

Chapter 4

Science for, in and with Society: Pragmatism by Default



Abstract To rethink the relation between science and society and its current problems authoritative scholars in the US and Europe, but also around the globe, have since 1980 implicitly and increasingly explicitly gone back to the ideas of American pragmatism. Pragmatism as conceived by its founders Peirce, James and Dewey is known for its distinct philosophy/sociology of science and political theory. They argued that philosophy should not focus on theoretical esoteric problems with hair-splitting abstract debates of no interest to scientists because unrelated to their practice and problems in the real world. In a realistic philosophy of science, they did not accept foundationalism, dismissed the myth of given eternal principles, the unique ‘scientific method’, absolute truths or let alone a unifying theory. They saw science as a plural, thoroughly social activity that has to be directed to real world problems and subsequent interventions and action. ‘Truth’ in their sense was related to the potential and possible impact of the proposition when turned in to action. Knowledge claims were regarded per definition a product of the community of inquirers, fallible and through continuous testing in action were to be improved. Until 1950, this was the most influential intellectual movement in the USA, but with very little impact in Europe. Because of the dominance of the analytic positivistic approach to the philosophy of science, after 1950 it lost its standing. After the demise of analytical philosophy, in the 1980s of the previous century, there was a resurgence of pragmatism led by several so-called new or neo-pragmatists. Influential philosophers like Hillary Putnam and Philip Kitcher coming from the tradition of analytic philosophy have written about their gradual conversion to pragmatism, for which in the early days they were frowned upon by their esteemed colleagues. This new pragmatist movement gained traction first in the US, in particular through works of Bernstein, Toulmin, Rorty, Putnam and Hacking, but also gained influence in Europe, early on though the works of Apel, Habermas and later Latour.

In the previous chapter I discussed the problems and distortions of the practice of scientific inquiry and of the organization of academia. These problems do not only affect how we do research, but also which research is being done or not done. The latter is what philosophers and sociologists designate the growth of knowledge, or to use Longino’s phrase ‘the fate of knowledge’. The latter reminds us that

knowledge claims can be reconsidered and refuted, but we also can think of knowledge that never was. It was not produced because the required inquiry it was decided, or even never consciously considered nor decided, not to be pursued. This is, as discussed in Chap. 3, not the classical problem of the ‘invisible hand’, but directly reflects the politics of science and research in academia influenced by idiosyncratic or otherwise motivated scientists, public and private funders and government agencies. This process is operated by very ‘visible hands’ belonging to a large number of individuals who are serving on boards and advisory or grant committees like NIH study sections of the many institutions and organizations of the science system, at the institutional, national and international level. These organizations still dominantly use frontstage narratives that largely originate from two major sources one from the inside and the other from the outside. From the inside it was the Legend with all the preconceived ideas and its consequences, discussed in the previous chapters, and from the outside it was the capitalist ideas of economic power and profit and of technological control in the modern knowledge society. These two ideologies have in strong synergy since the 1980s shaped scientific inquiry with serious consequences for the growth of knowledge and thus for society at large and at the personal level for the lives we live. This is experienced daily and is being increasingly recognised by virtually all researchers in the international scientific community, which in the past ten years has led to a global discussion of how science is broken and how to improve or, if possible, fix it.

Before going to discuss the prospects, opportunities, pitfalls and dangers for change of the aims and institutional organization of scientific inquiry, I will take a step back and reflect on the consequences of the conclusion of the previous chapter that the academy and the practice of research are in need of serious change. To successfully make this change happen, a series of essential changes have to be made, with the required precautions taken, that will gradually promote and enable the required transition in the coming years. For this transition we need to understand (as Hacking would say, ‘take a good look at’) the modern practice of science, how it is done in the daily life of researchers, but also how researchers off the record talk amongst each other about what they do. It is as important to understand how in general the community of researchers in fosters a particular image of science especially when talking to lay audiences and when scientists or science administrators appear in the media. It has become clear in the previous chapters that the popular image is a Legend and does not at all match with what the practice of science is and how research is (and was) done. That classical myth, although obsolete and untenable, is still dominant, and more important, inhibitory to the required change to make science and research fit for the future. In this chapter I will argue for a powerful alternative theory and vision. This new narrative needs to provide a modern, more social and humanistic image which must have a firm basis in modern thinking in philosophy, history and sociology of science. This modern image must thus not be a myth like the Legend but must be being recognized and practiced by active researchers and be an all-encompassing empirical account and theory about the many different styles and practices of scientific and scholarly research, in the past and at present.

Several writers about science who have discussed the practice of science have described new modes of science as it has developed since the 1980s or should develop, using labels like ‘industrialized’ (Ravetz, 1971) and ‘post-normal’ (Ravetz, 2011), ‘post-academic’ (Ziman, 1994, 2000), ‘Mode-2’ (Gibbons et al., 1994).

Ravetz (1971), Ziman (2000) and Nowotny et al. (2001) do elaborate on a general practical theory and philosophy of science which explicitly refers to recent developments in the philosophy and sociology of science and more broadly in STS research after 1980. As discussed above, until the early 1990s, the truly multidisciplinary Science and Technology Studies, which is what these writers practiced, had still to come of age as a respectable academic discipline in its own right. Mainstream professionals guarded the tribal fences between philosophy, sociology, anthropology, psychology, economics and history of science. This has not promoted our understanding of the interrelationships of society and science in history and modern times. Toulmin as we saw complained about it in the late 1950s. Even Bruno Latour who notoriously and successfully has been crossing these borders, which he argues is common in anthropological studies of tribal life in the Amazon or New Guinea, complained in his *‘We have never been modern’* about these dualistic seams between nature, culture and the sciences. *‘We pass from a limited problem - why do the (sociotechnological) networks remain elusive? Why are science studies ignored?- to a broader and more classical problem: what does it mean to be modern?- When we dig beneath the surface of our elders; surprised at the networks that- as we see it-weave our world, we discover the anthropological roots of the lack of understanding. Fortunately, we are being assisted by some major events that are burying the old critical mole in its own burrows. If the modern world in its turn is becoming susceptible to anthropological treatment, this is because something has happened to it.*

we have known that it took a cataclysm like the Great War for intellectual culture to change its habits slightly and open its doors to the upstarts who had been pale before (Quotes are from section 1.3) (Latour, 1993).

