DOI: https://doi.org/10.15388/SocMintVei.2017.1.10869

Conrad Russell

Second Culture and Second Nature: Fact, Post-Fact, and the Social Construction of Scientific Objects

Abstract. *The use of constructionism by climate change deniers and '9-11 truthers' to support 'post-fact' arguments in recent political and social debates has created controversy within science studies. Here, I seek to re-evaluate what constructionists actually say about facts in science. Through revisiting Gaston Bachelard – a key influence on scientific constructionism – I argue that science can penetrate to the 'noumenal core' of the phenomena it studies because it constructs them. This, however, need not imply that facts can be whatever we want them to be.*
Keywords: *facts, social construction, artefacts, epistemology.*
Raktažodžiai: *faktai, socialinis konstravimas, artefaktas, epistemologija.*

The Oxford Dictionary defines 'post-truth' in terms of the dominance of 'appeals to emotion and personal belief' over '*objective facts*' (cited in Fuller 2016; 2) [my emphasis]. This distinction between 'fact' and 'belief' has been central to certain positions within the history and philosophy of science, for example in Imre Lakatos's concept of 'rational reconstruction' and Karl Mannheim's distinction between 'immanent laws' and 'extra-theoretical factors', where only the latter fell in the domain of the sociology of knowledge, whereas the former have a privileged epistemological status (Barnes and Bloor 1982; 26). Famously, for Barry Barnes and David Bloor 'all beliefs are on a par with one another with respect to the causes of their credibility' – credibility must therefore be explained *without regard for truth or falsity* (ibid.; 23). This 'Symmetry Principle' means, in other words, that we cannot separate 'objective facts' from 'appeals to emotion and personal belief'. What counts as a reason for a belief in one context, may support the opposite belief in another. In terms of scientific explanation, this implies the underdetermination of theory by evidence, which may support a number of competing explanations (Sokal 1999; 66).[1] All beliefs, including those regarded by scientists as facts, can and should be explained in purely social terms, such as generational processes of

[1] Of course, Alan Sokal goes on to argue that concepts such as 'underdetermination' and 'theory-laden-ness of observation' have been *misapplied* by radical relativists (Sokal 1999; x).

knowledge transmission, formal and informal sanctions applied to positive and negative judgements, and processes of socialisation and social control (Barnes and Bloor 1982; 23).[2] So explanations for the origin, acceptance and rejection of knowledge claims 'are sought in the domain of the Social World rather than the Natural World' for all forms of knowledge – there is 'nothing epistemologically special about scientific knowledge' (Pinch and Bijker 1984; 401).[3]

A decade before 'post-truth' and 'post-fact' were in common use, Bruno Latour expressed concern that conspiracy theorists and the enemies of science had appropriated many of the arguments of 'social constructionism' – that there is no unmediated access to truth, we always speak from a particular standpoint, and that 'facts are made up' (Latour 2004; 230). Accounts of the '*lack of scientific certainty* inherent in the construction of facts', produced by Latour and others, were providing US Republicans with a strategy for denying climate change in the face of overwhelming evidence (ibid.; 227). Such 'agnotological projects' deliberately amplify disagreement amongst scientists in order 'to create a picture of complete dissensus' (Sismondo 2017; 5). The attempt to restore to scientific objects 'their aura, their crown, their web of associations', by exploring how they are constructed, has weakened their claim to reality, when the point was to add to it (Latour 2004; 236). This echoes Alan Sokal's warnings that undiscriminating attacks on scientific rationality might prove popular with exactly the kinds of obscurantist 'allies' that relativists do not want (Sokal 1999; 191). At the opposite end of the spectrum, Steve Fuller attacks the dictionary definition of 'post-truth' as simply revealing 'how those dominant in the epistemic power game want their opponents to be seen' (Fuller 2016; 2). A pejorative distinction between fact and belief is simply Plato's old 'double truth' – one for the elites, to support their rule, and another for the masses, to justify their subjection. For Fuller, 'post-truth' is the cost of epistemic democracy – once the instruments of knowledge production are available to all, 'they will end up working for anyone who has access to them' – just as Church control over revealed wisdom

2 I would be wary of the term 'belief' as implying *naïve* credulity. Bruno Latour dismisses the idea that either modern scientists or initiates in spirit-worship traditions possess some simple belief in the unproblematically 'autonomous' status of either Gods or cell-cultures. If belief exists at all, 'it is the most complex, sophisticated... reflective activity there is' (Latour 2010; 42).

3 Sokal argues that Barnes and Bloor are claiming a privileged status for sociological explanations which they deny to scientific (and indeed magical or mythical) ones (Sokal 1999; 80). This is also Latour's argument in his 2004 paper. We de-realise the objects we do not believe in but we lend an unexamined trustworthiness to those we *do* believe in – e.g. science and rationality (for the sceptics) or ideology and discourse (for the social constructionists) (Latour 2004; 237). However, Latour and Woolgar explicitly argued that their account of laboratory work was constructed in exactly the *same* way as facts are 'inscribed' in the laboratory (Latour and Woolgar 1986; 257). So here at least, there is an explicit attempt to apply the symmetry principle symmetrically.

was fatally destroyed by demotic versions of the Bible and mass printing (ibid.; 2).[4]

