which will allow me to bring together my parallel talks of scientism and pseudoscience into a single paradigmatic example—though this will turn out to be an instance of actual pseudoscience and therefore unsubstantiated labelling of “scientism.”

The debate got started with a paper by Smith (2012a) applying a utilitarian perspective to the issue of homeopathy and whether it should be practised in a medical

setting. Smith presents a systematic argument that begins with an explanation of the theoretical implausibility of homeopathy and, in particular, of the two fundamental principles of the practice—the “law of similars” and the “law of infinitesimals.” He then engages the empirical literature on homeopathy, finding it woefully insufficient to establish any of the claims on which the approach is based. So far, nothing really new, as homeopathy is regarded as one of the clearest examples of pseudoscience by both scientists and philosophers of science (Goldacre 2009; Pigiucci and Boudry 2013). Smith then moves to build his ethical argument on utilitarian grounds (though I suspect something very similar could easily be done on deontological as well as on a virtue ethical basis, too).

Smith’s argument assumes—correctly, as far as I can tell—that there is no evidence or reason to believe in any direct biomedical or physiological effect of homeopathic ministrations on the body. At best, homeopathy can “work,” in a very limited fashion, only by way of placebo effects. Smith then very carefully examines the possible benefits of homeopathy, including non-invasiveness and cost-effectiveness; its holistic approach; the possibility, range, and strength of placebo effects; and its fostering of patients’ autonomy regarding healthcare decisions. He concludes, again very reasonably, that “the benefits of homeopathy are rather minimal” (2012a, 405).

Next, Smith goes on to equally systematically analyse the possible disutilities of homeopathy: the risk of failing to seek conventional healthcare; the waste of resources that results from supporting homeopathic practice (since it is known not to work, outside of placebos); the problem raised by unwarranted credence, i.e., the credibility that homeopathy gains when it is endorsed by medical practitioners or healthcare agencies; the simultaneous weakening of support for evidence-based medicine and the weakening of support for types of “alternative” therapies that actually do work (e.g., some forms of meditation, massage, etc.). His conclusions are that “investment in homeopathy by public healthcare providers is unethical as it entails a waste of resources ... the effect [of such investment] is important and amounts to a serious net disutility” (Smith 2012a, 407).

Smith’s general judgement, after additionally considering the question of whether clinical trials of homeopathy should be conducted, is that

it appears indubitable that the quanta of disutilities clearly exceeds the quanta of benefits. Thus, on a

utilitarian account, homeopathy ought to be deprecated. ... [H]omeopathy ought not to be regarded as a mere tool [in the same guise of approved drugs or dialysis machines]. Because it is inherently ineffective, homeopathy cannot be ethically neutral (Smith 2012a, 408).

All of the above seemed to me—both as a biologist and as a philosopher of science—entirely uncontroversial, and I thought it a bit surprising that a major bioethical journal would go into this trite territory to begin with. Then I read the four responses that *Bioethics* published as a reaction to Smith’s article (Moskowitz 2012; Milgrom and Chatfield 2012; Sebastian 2012; Bellavite 2012; see also Smith’s response [2012b]). That’s where things got interesting—both in terms of pseudoscience and of scientism.

A few things to note before we get into the details: First, three out of the four responders are medical practitioners, not researchers affiliated with any university research centre (the exception is Bellavite). Second, none of the four responders actually engages Smith’s ethical argument, preferring to focus on the (alleged) scientific bases of homeopathy—despite the fact that the exchange was published in a bioethical journal and that one of the four responses (Sebastian’s) carries reference to Smith’s utilitarian argument in the title. Lastly, one of the responses (Milgrom and Chatfield’s) explicitly uses the word “scientism,” accusing Smith of that particular kind of (epistemic) malpractice.

I do not have time to go into each of the four responses in detail, their full-fledged arguments, and Smith’s (devastating) counterarguments, but let me give you a few highlights, especially where the issue of scientism is either explicitly brought up or very strongly implied. Moskowitz begins with the strange assertion that “if homeopathy is based on a mystery, that does not prove it to be a fake” (2012, 499), a type of reasoning that could just as well be used (and in fact has been used!) to defend the practice of astrology. He then goes on, boldly and strangely, to turn the criticism that homeopathy works by placebo and via the natural self-healing of the human body into a positive: “can a higher compliment be paid to a medicine than that its action cannot be distinguished from a gentle, spontaneous, and long-lasting cure requiring no further treatment?” (Moskowitz 2012, 500). Well, if a medicine does not do anything beyond the spontaneous healing of the body, is it still medicine? And why do we charge patients for it?