Although Latour continues this observation with the fall of the Berlin Wall in 1989, another cataclysmic global shock, for me his lines take us back to Chap. 1, and John Dewey who at the beginning of the twentieth century in fact before and after the Great War of 1914–1918, argued for another science and philosophy, that both are socially and culturally more inclusive and reflexive than the (natural) sciences of his days. It is pragmatism that recently many became to believe provides the best approach for our understanding of and contributing to the complex of society and science. The pragmatist theory of scientific inquiry, developed predominantly between 1870 and 1940 by the early American pragmatists, Peirce, Dewey and James, was rejuvenated and modernized by a group of high-profile ‘new pragmatists’ (Misak, 2007) in the second half of the last century. In this chapter, I will briefly discuss the essential features of pragmatism and argue that it provides the default theory and concepts of the aims and practice of science since it is open, non-dogmatic and pluralistic, inclusive and contextual, lives up to our present state of hyper-modernism and acceleration with fluidity of place and time. For the researchers it does not provide a mythical ‘scientific method/idealistic, positivist Cartesian

certainty based on formal rules and foundations, however, it does provide rich guidance and understanding of the objectivity of the reasoning, and functioning of the processes and practices of the communities of inquiry in the sciences and humanities and how they may change over time. Pragmatism is clear about the intersubjective procedure of evaluation of our accepted scientific beliefs, importantly in applying and testing them in actions and interventions and is honest about the intrinsic fallibility of our beliefs. Pragmatism is fallibilistic but is in essence against scepticism. Scepticism may be a fine attitude for the study room, academic debates and for papers, but it loses force in the outside world.

Pragmatism in principal sees scientific research as a means to an end. The ultimate aim is to address and alleviate problems and issues that prevent people from living the good life. Therefore, science must constantly engage with the publics and their problems and science is thus seen a key component of the aspiration of the true idea of democracy, not naive but realizing all its issues (Dewey & Rogers, 2016). This all-encompassing concept of theory and practice can provide guidance for shaping the organization of modern science and inquiry, of aims and ownership and the common good, participation, processes, ideal deliberations and agenda setting, inclusive evaluation criteria - incorporating facts, values and goals, action, interventions and implementation- and social reflexivity of all these steps which is needs [inside] because it hits us from [outside] from an ever more rapidly changing hyper-reflexive modern society (Beck et al., 1994; Nowotny et al., 2001). Outside and inside in the previous sentence were put in brackets because the classically defined boundaries between science and society, the experts and lay publics, are and have always been permeable, which was experienced with a negative connotation as leaky by those who had held on to the dualities of the scientific method of the Legend.

4.1 Pragmatism by Default

Given these considerations about science and society, and the demise of analytical philosophy, there are two main reasons why it is believed that pragmatism with the diverse new pragmatist interpretations of recent times is the best idea of science and philosophy of science. First, it provides insight and understanding which matches the practice of science since it starts from a realistic historical and sociological understanding of the social practice of science. Second, for philosophers of science who are active in the post-empiricist positivist era, pragmatism appears to be an acceptable and fruitful philosophical proposition that is not impeded by esoteric problems as empiricism and positivism both are.

For the philosophers who started their training and academic careers before the 1960s or even 1970s and whose philosophical thinking until late in life has been dominated by positivism or various kinds of theories of empiricism and realism, this 'pragmatic turn' has not been easy. All of them in their articles and books literally describe it as a process of conversion, a paradigm shift which was frowned upon or ridiculed by their peers and colleagues.

Most writers about pragmatism describe how pragmatism in the USA was dominant until the 1930s but was rapidly overtaken by the analytical tradition (Diggins, 1994; Misak, 2013). With the rise of the analytic positivistic tradition -which the members of the Vienna Circle, after fleeing Europe in the 1930s have spread across the USA- pragmatism rapidly lost its influence. As we have seen (in Chap. 2), mathematics and the natural sciences as dominant models for science and the Cartesian system of dualisms shaped the analytical and linguistic turn in philosophy of science. In the eyes of the diehard philosophers of those days, compared to the rational and formal approach of logical positivism and empiricism, pragmatism had little of epistemology and of a formal philosophical system to offer. Peirce's philosophy was nearest to such a system with his analysis of the three methods of inference: induction, deduction and abduction. Because of this, Popper and the Popperians and some philosophers who came through the analytical tradition, like Nagel, Putnam, Hacking and later Misak, had strong affinity for Peirce. James and Dewey did not bother with that formal philosophy and explained their thoughts and argued and reasoned in plain language. The new-pragmatists, like Rorty, Bernstein and Kitcher where more engaged with James and Dewey's broader view about the social and political, 'science in democracy' as Kitcher called it. Make no mistake, this writing style, reasoning and argumentation devoid of the esoteric 'analytical-logical-formal' however, is misleading regarding the depth of thought and insight proffered, as Putnam said about Dewey and Hacking said about Peirce and James.

4.2 Why Bother?

I believe that for practising scientists, both natural scientist and scholars from SSH, who have a certain degree of proper self-understanding of their methods, the meaning of its intersubjectivity, the limitations of its claims and the social aspects of their practice of inquiry, pragmatism may well be considered a most realistic image and theory of their daily work. Moreover, even those who have not reflected a lot, or young professionals who not yet thought a lot about these issues, which we know is not unusual at least in the biomedical and natural sciences, pragmatism may come on to them as quite naturalistic descriptive. What then does pragmatism have to offer to them? Given what I discussed in Chap. 2, in the confined space of the practice of inquiry, studying and researching, doing experiments and interventions -in the library, the lab, the clinic or in societal practices- not too much. At that level, scientists, do adhere to validated and accepted methods, logics and procedures of their respective disciplines, but do not bother on a daily basis with the higher levels of philosophical assumptions. So why should they, or we, now bother about pragmatism? They, and we, should very much care about pragmatism. We have seen in Chap. 3 that only one level up, where the mundane matters of management like strategy, policy and governance are discussed, the assumptions of the Legend still reign. This is most visible as soon as we have to consider issues of quality, excellence, acceptability, impact, and evaluation. Then assumptions of the Legend

immediately become visible and are at the table in the deliberations which sets scene and tone and in part cause the distortions discussed in Chap. 3. It is at this level that pragmatism will provide realistic guidance for these deliberations and agenda setting, inclusive evaluation criteria - incorporating facts, values and goals, action, interventions and implementation- and social reflexivity of all these steps. At an even higher level, it likewise can be instrumental for shaping the mission and strategy of the organization and government of science at institutional and national level, regarding its higher purpose, aims and ownership and relation to the wider public. At this level, pragmatism because of its realistic, modern, open and democratic view of science, allows for a better narrative with responsibility in how we communicate about science and research to and importantly engage with the various public representatives and public debates and in the media. What forces were working against the pragmatic turn?