My intention in this paper is to revisit the question; what is the epistemological and ontological status of facts in science? In other words, what kind of a thing are scientific facts? Can they claim any kind of epistemological 'specialness', or can they be accounted for exclusively with reference to social processes? Without anticipating my conclusions, I would suggest that a lot hinges on what we mean by 'social'. The symmetry principle assumes that the 'Social World' consists of specifically *sociological* processes – such as socialisation, social control, formal and informal sanctions, and tacit inter-group negotiations (Barnes and Bloor 1982; Pinch and Bijker 1984; Latour and Woolgar 1986). This raises a further question – do these processes exhaust what can be meant by the 'social world'? In order to address the status of 'facts' and 'social construction' in science, I propose to look carefully at arguments around 'facts', 'artefacts' and 'natural objects' put forward by the defenders and opponents of 'constructionist' approaches since the 1980s. However, I will also be tracing constructionism back to one of its sources – the French philosophy of science of the 1930s and 40s. This may provide us with some unexpected answers.

Facts and Artefacts

A 'fact' is commonly understood as 'some objectively independent entity which […] cannot be modified at will' (Latour and Woolgar 1986; 175). 'Artefacts' are accidents of scientific activity – a result of error, experimental 'noise', poor science or wishful thinking. However, 'fact' has a dual meaning, with roots in the Latin verb *facere* – 'to make' (ibid.; 174–175). This suggests a hidden blurred distinction between 'artefacts' and 'facts'.[5] Based on his observations at the Salk Institute, Latour discovered that there existed a continuum between facts and artefacts, rather than a neat, self-evident opposition (Latour and Woolgar 1986; 176). In the laboratory, facts are produced through a process of *inscription*; coding samples, reading statistical outputs, drafting lab reports, writing scientific papers. Laboratory equipment functions as a set of 'inscription devices'; 'any item of apparatus […] which can transform a material substance into a figure or diagram' (ibid.; 51). The cycle of writing scientific papers ('literary inscription') produces *types of statements* about the natural substances which the inscription process is taken to be revealing or discovering. Latour and Woolgar distinguished five types of statement; from 'Type 5' – an accepted fact needing no qualification, to 'Type 1' – pure speculation,

4 Fuller's argument can be taken as precisely suggesting that the attempt to exempt certain kinds of knowledge from the symmetry principle, or at least restrict certain kinds of people from making use of it, has now been 'unmasked' as an abuse of power – Latour (2004) makes a similar argument but draws different conclusions.

5 Latour, in his later work, makes a distinction between 'facts' and 'things' – focussing attention on the social, deliberative processes surrounding scientific objects, and on the Norse and Anglo-Saxon etymology of 'thing' as an assembly, a gathering (Latour 2004; 233). Established 'facts' can return to the status of a thing – a focus for public deliberation – in cases of scientific/technological failure (such as the Challenger disaster).

an artefact (ibid.; 75–79). A statement becomes accepted as a fact when qualifying *modalities*, ('it is unknown why [...]') can be removed from it. At this point of stabilisation, the statement becomes split, between the description itself and an independent scientific object with a life of its own, understood to have existed prior to its description (ibid.; 176). Here, all the constructive operations necessary to elicit the fact through inscription *disappear* (ibid.; 76). 'Facts' can *revert* to artefact status if modalities are successfully reattached to them, making the idea that they owe their status to an external reality which functions as an ontological guarantee difficult to sustain (ibid.; 179).

Inscription is accompanied by 'local tacit negotiations' between scientists – facts are 'created and destroyed' in brief conversational exchanges (ibid.; 154). Lab conversations mix technical and theoretical discussion with personal judgements about the reliability of other researchers and their motivations (ibid.; 166). Crucially, they seem lacking in 'objective' statements which 'escape the influence of negotiation between participants' (ibid.; 158). For example, judgements of whether to carry out a falsifying experiment and how much evidence would be required hinged on the relative status of the researchers in the conversation, and on competitive pressures from other groups of researchers. These tacit negotiations display 'interpretative flexibility', as facts can be interpreted in more than one way, and nature does not 'force the issue' (Pinch and Bijker 1984; 420). 'Interpretative loopholes' may be used to discredit a scientist's interpretation of their own data in one controversy, but in another dispute, there may be less scrutiny of the same scientist's data – because it is being deployed to shut down another scientist's claims (ibid.; 426). An apparently 'crucial experiment', providing decisive falsification of a claim, is often deployed rhetorically to persuade scientists outside of the 'core-set' – that is, those scientists most closely involved in the controversy. Such experiments may not be convincing to the 'core-set' itself, and may not actually falsify anything, as in the 'ether wind' controversy (Lakatos and Feyerabend 1999; 47). There is a parallel between the rhetorical strategies of the 'core-set' and the role of advertising in the relationship between producers and consumers of new technology (Pinch and Bijker 1984; 430). According to these accounts, the processes of inscription, negotiation and interpretation, which transform artefacts into facts, concealing their constructed origin in the process, are *social all the way down*.