Sebastian (2012), with a fallacious argument from authority, cites Nobel Prize winner Luc Montagnier's (a virologist) support for homeopathy as somehow relevant to the discussion, in lieu of actual evidence originating from properly controlled, large, and well-statistically analysed experiments. She characterizes "allopathic" medicine as based on a deductive-nomothetic model (thus displaying only a superficial understanding of the philosophy of science [Ladyman 2002]), claiming that that is not the "model" adopted by homeopathy, for which somehow uncontrolled and anecdotal evidence is supposed to be sufficient. She then goes on to accuse Smith of thinking that Mahatma Gandhi was unethical (because he was a proponent of homeopathy), which is an example of a colossal *non sequitur* (as well as yet another recourse to irrelevant authorities—Gandhi was not a medical researcher). Finally, and without any irony whatsoever, she concludes: "If Dr. Smith's argument were simply an exercise in ivory tower philosophizing, it would be of little concern—but knowing that the health and in fact the lives of others may be affected by such thinking is very disturbing" (Sebastian 2012, 505). Indeed, it is precisely because the health and lives of people are at stake that Smith judges the practice of homeopathy to have ethical import!

Bellavite (2012), rather idiosyncratically, prefers to focus only on a defence of the homeopathic principle of similitude—the idea that diseases causing certain symptoms are to be cured by the ministration of substances that produce similar effects on the body. He engages in a manifest example of mumbo jumbo, i.e., talk that appears to be technical but in fact says nothing of substance whatsoever:

[H]omeopathic medicines could interact with sensitive (primed) regulation systems through complex information, which simulates the disorders of natural disease. Reorganization of regulation systems, through a coherent response to the medicine, could pave the way to the healing of the cellular, tissue and neuro-immuno-endocrine homeodynamics (Bellavite 2012, 506).

Talk of reorganizing regulation systems and of neuro-immuno-endocrine "homeodynamics" is an artful mix of vacuities and obfuscatory language, as Smith (2012b) clearly saw in his rebuttal. Here is how Smith—

correctly—dispenses of Bellavite's (and Sebastian's) defence of the principle of similitude:

[T]he principle of homeopathic similitude is simply a category mistake: it cannot be applied to modern medicine. The principle was conceived 200 years ago when it was unknown that disease exists in fundamentally different forms, each caused by a specific malfunction of a tissue or an organ. In light of this knowledge, we now know that diseases cannot be treated according to a common rule such as "similitude." The only correct therapy for an illness is according to its very specific etiology and pathogenesis (Smith 2012b, 510).

Exactly.

Finally, let me turn to Milgrom and Chatfield (2012), the authors who explicitly invoke scientism in the context of the exchange. To begin with, as Smith (2012b) himself notes, their response is self-contradictory: on the one hand, they wish to defend homeopathy on the ground of scientific evidence; on the other hand, they accuse Smith of being scientistic precisely because he demands such scientific evidence. It is either one or the other; they cannot have it both ways. Milgrom and Chatfield complain that Smith avoids utilitarian scrutiny of conventional medicine, which of course not only was not the scope of the original article but also would help homeopathy not at all. (Should it turn out that some or even many of the practices of conventional medicine were ethically difficult to defend that would obviously imply precisely nothing about the ethics of homeopathy.) Similarly, they attempt to deflect criticism of the empirical evidence concerning homeopathy by stating that a lot of regular clinical trials have problems, too. Maybe so, but how does that make the evidence for homeopathy any stronger?

We then come to the crux of the issue with the following extended quote:

More perplexing is Dr Smith's claim that homeopathy could weaken support for science-based medicine. Such fear is rooted not in science but in *scientism*, i.e. the *unscientific belief* that compared to other forms of knowledge, science is the absolute and only justifiable access to truth. Taken to the extreme, scientism defaults to Internet-fueled inquisitorial intolerance which, supported by certain academics, sections of the media, and

(usually anonymous) blog sites, systematically vilifies anything considered “unscientific,” e.g. the campaign to undemocratically rid Britain’s NHS of its homeopathy/CAM facilities. Fortunately, not all share such fundamentalist views, especially at the frontline (Milgrom and Chatfield 2012, 502, *emphasis original*).