Reading the vast body, or even the top 10% of the literature of the past 30 years on pragmatism and the pragmatic turn is impossible and I believe not required for the argument to be made in this book. There is, paradoxically already a lot of esoteric writing about these philosophers whose thesis it was that philosophy should not deteriorate into esoteric writing that does not bother anybody in the real world anymore. The secondary literature on the classical philosophers, Russell, Popper, Kuhn and Wittgenstein, the famous Vienna Circle and the Frankfurt School is also vast, and many have read not so much the original texts but overviews in the books about philosophy of science and modern science. Until very recently, textbooks of the philosophy of science, even philosophy of the humanities, social science and even sociology rarely mention or discuss the work of the early pragmatists, some do refer to Rorty's progressive interpretations of James and Dewey. When I recently confronted some well-known Dutch authors of these textbooks who I knew clearly do sympathize with pragmatism with this omission, they shrug their shoulders. They reply with the words 'I thought it was not yet philosophically developed enough' or that 'it is not yet suitable for introductory texts books'. Instead, we offer our students mainly still the myth of The Legend vintage 1950s, with sometimes a small side dish of Kuhn vintage 1962 and a glims of the early works of Latour vintage 1979 or 1983 with the explicit warning 'watch out it's spicy'.

Barker and Kitcher, however in their very nice textbook *Philosophy of Science* (2013), where the demise of logical positivism is spelled out, if not celebrated, discuss how we are now able to come to a realistic image of the pluriform practices and can be frank about the limitations of the sciences. Even there, no reference to an alternative realistic narrative of pragmatism is to be found (Barker & Kitcher, 2013). This is of interest given the life-long struggle of Kitcher with his conversion described in Chap. 2. In his '*Preludes to Pragmatism*' and '*The Ethical Project*' written in the same years as his 2011, he takes Dewey's pragmatism as the leading philosophy to think about modern science and ethics in democracy (Kitcher, 2011, 2012). Is it really the case that main-stream philosophers, sociologists and science and technology scholars writing about science consciously kept a safe distance to pragmatism because intellectually and emotionally the gap between the Legend and pragmatism was too big for them? Yes, and Kitcher is most frank about it on the

very first pages of *Preludes*: ‘Classical pragmatism is, I believe, not only America’s most important contribution to philosophy, but also one of the most significant developments in the history of the subject... ‘Twenty years ago, I would not have made that judgement. Like most of my contemporaries in philosophy departments in the Anglophone world, I would have seen the three canonical pragmatists -Peirce, James and Dewey- as well-intentioned but benighted, labouring with crude tools to develop ideas that were far more rigorously and exactly shaped by the immigrants from Central Europe whose work generated what is (unfortunately) known as “analytic” philosophy.’pxi (Kitcher, 2012).

Because of this it has not resulted in a reform and its influence faded apart from a few philosophers who have kept the debate about it going. Is the pragmatic turn difficult, for them and most of us, because pragmatism does not offer a new myth or fresh ideology for the twenty-first century which provides a sense of certainty, an uncontested foundation, a legitimization with which we can assure ourselves and the public about the authority of science? Given Dewey’s severe criticism about this *quest for certainty* and the history of the demise of the Legend the deceptively common-sense philosophy of pragmatism clearly seems to contribute to the uncomfortable relation the philosophers and interested scientists have with pragmatism. In addition, we have seen that the Legend has had enormous impact on the politics of science in relation to society, as frontstage narrative, but that this narrative paradoxically is even in use within science, backstage (!) and there has distorted the general view of the sciences and the humanities. At both these levels of the scientific community the pragmatic turn thus will surely bring gains to many, but losses to others, the former academic elites that lose reputation, access to control and power and its many associated advantages. This institutional feeling of loss and uncertainty also may hold for the philosophers who did not want to be affiliated with non-mainstream philosophy and their proponents. Is it so that only after a successful mainstream professional career in academia, with independence of one’s peers, there is finally room and opportunity to engage with the non-mythical mundane pragmatism and does one have the guts to be frank about the Legend?

I will restrict myself here to a concise overview of the main concepts of pragmatism and discuss a bit more in detail the more recent works of the new pragmatists as far as it relates to the philosophical principles and ideas of inquiry.

Richard Bernstein, whose perspective is from the humanities and social sciences, and his experience in the US liberal arts college system, has written with great authority from the broader pragmatist perspective (Bernstein, 1983, 2010). His *Overview* (p1–49, (Bernstein, 1983)) is quite technical, but provides a comprehensive history of the concept of rationality in modern philosophy which makes the strong case that pragmatism is the default (in my words). His discussion of the work of Habermas and the early influence of Peirce on Habermas (Habermas, 1970, 1971) will be revisited in Chap. 5. Hacking’s *Representing and Intervening* (Hacking, 1983), I have quoted already, is very concisely discussing the problems of positivism, especially in the three last pages where the legacy of Peirce is brought in, and in the bit more than 5 pages on what pragmatism has to offer. Hillary Putnam’s *Pragmatism* (Putnam, 1995) especially the less technical chapters on

William James and the in total 18 pages of Chap. 2 on *Pragmatism and the Contemporary Debates* are very good reads.

The Metaphysical Club, by Louis Menand a professor of English, is a prize-winning highly praised, more literary intellectual history of pragmatism (Menand, 2001). It discusses what prompted these thinkers to work out this unique truly American philosophy between 1870 and 1940. He describes quite colourfully, how they differed in the range of issues they wrote about, in their style and temperament and political engagement. We also get a view of the very different sometimes deeply troubled personal lives they have had, which especially relates to Peirce. Reading this book makes you realize how different the world and the philosophical, religious and political issues were only one hundred years ago. At the same time, it becomes clear how modern and humanistic the pragmatists were regarding their ideas about scientific inquiry, their critique of the Cartesian and positivistic philosophies, the relation with society and the publics, the methods and social structures. It becomes clear that they reflected on inquiry not only from the point of view of *episteme* (theoretical knowledge), but also *techne* (technological application and action) and *phronesis* (practical wisdom and reason) (Bernstein, 1983). Dewey later started a real pragmatist movement which took the thinking and philosophy to many other fields of humanities and social sciences, most of all educational theory, ethics, and political theory on for instance the workings of democracy in the Chicago Laboratory School. Menand provides a fine accessible summary of pragmatism in non-technical language in chapter 13 (p351–375), which starts as follows:

Pragmatism is an account of the way people think, the way they come up with ideas, form beliefs, and reach decisions'...there is no noncircular set of criteria for knowing whether a particular belief is true. No appeal to some standard outside the process of coming to the belief itself.