Natural Objects and Social Objects

Maurizio Ferraris has recently criticised Latour's claim that the Egyptian Pharaoh Rameses II could not have died of tuberculosis – since the bacillus responsible for the disease was only discovered in 1882 – as resulting from a confusion between reality and our knowledge of it through conceptual schemes (Ferraris 2014; 32). He argues that this confusion has its roots in Kant's argument that 'without intuition, concepts are blind' (ibid.; 24). The idea that concepts are necessary to experience is inflated into the assumption that they therefore construct reality. Kantian schemata elevate mathematics from a scientific convention into the way our minds and senses work. Ontology is confused with epistemology as we no longer ask what things are, but 'how they should be known by us' (ibid.; 26). This model of Physicist-as-judge accounts for the exorbitant power given to science in postmodernist accounts, which becomes the only source of knowledge (ibid.; 43). Ferraris argues that ontology and epistemology, the world and what we can know about it, are distinct from one another because reality is *unamendable* – 'it cannot be corrected or changed by the mere use of conceptual schemes' (ibid.; 34). Descartes famously observes that the senses can easily be deceived (Descartes 2010 [1641]; 82). However, this supposed 'deceit' is actually *surprise*, which makes it possible to distinguish between reality and imagination. Seeing things we don't want to see (or which do not exist) is only 'illusion' if the senses are treated as cognitive tools, as scientific instruments – we should instead see them as a source of *reality's resistance* to our conceptual schemes (Ferraris 2014; 39).

This resistance is afforded by a class of *natural objects* – which have the attributes of three-dimensionality, coherence and persistence. Faced with such objects, epistemology has only a reconstructive function – acknowledging something which exists independently of itself (ibid.; 59). The knowing subject can impose a 'contingent unity' upon these objects – Ferraris gives the examples of flocks, forests and heaps. However, it is the set of properties these objects have independently of us which allow us to classify them in this way. So, the agency exerted by subjects is not that of the classifying scientist (Ferraris 2013; 35). There are, however whole categories of objects which are socially constructed – these social objects do '*constitutively* undergo the action of epistemology' (Ferraris 2014; 53). Such objects imply *inscribed acts*, which must be intersubjective and recorded – this may involve memory traces, as opposed to physical recording. Such inscriptions are 'decisive in the construction of social reality' (ibid.; 56). Importantly, social objects rely upon social subjects genetically, but not structurally – for example, a contract depends on the parties drawing it up in order to exist, but once it is drawn up, they 'depend on it for their existence as parties' (Ferraris 2013; 43). The dependence of social objects on subjects does *not make them subjective*. Despite the fact that he has clearly established the reified character of social objects without any reference to nature, Ferraris goes on to argue that grasping the essence of social objects would be seriously difficult without the existence of natural objects 'external to our perceptual schemes and resistant to their action' (ibid.; 35).

As we have already seen, Ferraris distinguishes science from ordinary perception – our minds are not schemata and our eyes are not scientific instruments. Science is also distinct from perception because it is *linguistic*; 'a system of communication, inscription, coding, filing and patents' (Ferraris 2014; 40). In contrast, everyday perception *encounters* reality rather than representing it (ibid.; 37). Ferraris's conception of scientific objects as dependent upon inscription appears quite similar to Latour's treatment of scientific facts and artefacts – both authors acknowledge the influence of Jacques Derrida (see Latour and Woolgar 1986; 261). Ferraris however argues for a 'weak textualism', where 'there is nothing outside the text' applies only to the social world, not the natural world (Ferraris 2014; 56). If scientific facts rely on 'inscribed acts', then they must be social objects, by Ferraris's own definition. However, he also argues that 'natural objects are independent of epistemology *and make science true*' (ibid.; 63) [emphasis added]. It is not clear how science can be both in the social world (of the 'text'), yet epistemologically guaranteed in some way by the natural world. Ferraris does not specify what the relationship is between unamendable nature and scientific objects as 'inscribed acts'. As he argues for the resistance of the real to conceptual schemes and for the nature of scientific knowledge as (at least plausibly) 'infinitely progressive', it could be inferred that he is arguing for a progressive approximation of the social objects of science to the truth of nature (ibid.; 41). This is the argument made by Sokal (1999; 56). He also makes arguments about the coherence and persistence of sensation which are similar to Ferraris's unamendability thesis. However, arguments based on progressive approximation fall foul of Thomas Kuhn's arguments about paradigm change and incommensurability (Kuhn 1996 [1962]; 103).[6] I will return to the issue of the discontinuous nature of scientific knowledge in the next section, as I explore the work of Gaston Bachelard – the originator of social constructionist accounts of scientific facts.

Bachelard: Second Culture and Second Nature

Although his extensive writings on science are little known in the 'Anglosphere', the philosopher Gaston Bachelard is a major influence on constructionist approaches to science, through the work of Bruno Latour (Latour and Woolgar 1986; 258; Latour 2010; 18). For Bachelard, there are no 'facts' in science in the ordinary sense of the term – events or states of nature available for verification (*constatation*) by the senses. Jean-Baptiste Lamarck's attempts to 'unmask' the workings of the igneous principle by observing burning paper were already comical by the standards of eighteenth-century chemistry – an 'empty phenomenology' filled by dream imagery (Bachelard 1953; 219). Inspired by the work of Carl Gustav Jung, whilst drawing very different conclusions, Bachelard discusses how the practical alchemists, faced with mysterious matter and uncertain experimental methods, drew on the unconscious for their theoretical concepts (ibid.; 39). Pre-scientific notions of the four 'basic elements' impeded the development of chemistry, until Joseph Priestley and Henry Cavendish demonstrated that water and air are not elements, by deploying concepts removed from sense-experience, the 'invisible' substances oxygen and hydrogen (ibid.; 74–75).