To begin with, notice that Smith has never claimed that science is the “only justifiable access to truth,” much less that scientific knowledge is “absolute,” claims that truly would qualify as scientistic. He has simply treated medical research as a science, from which it follows that any claim about the medical efficacy or lack thereof of any treatment ought to be substantiated with the best scientific evidence available. I don’t know about you, but I quite like the medical advice I receive to be science-based. Notice also the semi-paranoid reference to undemocratic conspiracies to undermine homeopathy. As Smith himself explains in his rebuttal, public information campaigns about the lack of substantive evidence in favour of a particular practice, and calls for it not to be funded with taxpayers’ money, are—on the contrary—eminently democratic. Finally, also notice the use of the pejorative term “fundamentalism,” accompanied in the paper by a reference to an article by Holmes et al. (2006) where the word “fascism” is repeatedly used⁵ when writing about demands for scientific approaches to medical research. This sort of highly emotive talk—accompanied by precious little substantive evidence to back up one’s extraordinary claims—is one of the hallmarks of pseudoscience and in this case also represents an egregious, ideologically motivated misuse of the term “scientism.”

⁵ It is true that Holmes et al. (2006) qualify their usage by the prefix “micro,” as in microfascism. But here is what they say right at the beginning of their paper (which, incidentally, is entitled “Deconstructing the Evidence-Based Discourse in Health Sciences: Truth, Power and Fascism,” with no “micro” modifier): “Although it is associated with specific political systems, this fascism of the masses, as was practised by Hitler and Mussolini, has today been replaced by a system of microfascisms—polymorphous intolerances that are revealed in more subtle ways. Consequently, although the majority of the current manifestations of fascism are less brutal, they are nevertheless more pernicious” (Holmes et al. 2006, 180). So, according to Holmes et al. (2006), there is a definite link between the original fascism of Hitler and Mussolini and the “micro” variety practised by some within the healthcare community. Which, of course, is nonsense on stilts.

Scientism and the Two Cultures

I have argued that there are compelling similarities between the concepts of pseudoscience and of scientism: they both point to real problematic epistemic attitudes—the first one comprises examples of discredited or untenable notions being passed for scientifically valid ones; the second one characterizes instances of overreach by the natural or social sciences into areas or questions for which their methods are either unsuited or can be seen as complementary at best. In both cases, the term can be used properly or abused in the service of a specific agenda. It is tempting to label as “pseudoscientific” notions that may actually be worthy of further investigation, and it is equally tempting to deploy the “scientistic” trump card to make sure that importune scientists are not going to question one’s sacred cows.

Indeed, in a sense, pseudoscience and scientism are symmetrical notions: the first tends to be deployed mostly by scientists (and a number of philosophers of science), while the second is often used by humanists (and a number of philosophers whose area of expertise lies further from the sciences). Which means that the study of the use and misuse of the two terms is a microcosm of the general unfortunate state of relations between the sciences and the humanities, i.e., Snow’s “two cultures.” If we are to make substantive progress in that respect, i.e., in reconciling the two cultures and letting them proceed to do what they do while benefiting from each other, we will have to foster more dialogue, mutual understanding, and especially respect across the divide. I suggest that bioethics may turn out to be one of those fields that naturally lends itself to this sort of crosstalk: by its very nature it is frequented by scientists (medical researchers) and humanists (ethicists) who have very consciously decided to engage in a multi-disciplinary fashion to reciprocal advantage. Perhaps this is one of the loci where we can systematically parse the legitimate and illegitimate uses of the “scientistic” and “pseudoscientific” labels, thereby facilitating that much-needed and beneficial rapprochement invoked by Snow.

References

- Bellavite, P. 2012. On the plausibility of homeopathic “similitude.” *Bioethics* 26(9): 506–507.
- Blackford, R. 2010. Book review: Sam Harris’ *The Moral Landscape*. *Journal of Evolution & Technology* 21(2): 53–62.
- Goldacre, B. 2009. *Bad science*. London: Fourth Estate.