He cites James who had the most expressive style of writing and has been instrumental in promoting the work of Peirce and Dewey in the USA: *'Truth happens to an idea. It becomes true, is made true by events. Its verity is in fact an event, a process, the process namely of verifying it.'* *'Beliefs, in short, are really rules for action, and the whole function of thinking is but one step in the production of habits of action.'* He cites James' most discussed and debated statement, which takes the philosophy of Peirce in the eyes of Peirce much too far, but has much inspired Rorty sixty years later years later: *'...the true is the name of whatever proves itself to be good in the way of belief'*. This could in our days well have been a tweet.

Charles Sanders Peirce (1839–1914) was the real founder of pragmatism in the eyes of most philosophers of science. What he thought and wrote at the age of 29 in 1870 is most impressively reflecting unbelievable intelligent, independent broad and original scholarship. Reading about him, his temperaments, his personal problems, the hardships that befell him, and how that has also affected his professional career makes you feel sad. Peirce was trained as a natural scientist with laboratory experience and made major contributions to mathematics and formal logics and is regarded as one of the most brilliant American philosophers (Nagel, 1940). He showed us the way out of Cartesian dualisms, the dichotomy of fact and value, the

problem of representation by theory of reality and the problem of foundations and ‘truth’. The impact of his work outside the US was recognized in England by Frank Ramsey in the 1920s. Ramsey discussed Peirce’s philosophy with Russel and Moore and in several sessions with Ludwig Wittgenstein in Vienna. (Misak, 2013; Putnam, 1995) Peirce also influenced Popper who agreed with ‘his critique of the search for epistemological origins that has dominated so much of modern philosophy’ (Bernstein, 1983, 2010). Bernstein emphasizes that Peirce, next to more methodological ideas, has strongly proposed the concept of the community of inquirers and ‘his relentless criticism of the subjectivism that lies at the heart of so much modern epistemology’ and connects to modern major influential thinkers, in the next lines: ‘...he develops an intersubjective (social) understanding of inquiry, knowing, communication, and logic. Jürgen Habermas has argued that at the turn of the twentieth century there was a major paradigm shift from a ‘philosophy of subjectivity’ or a ‘philosophy of consciousness’ to an intersubjectivity (social) communicative model of human action and rationality. One of the primary sources of this shift is evident in Peirce’s early papers. The above passage also anticipates the centrality of the community of inquirers in Peirce’s pragmatism. ..To say that inquiry is self-correcting is to say that a critical community of inquirers has the intellectual resources for self-correction.’

It is only in and through subjecting our prejudices, hypotheses, and guesses to public criticism by a relevant community of inquirers that we can hope to escape from our limited perspectives, test our beliefs and bring about the growth of knowledge (p35/36) (Bernstein, 1983).

We have seen in the previous chapter that this is an ideal of integrity, a major critical aspiration that the community has to effectively perform at all levels of inquiry. Peirce and especially Dewey have been criticized as being naïve in their views of communication and interactions in the process of inquiry and, in Dewey’s later works, engaging publics from outside academia. Popper (Popper, 1981) who also in the same vein emphasized the continuous process of criticism in science, also warned against distortions of the discourse by internal and external interests. As the founder, or one of the founders of pragmatism Peirce is favoured and admired especially by philosophers who came from the analytic tradition. Above I cited James’s popular version, we would now say ‘tweet’ of the pragmatic maxim, but Peirce as originator of the maxim was much more subtle on this. Misak, but also others have tried to correct the popular view that was instigated by James. Misak (p29) writes that his notorious statement is to be understood as follows: ‘Consider what effects, which might conceivable have practical bearings, we conceive the object of our conception to have. Then, our conception of these is the whole of our conception of the object’. ... ‘we must look to the upshot of our concepts in order to rightly comprehend them’. And Misak’s favourite: ‘we must not begin by talking of pure ideas, – vagabond thoughts that tramps the public roads without any human habitation, – but must begin with men and their conversation’ Misak p31 (Misak, 2013).

He rejected given, timeless principles, stating that ‘there is no cognition “not determined by a previous cognition” or “something outside of consciousness” (p39). “*he thought that ‘truth was a matter for the community of inquirers’ not for the individual inquirer’. Science and inquiry and rationality are matters of getting our beliefs in line with experience, evidence and reason in an ongoing community project. In our efforts to understand reality “each of us is an insurance company’* (p37). This process in practice does never stop. Peirce is categorical to state that this is the case since all our beliefs are imperfect and are subject to continuous testing. There are degrees of acceptance and of trust in a belief of course. It is, he proposes, by this process of *Fixation of Belief* we gradually improve and finally come to a set of converging true beliefs. But when is finally? This is problematic but not really: like Popper, Peirce proposed a metaphor: *‘its reasoning should not form a chain which is never stronger than its weakest link, but a cable whose fibres may ever be so slender provided they are sufficiently numerous and intimately connected* (Collected Papers 5.265). He proposed no unique method, but deduction, induction and abduction, also designated inference to the best explanation. This reminds us in many respects of Poppers falsificationism of conjectures and refutations. It does sound familiar to active scientists in the natural and social sciences with respect to the hypo-deductive method starting with an idea, or hypothesis to be tested and proven, but falsification and refutation is not really the main goal in daily in practice.

John Dewey, a student of Peirce, was very much inspired by the work of Peirce but his view of philosophy and scientific inquiry was much broader. He was concerned with the role of science in the broad scheme of the problems of society and its diverse publics and of democracy. He wrote extensively about the relation between science, the conduct of inquiry and the problems of these publics. This philosophy which naturally flows over in political theory is the pragmatism I will discuss in Chap. 5 where involvement and engagement of the publics with scientific inquiry will be discussed in terms of the present societal challenges in our modern times. Dewey had a background in educational theory and pedagogy, child upbringing and development. In his thinking education was a major factor in building civic communities that could allow for public to participate in deliberation about inquiry and action. Education in his mind was life itself. For him inquiry must be prompted by a concrete situation of doubt or a problem and thus foremost had the obligation to contribute to mitigation or solving issues that hindered people from leading the good life. This was the short-term aim of science and he did not bother with the Peircean epistemological problems how in ongoing inquiry in the long run ‘truth’ comes about. Dewey was a true public intellectual who connected in a natural way inquiry with social action in which he himself engaged forcefully in political actions. He had high visibility in American public life, politics and its debates for instance at the times of McCarthyism.