All forms of knowledge are not ultimately reducible to sense perception – for example,

[6] Sokal quotes Maudlin to the effect that a paradigm cannot have such a strong effect on experience so as to guarantee that theory and experience always correspond, or there would never be a need to revise one's theory (Sokal 1998; 70). However, this assumes that paradigms contain no anomalies, as it is precisely these which give rise, ultimately, to their collapse (Kuhn 1996 [1962]). Paradigms can wholly shape experience yet also be contradictory and thus unstable.

the three 'basic' colours (red, green and blue) are only basic to the human eye, which has difficulty discriminating between 'shades' of colour, which tend to blur into the 'primary' ones. Using a prism, Isaac Newton demonstrates the equal importance of all the colours of the spectrum – forming the basis for the later discovery of ultra-violet radiation, infra-red and x-rays (Bachelard 1949; 116). Disconnected observable facts only make sense when enmeshed in a *network of reasons* removed from sense-experience, hence Bachelard's observation that 'the moving Earth was an *idea* before it was a fact' (ibid.; 123). As scientists work on intangible objects, using indirect methods, experience not mediated by theory is 'mutilated' (ibid.; 35). Rather than a 'naïve' rationalism made up of basic principles grounded in sense-experience, modern science can be understood as an 'experimental rationalism' (*rationalisme appliqué*).[7] This involves a complex relationship between 'theoretical coherence', and 'experimental precision', which serves to produce 'stable scientific objects' (ibid.; 9). Observation is always 'second order' observation – resulting from successive movements between ever more precise experiments and ever finer theoretical concepts. Bachelard argues for an *a posteriori* dialectics, working on contingent, changeable notions, rather than starting from *a priori* fixed principles (Bachelard 1972; 8). This is 'an account of empirically engaged reasoning, not of theoretical reasoning subsequently applied' (Tiles 2012; 24).

Just as there are no 'empirical data', experimental rationalism has no 'basic facts', from which complex models would then be 'built up'. For example, René Descartes's simple separation of figure from movement makes no sense at sub-atomic level (Bachelard 1934; 142). Scientific objects are not discrete fixed entities, but *relationships* – the 'pyramidal' structure of the carbon atom is not an inherent property, but a result of its 'excitation' by other atoms and a complex and slow development of theory in both classical and quantum chemistry was necessary before this was fully understood. For Bachelard, 'it is the relationship which sheds light on being' (1934; 148; Bachelard 1953; 120). Bachelard explicitly refers to this elucidation of structure through the relationships between particles and molecules – and the corresponding development of dense networks of theory and experimental data – as processes of *construction*. Bachelard uses the successive reinterpretations of the periodic table, interwoven with developments in physics and chemistry, as an exemplar of this construction process. Artificial means had to be employed to fill the 'gaps' in Mendeleev's table – irradiation and radiation counters – producing substances which are not only invisible but 'escape the category

7 I have taken the liberty of avoiding strictly literal translations of Bachelard's key terms – as Mary Tiles observes, 'Applied Rationalism' is a misleading translation of '*Rationalisme Appliqué*' as it suggests a derivation of knowledge from first principles (Tiles 2012; 24). It also could be seen to imply some kind of technocratic 'STEM' vision of scientific knowledge. I think that 'Experimental Rationalism' better captures Bachelard's argument – that both reason and the real are 'in play' and dialectically related in the scientific enterprise.

of quantity' (Bachelard 1953; 99). The science of matter is 'a science which *constructs its object*' (ibid.; 115) [emphasis added].

Phenomeno-technics (*Phenomènotechnique*) constructs the phenomena under study by means of rational, algebraic laws (Bachelard 1949; 109). 'Raw nature' does not reveal its essence to us, as the geological and physical events which shaped it are in the distant past. Earthquakes and volcanoes are only sporadic expressions of 'the earth as a laboratory' (Bachelard 1953; 32). Unmediated nature constitutes an illegible 'statistical disorder', whilst 'stylised nature' prepared using mathematical schemata is less opaque than that available to direct observation (Bachelard 1934; 170). The manufactured nature of the phenomena allows us to *know their essence*. Bachelard uses the example of wax prepared in the laboratory to precise specifications, to mark the differences between modern science and Cartesian rationalism. In giving up on the deceptive senses once the wax began to evaporate in the heat of the fire, Descartes failed to see that a dialectical unity of thought and experience could serve to reconstruct the phenomenon (ibid.; 172). The disappearance of unconscious imagery and 'rêverie' from scientific thinking is a result of the scientific spirit educating itself through abandoning nature and turning to 'matter artificially created through human action' (Bachelard 1953; 50). Given the production of such 'substances without accidents', the philosopher can no longer project the irrational onto nature's 'unspeakable depths' (ibid.; 81).