- Harris, S. 2010. *The moral landscape: How science can determine human values*. New York: Free Press.
- Holmes, D., S.J. Murray, A. Perron, and G. Rail. 2006. Deconstructing the evidence-based discourse in health sciences: Truth, power, and fascism. *International Journal of Evidence-Based Healthcare* 4(3): 180–186.
- Hume, D. 1748. *An enquiry concerning human understanding*. Edited by L.A. Selby-Bigge. <http://www.gutenberg.org/ebooks/9662>.
- Hylton, P. 2014. Willard van Orman Quine. *Stanford Encyclopedia of Philosophy*, <http://plato.stanford.edu/entries/quine/>. Accessed December 22, 2014.
- Ladyman, J. 2002. *Understanding philosophy of science*. London: Routledge.
- Ladyman, J., and D. Ross. 2007. *Every thing must go: Metaphysics naturalized*. Oxford: Oxford University Press.
- Laudan, L. 1983. The demise of the demarcation problem. In *Physics, philosophy and psychoanalysis: Essays in Honor of Adolf Grünbaum*, edited by R.S. Cohen and R. Laudan, 111–127. Dordrecht, The Netherlands: Springer Publishers.
- Loughlin, M., G. Lewith, and T. Falkenberg. 2013. Science, practice and mythology: A definition and examination of the implications of scientism in medicine. *Health Care Analysis* 21(2): 130–145.
- Milgrom, L., and K. Chatfield. 2012. Is homeopathy really “morally and ethically unacceptable”? A critique of pure scientism. *Bioethics* 26(9): 501–503.
- Moskowitz, R. 2012. For homeopathy: A practising physician’s perspective. *Bioethics* 26(9): 499–500.
- Nussbaum, M. 2010. *Not for profit: Why democracy needs the humanities*. Princeton, NJ: Princeton University Press.
- Pigliucci, M. 2008. The borderlands between science and philosophy: An introduction. *The Quarterly Review of Biology* 83(1): 7–15.
- Pigliucci, M. 2012a. Who knows what. *Aeon magazine*, October 8. <http://aeon.co/magazine/philosophy/massimo-pigliucci-on-consilience/>. Accessed December 31, 2014.
- Pigliucci, M. 2012b. Lawrence Krauss: Another physicist with an anti-philosophy complex. *Rationally Speaking*, April 25. <http://rationallyspeaking.blogspot.com/2012/04/lawrence-krauss-another-physicist-with.html>. Accessed December 22, 2014.
- Pigliucci, M., and M. Boudry, eds. 2013. *Philosophy of pseudo-science: Reconsidering the demarcation problem*. Chicago: University of Chicago Press.
- Popper, K. 1962. *Conjectures and refutations. The growth of scientific knowledge*. New York: Basic Books.
- Rosenberg, A. 2011. *The atheist’s guide to reality: Enjoying life without illusions*. New York: W.W. Norton & Company.
- Sandel, M. 2009. *Justice: What’s the right thing to do?* New York: Farrar Straus and Giroux.
- Sandel, M. 2012. *What money can’t buy: The moral limits of markets*. New York: Farrar, Straus and Giroux.
- Sebastian, I. 2012. Homeopathy and extraordinary claims—A response to Smith’s utilitarian argument. *Bioethics* 26(9): 504–505.
- Shermer, M. 2015. *The moral arc: How science and reason lead humanity toward truth, justice, and freedom*. New York: Henry Holt and Co.
- Shook, J. 2014. Spelling out scientism, A to Z. *Scientia Salon*, April 12. <http://wp.me/p4rWb7-2V>. Accessed December 22, 2014.
- Smith, K. 2012a. Against homeopathy—a utilitarian perspective. *Bioethics* 26(8): 398–409.
- Smith, K. 2012b. Homeopathy is unscientific and unethical. *Bioethics* 26(9): 508–512.
- Snow, C.P. 1959. *The two cultures*. Cambridge: Cambridge University Press.
- Sorell, T. 1994. *Scientism: Philosophy and the infatuation with science*. London: Routledge.
- Turchin, P., and S.A. Nefedov. 2009. *Secular cycles*. Princeton, NJ: Princeton University Press.
- Wittgenstein, L. 1953. *Philosophical investigations*. Hoboken, NJ: Basil Blackwell.