Bernstein elaborates on Dewey’s vision of radical democracy which will be revisited in Chap. 5 (Bernstein, 1983). Dewey wrote widely and a lot. His contribution to the philosophy of science which is most relevant here has been summarized by Hacking where he divides pragmatism in two *‘Peirce and Putnam on the one hand and James, Dewey and Rorty on the other. ..It is interesting, for Peirce and*

*Putnam both to define the real and to know what, within our scheme of things, will pan out as real. This is not of much interest to the other sort of pragmatism. How we live and talk is what matters, in those quarters. There is not only no external truth, but there are no external or even evolving canons of rationality. Rorty regards all our life as a matter of conversation'. Dewey rightly despises the spectator theory of knowledge...the right track in Dewey is the attempt to destroy the conception of knowledge and reality as a matter of thought and **representation**. He should have returned the minds of philosophers to experimental science... in his opinion things we make (including all tools, including language as a tool) are instruments that **intervene** when we turn our experiences into thoughts and deeds that serve our purposes..' (p 62/63) (Hacking, 1983).*

Putnam, whom I introduced in Chap. 2, has made an intellectual journey from analytical philosophy to pragmatism, and even after 1981 apparently became more influenced by the works of James and Dewey than Hacking in 1983 had anticipated. In the collection of papers published with the telling title *Words and Life* (Putnam, 1995; Putnam & Conant, 1994) there is deep admiration for Dewey's philosophy of inquiry as shown in *Pragmatism* that same year. '*Perhaps the most detailed case for the view just defended, the view that all inquiry, including in pure science itself presupposes values, is made by Dewey in his Logic (Dewey, 1939), here I want only to discuss one aspect of Dewey's view, the insistence on a very substantial overlap between our cognitive values and our ethical moral values. I have already examined the claim that there is a fundamental ontological difference between cognitive or 'scientific' values, and found that the reasons offered for believing that claim fail.*

Comparing Carnap's (positivistic) view with Dewey's: '*For Dewey, inquiry is cooperative human interaction with an environment; and both aspects, the interactive intervention, the active manipulation of the environment, and the cooperation with other human beings, are critical. For the positivists...the most primitive form of scientific inquiry, and the form that they studied first when they constructed their (otherwise very different) theories of induction, was by simply enumerating. The model is always a single scientist...For Dewey the model is a group of inquirers trying to produce the good ideas and trying to test them to see which ones have value*'.

Putnam then states: *...cooperation must be of a certain kind in order to be effective,. It must, for example, obey the principles of "discourse ethics" [here he cites Habermas]...When relations among scientists become relations of hierarchy and dependence, or when scientists instrumentalize other scientists, again the scientific enterprise suffers.* Dewey was as Putnam states, *not naïve and was aware that there are power plays in the history of science as in the history of every human institution, "but he still holds that it makes sense to have a normative notion of science...Both for its full development and for its full application to human problems, science requires the democratization of inquiry.*

"Dewey opposes the of the philosophers 'habit of dichotomization of inquiry.' in particular he opposed both the dichotomy "pure science/applied science" and the dichotomy 'instrumental value/terminal value". Pure science and applied science are interdependent and interpenetrating activities, Dewey argues. ..Science helps us to achieve many goals other than the attainment of knowledge for its own sake,

and when we allow inquiry to be democratized simply because doing so helps us achieve those practical goals, we are engaged in goal-oriented activity. ..we are not- nor ever were-interested in knowledge only for its practical benefits; curiosity is coeval with [= as old as] the species itself, and pure knowledge is always, to some extent, and in some areas, a terminal value even for the least curious among us (p172, 173) (Putnam & Conant, 1994).

I have in the previous chapter demonstrated, using Bourdieu's theory of 'the field'(Bourdieu, 1975), how the internal politics and power games of science have in the past 40 years developed into a system where the discourse ethics due to, among others these dichotomies of the Legend and other related interests is heavily plagued if not seriously distorted. I will discuss in the next chapter how I think the community of inquirers can be improved and organized based on these insights.

4.3 New Pragmatists

Philip Kitcher is widely considered to be one of the leading figures of contemporary philosophy of science. I have in Chap. 2 referred to his profound intellectual struggles to release or even to liberate himself of the analytical tradition and the myths of the Legend. In his *Science, Truth and Democracy* (Kitcher, 2001), he takes his critique of the Legend quite some steps further than in *The Advancement of Science* published only eight years before.(Kitcher, 1993) His phrasing is cautious, given the then still raging 'science wars' about foundations, objectivity and scientific authority, in order '*to articulate a picture of the aims and accomplishments of the sciences so that moral and social questions can be brought into clearer focus*' (p xii). He discusses in the first six short chapters the claims and problems of the Legend related to objectivity, theory choice and how next to cognitive values, social and ethical values play a role gradually introducing the context of inquiry: aims, theoretical and practical interests and social, moral, political and religious values. It feels as if he wants to take the believers of the Legend by the hand and lead them through the desert (of the demise of the Legend) to the other side where between the extremes fertile soil await scientific inquirers, no matter if they are from the 'hard' or 'soft' sciences. In this book, Kitcher does not explicitly tell the reader that this fertile soil is to be found in the land of pragmatism. Rorty, who wrote like Dupré some nice lines on the back of the paperback edition of 2003, put it like this '*Kitcher navigates very skilfully between the extremes of positivistic science-worship and Foucauldian distrust of the regimes of truth*'. Kitcher, reflects on representation and interventions (p52): '*Representations are constructed, but do not construct the world*'. But...' *the impact of categories [claims and theories] on reality 'by way of human intervention is more evident in the biological sciences than in the physical sciences and most striking in those areas of inquiry in which we study ourselves.'* '*Categories are consequential. Accordingly, there is important workto do be done in reconstructing the ways*

in which our most influential divisions (ideas about reality) were constructed and how they have left their mark on the world we inherit’.