The artificially produced phenomenon is always in a dialectical relationship with its *noumenon*, expressed algebraically – thought processes are carried by mathematical expressions which are at the same time physically embodied in the laboratory (Bachelard 1934; 162; Tiles 2012; 26). Bachelard observes that a hypothesis is not a common-sense 'assumption', it is 'written right into the equipment' (Bachelard 1949; 134). With mass spectroscopy, the noumenon – theorems governing the trajectory of isotopes – drives the construction of the equipment, and 'a long detour through theoretical science' is required to understand the output, no longer in the form of simple data, but of experimental *results* (ibid.; 103). By contrast, the nineteenth-century chemist's scales were grounded in common-sense understandings of equilibrium as an identity between two masses. Completing the dialectical movement, the constructed phenomena then serve to further develop the mathematically expressed noumena. Bachelard remarks that the filters used in radiophonic equipment not only correct 'noise' in the equipment itself, but also in the related sets of equations (ibid.; 159). Latour and Woolgar draw on Bachelard's 'phenomeno-technics' to argue that we cannot construct an opposition between 'material' and 'conceptual' components of scientific activity:

> when, for example, a member of the laboratory uses a computer console [...] he mobilises the power of both electronics and statistics. When another member handles the NMR spectrometer [...] to check the purity of his compounds, he is using spin theory and the outcome of some twenty years of basic physics research. (Latour and Woolgar 1986; 66)

The apparatuses in the laboratory are the reified outcomes of long scientific controversies.

They are then themselves used to settle fresh controversies – the mass spectrometer, which Bachelard was already discussing in the 1940s, is the ultimate weapon in such disputes. As it is 'the reified part of a whole field of physics', it is almost impossible to challenge (Latour and Woolgar 1986; 242). Once a controversy is settled, the new substance or theorem which is its outcome can then be reified in turn, by being incorporated into the laboratory equipment. Thus, Latour and Woolgar argue, the inscription devices of the laboratory are *reified theories* – a direct translation of Bachelard's *théorie réalisée* (ibid.; 66; Bachelard 1966; 26).

This 'directed phenomenology' at the heart of modern science is an inherently *social and historical* process. One could imagine a child genius re-inventing Euclidean geometry from scratch with toy blocks, but 'one cannot imagine a materialist genius remaking chemistry, far from any books, with rocks and powders' (Bachelard 1953; 65). The complex processes involved in creating pure isolated substances in forms not found in nature implies a complex social infrastructure. The potential vicious circle, where the purity of a substance is only guaranteed by the purity of those substances making it up, with no independent measure of purity, is broken by the very social-historical nature of science. Every period in the development of chemistry, for example, established a body of reagents at a set standard of purity, which each succeeding era surpasses. So, science has a historical and 'social guarantee' of its progressive approximation to absolute purity (ibid.; 79). As with the constructed phenomena, the 'noumenal' theoretical models are also dependent upon the size and complexity of the social networks inherent in modern scientific activity. The ordering of the elements in the periodic table depended upon the sheer weight of experimental work which these networks permit (ibid.; 85). The corporate nature of science as a 'Guild' (*cité*) drives the development of 'experimental rationalism' – as the dialectical movements between theory and experiment continuously accelerate and multiply as a result of the grouping together of ever larger numbers of 'proof-workers' (*travailleurs de la preuve*) (ibid.; 86). An isolated individual researcher would be unable to move beyond poorly formulated 'basic questions' – whereas the collective scientific enterprise, driven by experimental rationalism, is constantly changing and refining its problematics. Becoming a scientist means situating oneself culturally, taking on rank and position within the 'Guild of Scientists' (*cité scientifique*). This has a profound transformative effect on individual consciousness. The lack of rigour of isolated, 'gentleman amateur' investigations of nature leads to an understanding of the natural world as indefinite and mysterious, and ultimately unknowable (ibid.; 3). Scientific reasoning at the individual level is a product of social and cultural practices through which scientists are socialised into a *second culture*, implying a sharp break with 'naïve materialism' (Tiles 2012). Whilst Bachelard is distinctive in 'insisting that any epistemology must include the role of the knower', this reasoning subject is always a social subject (Tiles 2012; 25). The models and schemata produced by science at a given moment in its development have a function as 'pedagogical values' (Bachelard 1953;

121). This is close to Kuhn's discussion of the way in which scientists are socialised into the dominant paradigm through learning how to solve specific problems or 'puzzles' (Kuhn 1996 [1962]; 46–47).

At the core of Bachelard's philosophy of science lie facts as *complex constructs* – both because the facts only make sense as a network of elements interwoven with theory, and, in a more literal sense, because theory grounded in experiment serves to *produce facts* – new experience and new thought are produced by 'objective meditation [...] in the laboratory' (Bachelard 1934; 176). Both aspects of this process – 'experimental rationalism' and 'phenomeno-technics' – depend on the fact that modern science functions as a 'Guild' (*cité*), in other words as a *social body*. So Bachelard is precisely talking about the *social construction* of facts in science, which represents a 'second culture' – to use Tiles's expression – which has broken decisively with empiricism and self-evident 'facts of nature'.[8] As experimental rationalism is a social process, so the nature upon which it works is a *social product*. Bachelard stresses that phenomeno-technics does not 'extract' dormant properties from nature – it transforms nature, and, by so doing, *socialises* it. Hydrogen and oxygen are 'social gases, gases of high civilisation' (Bachelard 1953; 31). The modern chemist does not approach the mineral order as a set of external facts to be investigated from scratch, as it reflects the traces of human historical scientific activity – it has a 'human depth' (ibid.; 22). Chemistry has projected a network of relations onto the mineral realm which do not exist in nature. The 'second culture' of modern experimental science is reflected in a *second nature*, which it has produced.

Bachelard suggests that human reason in a sense serves to complete the work of nature. Plants and other living organisms, as they evolved, reintroduced dynamic chemical processes into an 'inert' earth, whose processes of geo-chemical formation had ceased. However, these pre-human phenomena are surpassed once human beings develop culture, and, ultimately, scientific activity. Bachelard is perhaps not entirely serious when he suggests that 'nature, wishing to do chemistry, finally created the chemist' – an echo of the ancient Hermetic idea that God created Man because 'there had to be another being who could contemplate what God had made' (ibid.; 33; Yates 1991; 36). Given that the nature which the modern chemist or physicist is working with is precisely

[8] Bachelard also stresses the role of scientific *polemic* (an inherently social activity) in driving forward the dialectics of theory and experiment – for example in the controversies over the valency of the carbon atom and the position of the transuranic elements in the periodic table (Bachelard 1953). Proof is 'a truth which has survived a polemic' (Bachelard 1949; 31). This position is echoed by Latour's 'Third Rule of Scientific Method'; 'the settlement of a controversy is the cause of nature's representation' (Sokal 1998; 85; Latour and Woolgar 1986; 180 for a similar formulation). Bachelard likewise stresses that facts are intertwined with an a *posteriori* dialectics – there are no 'a priori' facts of nature. There is also a close parallel between Lyotard's agonistic/language game model of science as used by Latour and Woolgar (Lyotard 1979; Latour and Woolgar 1986), and Bachelard's analysis of the role of 'polemic' in science (Bachelard 1949).

a *socialised nature*, it might be possible to argue that rather than nature creating humans so that it could know itself, we have created a humanised nature – as it is the only nature which it is possible for us to know. Bachelard stresses repeatedly that direct contemplation of nature 'as it is' is simply 'empty phenomenology'. We can only know a nature which has taken a 'long detour through the theoretical sciences'. Also, as we have seen, he rejects Descartes's positing of simple basic entities which can be known directly, in favour of complex constructed facts (Bachelard 1934; 146). It was precisely against this Cartesian reasoning from basic entities that Giambattista Vico proposed the *verum factum* principle; 'that full knowledge of any thing involves discovering *how* it came to be what it is as a product of human action' (Costelloe 2016). Bachelard's work is precisely about understanding this human action, in the form of experimental rationalism. Therefore, it is possible to argue that scientific facts are true (*verum*) because they are made (*factum*). Latour and Woolgar infamously argued that the correspondence between statements and the external entities to which they refer is because they are identical (Latour and Woolgar 1986; 177). Bachelard's experimental theories and theory-laden facts may not be identical, but they are both 'abstract concrete' moments of the same dialectical process (Tiles 2012).

Bachelard himself might object to this – possibly rather bold – interpretation, as he argues that science – after its break from the 'rêveries' of pre-science – never regresses. If science 'changes its constitution', it is because this change represents a demonstrable advance over earlier forms (Bachelard 1949; 31). This suggests a model of progressive 'approximation to the truth', as is also suggested by his account of the historical development of purification processes in chemistry, discussed above (Bachelard 1953; 79). He also suggests that theoretical schemata and empirical knowledge gradually 'oscillate' more and more closely together, towards a point of convergence (ibid.; 121). However, Bachelard explicitly attacks the notion that the development of scientific understanding through education should be 'essentially cumulative' – where one learns basic principles as an 'inheritance' and simply builds on them by refining existing taxonomies of natural objects and deducing the odd additional theorem (Bachelard 1972; 10). Reason should not become ossified into a *tradition*. As it is experiment-driven and dialectical, reason is constantly displaced; e.g. electricity no longer has the same meaning that it did in the 18^{th} century (Bachelard 1949; 39). Even within modern chemistry, beneath the continuity of nomenclature, 'there is radical variation in the concepts' (Bachelard 1953; 6). Scientific materialism is constantly changing its own foundations, so that, paradoxically, it is the *new* which is the most basic. He criticises philosophers who see a false continuity in science, by projecting its early slow development onto its later, more revolutionary phases. Scientific innovation points to discontinuity in knowledge (*savoir*) (ibid.; 211). Given such discontinuity, Bachelard could be taken to be implying incommensurability between different moments in the development of science, in which scientists on either side of the dialectical shift are 'in different worlds […] see[ing] different things when they look in from the same point in the same direction' (Kuhn 1996 [1962]; 150). If this is in fact the case, then a progressive approximation to nature cannot be the result of the dynamic process of experimental rationalism, because there is no neutral standpoint from which to assess it.

Conclusions

I will now attempt to draw out the implications of my argument about the ontological and epistemological status of scientific facts, which I have been developing throughout this paper. I will first briefly resume my discussion in the last section. Bachelard's description of a socialised nature constructed by scientific activity can only be taken to refer to an *a priori* 'state of nature' if we accept a model of science as a progressive process of approximation to the real. I have argued that this is difficult to sustain, given Bachelard's understanding of scientific knowledge as discontinuous. The discontinuity between paradigms was also my objection to Ferraris's argument that scientific objects are social, yet somehow grounded in natural objects which 'make them true'.[9] If we abandon progressive approximation, we are left with a nature that is knowable because it is constructed – a 'second nature' created by science's 'second culture'. In this case, it is literally true that 'the facts are made up' (Latour 2004; 230). However, this 'made-up-ness' cannot simply be reduced to local tacit negotiations between scientists, which is certainly how Latour's early work can be interpreted, even though he was at pains to point out that it was not his intention to argue that scientific facts are not real (Latour and Woolgar 1986; 176). As Ferraris argues, the fact that something is a social object – i.e. a social construct – does not mean that it is structurally dependent on the social actors who constructed it. Actors can in fact become dependent on their own constructs. There is 'a before and an after, namely a before and an after of the inscription of the act by which [social objects] are constituted' (Ferraris 2013; 43). Latour, in one of his later works, discusses Louis Pasteur's account of his own laboratory work, in which he asserts the reality of 'his' lactic acid because he 'carefully set the stage on which the ferment revealed itself on its own' (Latour 2010; 17). Pasteur concedes that his conclusions about the nature of the acid 'go beyond the facts', resting rather on criteria of methodological consistency, yet also argues that any rejection of the argument that fermentation is a living process has been *contradicted by the experiment.* Thus, he moves back and forth between Realist and Constructionist 'repertoires' (ibid.; 18). Latour goes on to argue that all human activity involves this 'middle passage' between subject and object, construction