The history of the ‘hard’ sciences provides excellent examples for this, but Kitcher mentions scientifically derived labels such as ‘insanity’, ‘race’ ‘homosexuality’, we now would add ‘inequality’, ‘health’ or from a reflexive viewpoint ‘absolute truth obtained by pure scientific inquiry’. Kitcher refers to the theoretical and social critique of Michel Foucault, a stranger in the land of the Legend, but thriving on the fertile soil of pragmatism. In the next step Kitcher moves to the idea that theories are to be regarded as maps, a powerful metaphor explicitly put forward before by Wittgenstein, Toulmin and Ziman. Maps are not to be taken to literally reflect the world, but always be a substitute that, when accurate, of great value to assist us in navigating and intervening in the world. To take actions, humans trust accepted beliefs that have been shown and proven to work. Users of a specific map, can improve the map (or have the map improved) based on problems they experienced when they used it, applying new knowledge and technology. There are at the same time many maps possible of a given territory dependent on the changing interests of its users and with new knowledge other maps will be produced. These are different, but not per definition better maps. The key question for us now is: Who does, and how do we define what is good? With the metaphor of the map Kitcher arrives at the question of ‘*the goals of inquiry, a specification of what constitutes significant science that will apply across all historical contexts and, independent of the evolving interests of human beings*’ p62). Indeed using examples from biology, he concludes: ‘*Like maps, scientific theories...reflect the concern of the age. There is no ideal atlas, no compendium of laws, or “objective explanation” at which inquiry aims*’. In an interesting intermezzo, the issue of value neutrality, autonomy and academic freedom, classical flaws of the Legend are addressed. These nearly six pages are thus very relevant for our discussion of the myth and how an alternative more realistic theory of scientific inquiry may help out. Kitcher approaches the problem via what he calls ‘the myth of purity’, the ‘pure versus applied dichotomy’ rejected on conceptual grounds by scholars before (see Chap. 1).

Kitcher, agrees with Dewey that science for the sake of science, to add to the body of knowledge can be significant on pure cognitive grounds. ‘*The aim of science (pure science, basic research) is to find truth; the aim of technology (applied science) is to solve practical problems.*’ But it is not that simple: ‘*the aim of science is to discover significant truths*’ (p87). It is recognized that there is always a chance of practical use somehow, but this is not the interest of the investigator who says to pursue curiosity for curiosity sake. Indeed, we know that, although these investigators virtually all proudly state that they do pure fundamental science, as soon as they are interviewed about their work because of a Nobel prize, a breakthrough paper or a major personal grant that they have won, they start to explain how their work may lead to a new method of treatment, medicine, help solve problems of green energy, etc. There are, says Kitcher always motives for the ‘pure’ scientist in the background or actually, as we saw in Chap. 3, in the foreground, as reputation, fame, career options, access to funding because of discoveries to be made. That is not

different for pure or applied science and not even for technical sciences. The distinction between pure and applied research is blurry, complex and *'in extreme cases researchers can quite legitimately declare their intentions to be thoroughly epistemic. However, when only little curiosity is needed to see that the current [knowledge] has been shaped by dubious ventures from the past, or when the propensity of others to engage in morally consequential applications ought be obvious, the researcher who proclaims solely epistemic intent is guilty of self-deception (at the very least). Pure researchers, then are not simply whose intentions are entirely to promote epistemic significance but whose lack of interest in the practical can be justified'* (p89) Why has the distinction seemed so important? *'It seems to be to limit the scope of moral, social, and political appraisal...to which the practice of science is accountable....but only in the context of applied science, or of technology. The myth of purity proposes that there is a distinction that fulfils these purposes.'* (p89-90) Kitcher obviously rejects this myth for this specific reason of neutrality and evasion of responsibility. We have seen in the previous chapters that the myth of purity also implicitly and explicitly confers the message to and from academia that pure science is morally and ethically pure and therefore the 'high church', whereas applied science and technology are stained with non-scientific bias and interests hence are 'low church'. This goes back to Greek philosophy and has survived until it was incorporated in the Legend but is firmly rejected by pragmatism. It are the intentions, the value and impact, the actions it makes possible, not the practices and methods of inquiry that count.

In the following chapters, he takes the final step, beyond *'the traditional philosophy of science .. that provided a very narrow normative perspective science.'* (p111) The next problem is how to organize *well-ordered science* in the larger community of inquiry in interaction with policy making and the publics knowing that for significant science it must relate to contexts where the problems are. This is a central theme encompassing all sciences alike pure, applied and technology. Kitcher agrees with the pragmatists that it is the obligation and responsibility of scientists to strive for well-ordered science. The interests of the less powerful publics are to be cared for, taking into account as Kitcher states, the problem of vulgar democracy and tyranny of the ignorant which is a nightmare scenario for scientists who believe any interaction with representatives of lay publics threatens basic science. On the other hand, scientific inquiry needs to be protected against the interests of the powerful private parties who have advantages in funding and protected from unwanted political influences. A problem that has grown bigger and bigger since 1945.

In his *Science in a Democratic Society* published in 2011, Kitcher again takes on the problem of the ideal of well-ordered science in a well-ordered society, obviously much inspired by Dewey. In this book, Kitcher apparently deliberately abstains from explicitly presenting pragmatism as an alternative, or as I say, the default for the obsolete flawed views of the Legend. Still, Kitcher states that the problems of science, in his opinion, relates to the classical theoretical picture of scientific inquiry, designated the mythical Legend by him before. The legacy problems of the Legend, as we discussed in Chaps. 1, 2 and 3, also carry over to the way science and its elites interact with society. This I will address in the next chapters.

Before doing so, I will briefly discuss Ian Hacking's general thoughts about pragmatism mainly based on his contribution to Misak's *New Pragmatists* (Misak, 2007). Hacking (1936), who I have cited frequently already, has contributed significantly to the philosophy of science. This not from within one particular school of thought, but always taking his own point of view and critically reflecting on the thoughts of others and himself. Hacking is a truly independent thinker who kept his intellectual distance to the logical positivists of the Vienna Circle, to those who critiqued the positivists, to most of the new pragmatists and to pragmatism. He refuses to be labelled. He is however not a nihilist, nor a plain relativist or sceptic and he is not at all in total doubt about science. Like many of the philosophers we mentioned until now, he started in physics and mathematics and then changed to philosophy in England in the 1950s. He thus escaped from the omnipresent formative influence of logical positivism in the USA in those days and confesses that the work of Popper has been his main influence, which lead Hacking to Peirce. With that philosophical background, he came to the USA in 1974. He says he had no idea why so many young American philosophers found Rorty's *Philosophy and the Mirror of Nature* (Rorty, 1979) so exciting' (p35). That book in fact was, Rorty's very progressive rejection of positivism and rediscovery of pragmatism which for Hacking coming from the UK was not a surprise, but in these days for mainstream American philosophy it surely was. Hacking in his typical argumentative style refuses to be regarded a new pragmatist, but on several of the main themes agrees with the pragmatists: the idea that knowledge has no timeless foundation and is fallible, but that '*science has the unusual virtue being intrinsically self-correcting*'. That came to him via Lakatos and Popper but he says: '*it never occurred to me that all knowledge needs foundations, so I did not well, understand what Popper opposed*'. '*Frege had a dream of understanding a pre-given truth that made arithmetic certain, but I never caught the dream*' (p36). '*When I was a student, the search for certainty seemed as dated as Edwardian clothing soon to be favoured by Teddy boys.*' In this context he agrees very much with Dewey '*scathing phrase (of the) 'spectator theory of knowledge which occupied the classical analytic philosophers. He agrees with the pragmatist's idea, first proposed by Peirce of the community of inquirers that is instrumental in achieving and testing accepted beliefs. He applauds the pragmatists 'for taking a look' at the practice of inquiry in that sense he says he has always been a pragmatist looking at 'real-life examples and real-life expertise'. He argues however that this 'is now no more characteristic to pragmatism than it is to any other contemporary style of philosophizing*'. Hacking as quoted in Chap. 2 before said that '*his view (that) realism (of theories and claims) is more a matter of intervention in the world than of representation on words and thought, surely owes much to Dewey*'. *I recognised that Dewey has there been before me. How did I get there? By talking to my scientific friends*' (p41). In a very interesting paragraph about the problem of the reality of non-observable theoretical entities in physics, he says that for physics it does not make the slightest difference. '*Perhaps it does matter to the funding of physics: It was once alleged that in the journal Nature that the fallibilism of anti-realism of Popper, Kuhn, Lakatos and Feyerabend caused Mrs*