[9] Further, Ferraris's class of 'natural objects' relies on a theory of direct perception, which is itself difficult to sustain. Kuhn suggests that 'something like a paradigm is prerequisite to perception itself' (Kuhn 1996 [1962]; 113). If natural objects shape perception, this presupposes that they appear in the same way in every situation and can be neatly distinguished from one another – otherwise we are reliant on linguistic networks of meaning for perceptual judgements (Mulkay 1979; 34).

and autonomous existence 'out there'. Pasteur's actions are uniquely his own at that moment at which they slightly escape him, like those of Candomblé practitioners eliciting ancient deities through ritual. In both cases, it is '*precisely because* their actions have gone slightly beyond them' that they are uniquely theirs (ibid.; 41) [emphasis added]. This is the moment at which 'before' turns into after, and lactic acid and ancestral gods *become real*. As this comparison suggests, the facts of science do not have to become the model for all of reality – even if all of reality is constructed – although Ferraris's observation that certain kinds of postmodernist thought did make such a conflation may well be accurate (Ferraris 2014; 43).

My argument so far suggests a peculiar ontological status for scientific objects – they do not rely on a 'Natural World' for their existence, but they escape from their creators and constitute a perfectly real objective world, which is structurally, but not genetically, independent from them. Scientific facts are thus *neither* natural objects nor discourse effects. They are objectively real, yet 'social all the way down'. As we saw in our discussion of Bachelard's phenomeno-technics, scientific facts are both expressed through – and elicited from – the algebraic laws which are their noumena (Bachelard 1934; 162; Tiles 2012; 26). Thus, it is difficult to accept the idea that they are not 'epistemologically special' – as this ultimately implies that sociologists, with their models of generational transmission, social control, and tacit negotiation, can know all there is to know about them. In dismissing the 'epistemological specialness' of science, Trevor J. Pinch and Wibe E. Bijker argue that science can be studied in the same way as, e.g. 'primitive' mythology (1984; 401). At first sight, this argument might appear as a welcome move against Eurocentric accounts of post-Cartesian science. However, if all knowledge claims can be assessed in terms of categories derived from Euro-American sociology, such as 'socialisation' (Barnes and Bloor 1982), then this is not a 'relativistic' or a 'post-colonial' approach, but a positivistic one – despite the claims of 'epistemological relativism'. This type of account relies on reducing the objects under study (but never its own sociological categories) to what Latour terms 'fairy objects' (Latour 2004). In anthropological terms, this is an *etic* position – one which makes generalised statements classifying data into a single system, based on situationally transcendent criteria. This is contrasted with an *emic* (or 'insider') perspective, which describes 'the pattern of [a] particular language or culture in reference to the way in which the various elements of that culture are related to each other in the functioning of that particular pattern' (Jardine 2004; 264). Some anthropologists reject etic approaches altogether, whilst others combine emic and etic perspectives (ibid.; 265–266). Such a combined – or indeed dialectical – approach would be the one most congruent with my argument in this paper. Etic sociological accounts may be necessary to explaining science, but they are not sufficient. Bachelard does argue that individual scientists need to be socialised into scientific culture, but he does not reduce experimental rationalism to a set of social norms (Bachelard 1953; Tiles 2012).

If my overall argument about the nature of scientific facts is a valid one, this would suggest that Sergio Sismondo is right in his wariness about Steve Fuller's claim that the 'post-fact' era is simply the inevitable cost of the 'democratisation' of constructionism. As he argues, the fact that 'it could be otherwise' does not equate to saying that 'it could easily be otherwise' (Sismondo 2017; 3). Echoing Bachelard, Sismondo points out that infrastructure, effort and validation structures are required in the construction of knowledge. Bachelard does stress that science can – and often does – change its own foundations (Bachelard 1953). But this cannot be equated with 'simply blowing up existing structures of knowledge', which, as Sismondo suggests, is likely to have anything but democratic consequences (Sismondo 2017; 4). Whilst I have argued against Ferraris's insistence that we must retain a category of natural objects in order to avoid 'nihilistic outcomes', I would agree that careless formulations of constructionism run the risk of asserting that 'the reason of the strongest is always the best' (Ferraris 2014; 72).

Acknowledgements

I would like to thank Christopher Till and Karl Spracklen for encouragement and constructive criticism on various drafts of this paper. I'd also like to thank A. Salem for allowing me to present a different version of this research to the 2017 CTRG symposium 'Critical and Philosophical Issues after Post-Structuralism' held at Leeds Beckett University.

REFERENCES

Bachelard, Gaston. 1934. *Le Nouvel Esprit Scientifique*. Paris: Presses Universitaires de France.

Bachelard, Gaston. 1949. *Le Rationalisme Appliqué*. Paris: Presses Universitaires de France.

Bachelard, Gaston. 1953. *Le Matérialisme Rationnel*. Paris: Presses Universitaires de France.

Bachelard, Gaston. 1966. *La Philosophie du Non – Essai d'une Philosophie du Nouvel Esprit Scientifique*. Paris: Presses Universitaires de France.

Bachelard, Gaston. 1972. *L'Engagement Rationaliste*. Paris: Presses Universitaires de France.

Barnes, Barry; Bloor, David. 1982. 'Relativism, Rationalism and the Sociology of Knowledge' in Martin Hollis and Steven Lukes (eds.) *Rationality and Relativism*. Oxford: Blackwell: 21–47.

Costelloe, Timothy. 2016. 'Giambattista Vico' in Edward N. Zalta (ed.) *The Stanford Encyclopedia of Philosophy*. <https://plato.stanford.edu/archives/sum2016/entries/vico/> (Accessed: 28 March, 2017).

Descartes, René. 2010 [1641]. *Meditations on First Philosophy* (trans. Desmond M. Clarke). London: Penguin.

Ferraris, Maurizio. 2013. *Documentality: Why it is Important to Leave Traces*. New York: Fordham University Press.

Ferraris, Maurizio. 2014. *Manifesto of New Realism*. Albany: State University of New York Press.

Fuller, Steve. 2016. 'Embrace the Inner Fox: Post-Truth as the STS Symmetry Principle Universalised', *Social Epistemology Review and Reply Collective*. <https://social-epistemology.com/2016/12/25/embrace-the-inner-fox-post-truth-as-the-sts-symmetry-principle-universalized-steve-fuller/#comments> (Accessed: 12 March, 2017).

Jardine, Nick. 2004. 'Etics and Emics (not to mention anaemics and emetics) in the History of the Sciences', *History of Science* 42 (3): 261–278.

Kuhn, Thomas S. 1996 [1962]. *The Structure of*

Scientific Revolutions. Chicago: University of Chicago Press.

Lakatos, Imre; Feyerabend, Paul K. 1999. *For and Against Method: Including Lakatos's Lectures on Scientific Method and the Lakatos–Feyerabend Correspondence*. Chicago: University of Chicago Press.

Latour, Bruno; Woolgar, Steve. 1986. *Laboratory Life: The Construction of Scientific Facts*. Princeton, NJ: Princeton University Press.

Latour, Bruno. 2004. 'Why Has Critique Run Out of Steam? – From Matters of Fact to Matters of Concern', *Critical Inquiry* 30: 225–248.

Latour, Bruno. 2010. *On the Modern Cult of the Factish Gods*. Durham, NC/ London: Duke University Press.

Lyotard, Jean-François. 1979. *La Condition Postmoderne*. *Rapport sur le savoir.* Paris: Les éditions de minuit.

Mulkay, Michael. 1979. *Science and the Sociology of Knowledge*. London: Allen and Unwin.

Pinch, Trevor J.; Bijker, Weibe E. 1984. 'The Social Construction of Facts and Artefacts: Or how the Sociology of Science and the Sociology of Technology Might Benefit Each Other', *Social Studies of Science* 14 (3): 349–441.

Sismondo, Sergio. 2016. 'Editorial: 'Post Truth?', *Social Studies of Science* 47 (1): 3–6.

Sokal, Alan; Bricmont, Jean. 1998. *Intellectual Impostures: Postmodern Philosophers' Abuse of Science*. London: Profile Books.

Tiles, Mary. 2012. 'What does Bachelard Mean by *Rationalisme Appliqué*?', *Radical Philosophy* 173 (May/June): 24–26.

Yates, Frances A. 1991. *Giordano Bruno and the Hermetic Tradition*. Chicago: University of Chicago Press.

SANTRAUKA

ANTRINĖ KULTŪRA IR ANTRINĖ GAMTA: FAKTAI, POSTFAKTAI IR SOCIALINIS MOKSLINIŲ OBJEKTŲ KONSTRAVIMAS

Politinėse ir visuomeninėse diskusijose „9–11“ konspiracijos teorijos šalininkai ar neigiantieji klimato kaitą dažnai imasi konstruktyvizmo, kurį naudoja kaip „post-faktus“ pagrindžiantį argumentą. Mokslo studijose konstruktyvizmas irgi sukėlė nemenką sumaištį, todėl šiame straipsnyje noriu naujai pažvelgti į tai, ką apie mokslo faktus kalbėjo patys šios intelektualinės tradicijos atstovai. Remdamasis Gastono Bachelardo įžvalgomis, labai svarbiomis mokslinio konstruktyvizmo sampratai, bandau įrodyti, kad mokslas gali prasiskverbti į tiriamų reiškinių „noumeno esmę“ todėl, kad jis juos konstruoja. Tačiau tai nereiškia, kad moksliniai faktai gali tapti viskuo, kuo tik mes įsigeistume, kad jie būtų.

School of Social Sciences
Leeds Beckett University
Calverley Building, Portland Way
Leeds LS1 3HE, UK
Email: C.Russell@leedsbeckett.ac.uk