Thatcher to put a spoke in the wheel of British physics.’ Actually, Hacking argues she wanted economic returns on investment, ‘*cash value and saleable results.*’ (p42) After much praise for Dewey, James and Peirce and after he connected Nelson Goodman and Erwin Goffman to pragmatism, at the end of the only 14 pages of his contribution, he remembers how Goodman liked his review of Latour and Woolgar, *Laboratory Life* written nine (!) years after its publication (Hacking, 1988).

Latour and Woolgar and especially Bruno Latour have fundamentally changed the discourse about science by ‘taking a very serious look’ indeed for two years in the 1970s at a biochemistry lab headed by Roger Guillemin. This happened to be the Salk Institute at La Jolla, where I had just in the spring of 1984 visited a Dutch friend who did his post-doc there with another famous group leader. I discovered *Laboratory Life*, a truly seminal book in the summer of 1984 when I was finishing my PhD on the immunology of human leukaemia’s and had already started to work on HIV/AIDS. Kuhn’s book was absolutely an eye opener, but this approach of ‘taking at good look to science’ made a lot of sense to me while culturing cells, doing assays and playing the international games of conferences, publishing and the first experience with grantsmanship. Yet, it was totally different from anything I had read before (Miedema, 2012) (p15).

4.4 Beyond the Legend

In pragmatism and its view of scientific inquiry, the ‘external’ criteria and values do come in, at the stage of testing of reliability and *robustness* from the perspective of the potential user and stakeholder in society (p194) (Kitcher, 2001). This *invasion* of science by external values and perspectives of societal stakeholders, politics, governments and the diverse publics with their interests and problems is felt by many as a breach of Enlightenment, the ‘modern Cartesian’ ideas of rationality of science and investigation. Some of the new pragmatists, especially Rorty has gone to the extreme of this post-modernism with the apparent conclusion that it all comes down to ‘*having a conversation*’ (Rorty, 1979). Science in that view had no special claim on knowledge and is just a matter of politics and debates, where power and interest, money, emotions and vulgar democracy are at play. Unfortunately, but understandably this latter (‘post-modernist’) interpretation has in the 1990s led to a vigorous discussion between those who got carried away by it and defenders of science. The defenders presented thoughtful reactions, as outlined in Chap. 2 and above, regarding the status of the knowledge claims of science without seeking refuge in unrealistic theoretical epistemologies, metaphysics or plain ideology of the Legend (Putnam, 1981, 1995, 2002; Putnam & Conant, 1990, 1994) (Hacking, 1983, 1999) (Longino, 2002) (Bernstein, 1983) (Haack, 2003; Kitcher, 2001, 2012).

Indeed, as we saw, some of the defenders, like Perutz leaned heavily on these empirical positivistic myths of the Legend in their sometimes, resentful writing aimed at ‘post-modernist’ writers (Perutz, 1995).

As we have seen in Chap. 2 and 4, philosophy, sociology and history of modern science have over the past 40 years converged to a more pragmatic naturalistic view of science. This is based on the study of the practice of science by sociologists and the so-called new pragmatists and scholars that are close to the philosophies of pragmatism but also by more independent scholars. The conclusion is that scientific knowledge is robust and trustworthy, not because science applies a unique method, with formal rules founded on a metaphysical framework, that provides an algorithm for arriving at ‘truth’. It holds the view that the way knowledge is produced in science is based on a way of working that is very robust and rests on continuous collective inquiry and intersubjective testing, to decide again and again what are the best insights, theories or beliefs. Testing, validation and failing, involves the testing of knowledge claims in the various theoretical and historical contexts, but including that of the practice of the corresponding problems in the real world. Knowledge has significant value if it proves to be useful, for peers, or if it is more than a consistent theory and whether it also successfully informs our actions in the real world. This in fact relates to science, all sciences and research, as it is how researchers in and outside academia and universities have come to know it by doing it – and not in the least, because it is how it is actually very successfully being done and has successfully been done since centuries.

Having shown the power of pragmatism in explaining how knowledge is produced and how in open two-sided interaction and communication with the relevant publics the impact of inquiry on the real world and our social life could be improved, one wonders why it has not become mainstream philosophy and sociology of science. Why has it gone through a decline after 1945 until at least the late 1960s. I have in Chap. 2 discussed the epistemological side of this coin, in the philosophy and sociology of science the Legend was too strong to be replaced, or better said, to let is self be replaced. From the 1920s on, Dewey’s influence and the influence of pragmatism in particular on the educational system, liberalism and political thinking in the USA cannot be underestimated. After 1945, in that domain of society, an additional and possibly even more important debate with political and religious factions in the USA had to be fought by Dewey, and by his followers after his dead in 1952. The successful launch of Sputnik by the Soviets in October 1957 was a shock to the USA with major long lasting effects on its politics and its science (Lepore, 2018). Because of Sputnik, researchers engaged even more in basic natural science who since 1945 were already funded largely and generously by the military, and the NSF was told to deliver to the problems and needs of the military and the space race with ‘The Reds’.

After ‘Sputnik’ and with the Cold War getting more and more impact via the political conservative factions, Dewey’s liberal and progressive educational method and his humanistic vision of science and society was openly blamed for the lack of educating competent natural (‘hard’) scientists who could compete with the Soviets. Dewey was accused for not rejecting Soviet communism, especially Stalinism and of

anti-religious sympathies. This was, as we saw in Chap. 2, in support of the popular positivist and the Mertonian vision of science. Importantly, it resonated with the fears of the positivist philosophers of science who had before the war emigrated to the USA from Europe for influence from Marxist and dictatorial politics on science. Although the accusations of Dewey were very poorly supported and mostly derived from poor reading of his work, Dewey and pragmatism despite significant and diverse support from Sidney Hook and the more moderate Reinhold Niebuhr were side-lined through political and public pressure groups and also eventually by President Roosevelt himself. In addition, the subsequent wave in the 1970s when positivism was associated with technocrats and warfare, the fact that the prominent initiators of the Frankfurter Schule, Marcuse and Horkheimer erroneously associated pragmatism with positivism and scientism and repression had its effects. This is important with respect to our understanding of the temporary decline of pragmatism and its impact on science and research in the twentieth century. The social and political analysis of this decline is of great interest, since it is a case in point how external influences of political, cultural and religious values and opinions shape the growth of modern science. It is however outside the scope of this book, and I refer for that to Patrick Diggins' detailed history of *The Promise of Pragmatism* (Diggins, 1994).

References

- Barker, G., & Kitcher, P. (2013). *Philosophy of science: A new introduction*. Oxford University Press.
- Beck, U., Giddens, A., & Lash, S. (1994). *Reflexive modernization: Politics, tradition and aesthetics in the modern social order*. Polity Press.
- Bernstein, R. J. (1983). *Beyond objectivism and relativism: Science, hermeneutics, and praxis*. Basil Blackwell.
- Bernstein, R. J. (2010). The pragmatic turn. In *Cambridge*. Polity.
- Bourdieu, P. (1975). The specificity of the scientific field and the social conditions of the progress of reason. *Information (International Social Science Council)*, 14(6), 19–47. <https://doi.org/10.1177/053901847501400602>
- Dewey, J. (1939). *Logic: The theory of inquiry*. George Allen & Unwin.
- Dewey, J., & Rogers, M. L. (2016). *The public and its problems: An essay in political inquiry*. Swallow Press.
- Diggins, J. P. (1994). *The promise of pragmatism: Modernism and the crisis of knowledge and authority*. University of Chicago Press.
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994). *The new production of knowledge: The dynamics of science and research in contemporary societies*. SAGE Publications.
- Haack, S. (2003). *Defending science—within reason: Between scientism and cynicism*. Prometheus Books.
- Habermas, J. (1970). *Toward a rational society*. Heinemann Educational Books.
- Habermas, J. (1971). *Knowledge and human interests*. Beacon Press.
- Hacking, I. (1983). *Representing and intervening: Introductory topics in the philosophy of natural science*. Cambridge University Press.
- Hacking, I. (1988). The participant irrealist at large in the laboratory. *The British Journal for the Philosophy of Science*, 39(3), 277–294. <https://doi.org/10.1093/bjps/39.3.277>
- Hacking, I. (1999). *The social construction of what? Harvard University Press*.
- Kitcher, P. (1993). *The advancement of science: Science without legend, objectivity without illusions*. Oxford University Press.

- Kitcher, P. (2001). *Science, truth, and democracy*. Oxford University Press.
- Kitcher, P. (2011). *The ethical project* (pp. 1 online resource (ix, 422 pages)). Retrieved from JSTOR. Restricted to UCSD IP addresses <https://www.jstor.org/stable/10.2307/j.ctt2jbqjz>
- Kitcher, P. (2012). *Preludes to pragmatism: Toward a reconstruction of philosophy*. Oxford University Press.
- Latour, B. (1993). *We have never been modern*. Harvard University Press.
- Lepore, J. (2018). *These truths: A history of the United States* (1st ed.). W.W. Norton & Company.
- Longino, H. E. (2002). *The fate of knowledge*. Princeton University Press.
- Menand, L. (2001). *The metaphysical club*. Flamingo.
- Miedema, F. (2012). *Science 3.0. Real science real knowledge*. Amsterdam University Press.
- Misak, C. (2013). *The American pragmatists* *The Oxford history of philosophy* (First edition. ed., pp. 1 online resource (xvi, 286 pages)). Retrieved from ProQuest. Restricted to UCSD IP addresses. Limited to one user at a time. Try again later if refused <https://ebookcentral.proquest.com/lib/ucsd/detail.action?docID=1132322>
- Misak, C. J. (Ed.). (2007). *New pragmatists*. Clarendon Press; Oxford University Press.
- Misak, C. (2020). *Frank Ramsey: A sheer excess of power*. Oxford University Press.
- Nagel, E. (1940). Charles S. Peirce, Pioneer of modern empiricism. *Philosophy of Science*, 7(1), 69–80. <https://doi.org/10.1086/286606>
- Nowotny, H., Scott, P., & Gibbons, M. (2001). *Re-thinking science: Knowledge and the public in an age of uncertainty*. Cambridge Malden, MA, Polity Press
- Perutz, M. (1995). The pioneer defended. In *The New York review of books*.
- Popper, K. R. (1981). The rationality of scientific revolutions. In I. Hacking (Ed.), *Scientific Revolutions*. Oxford University Press.
- Putnam, H. (1981). *Reason, truth, and history*. Cambridge University Press.
- Putnam, H. (1995). *Pragmatism: an open question*. Blackwell.
- Putnam, H. (2002). *The collapse of the fact/value dichotomy and other essays*. Harvard University Press.
- Putnam, H., & Conant, J. (1990). *Realism with a human face*. Harvard University Press.
- Putnam, H., & Conant, J. (1994). *Words and life*. Harvard University Press.
- Ravetz, J. R. (1971). *Scientific knowledge and its social problems*. Clarendon Press.
- Ravetz, J. R. (2011). Postnormal science and the maturing of the structural contradictions of modern European science. *Futures*, 43(2), 142–148. <https://doi.org/10.1016/j.futures.2010.10.002>
- Rorty, R. (1979). *Philosophy and the mirror of nature*. Princeton University Press.
- Ziman, J. M. (1994). *Prometheus bound: Science in a dynamic steady state*. Cambridge University Press.
- Ziman, J. M. (2000). *Real science: What it is, and what it means*. Cambridge University Press.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

