Bachelard and Deleuze on and with Experimental Science, Experimental Philosophy, and Experimental Music

-- Iain Campbell

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Introduction: Transdisciplinary experimentation

Recent work on transdisciplinarity in the humanities has sought to challenge and complicate what has been referred to as the 'technocratic' mode of transdisciplinary research (Osborne 2015: 11; Maniglier forthcoming). This technocratic conception takes as its goal the discovery of solutions to clearly-defined problems, especially widely recognized social problems like global environmental and health issues, bringing a variety of disciplinary procedures into the service of 'extra-intellectual' needs. As Peter Osborne notes, such a conception of transdisciplinarity has more often taken on the character of meta-disciplinarity. Losing the radical socio-political impulses found in strains of interdisciplinary research of the 1970s and '80s, this research model involves not so much the immanent movement across disciplines that would characterize transdisciplinarity properly speaking, but rather finds a point of disciplinary unity in its requirement to serve the functions of the neoliberal state (Osborne 2015: 13).

Patrice Maniglier (forthcoming) has recently developed a theory of the problem drawing on the work of Gilles Deleuze and Gaston Bachelard, elaborating on this important yet undertheorized concern of transdisciplinary research. In so doing, Maniglier demonstrates how transdisciplinarity can constitute a distinct form of thought, a creative and critical mode of inquiry that does not merely serve as a means to state or institutional ends. In this essay I too will draw on these two thinkers, posing my engagement with them around the figure of *experimentation*: as Éric Alliez makes clear, transdisciplinarity is achieved in Deleuze's work through experimentation, an 'experimentation with the complexity of the real' (Alliez 2015: 145-46) that involves a necessarily multiple approach to research and practice.[1]

[1] Here I will alternate between speaking of transdisciplinary practices and transdisciplinary research, but we could perhaps speak of a transdisciplinary 'study' in the mode of Stefano Harney and Fred Moten, encompassing collective practices of an intellectual, artistic and social character (Moten and Harney 2013). Deleuze's collaborator Félix Guattari would speak more explicitly of the transdisciplinary than Deleuze did, positing it as a means to position research '"astride" science, art and social communication' and speaking of 'a transdisciplinarity that would enable the problematic of one model in relation to another to be clarified' (Guattari 2015: 135). As Alliez stresses, it is indeed ultimately only through Guattari that a full articulation of Deleuze's investment in transdisciplinarity will become clear, beginning with the adoption of Guattari's notion of the transversal in Deleuze's 1970 revision of his *Proust and Signs* (Deleuze 2008). Here, however, I will be setting aside the

In this essay I will take experimentation as a candidate for a method of transdisciplinary research: a method for establishing the reciprocal meeting of divergent disciplinary systems, without returning to a single higher meta-disciplinary order or falling into a merely eclectic relativism. Experimentation would be the means of producing transdisciplinary research outside of the bounds of its highly formalized and institutionalized forms. But this formulation must be nuanced. If we do not want experimentation to take on the role of meta-disciplinary arbitrator of disciplinary interactions itself, it must itself be considered in its role as a transdisciplinary concept. How are we to think of experimentation as a concept that operates in different disciplines, that moves across them in varied ways, and that bears the trace of each in its particular manifestations?

Here I will take the examples offered by Deleuze and Bachelard to engage with three iterations of experimentation and the relations between them. The three disciplines I will be considering are philosophy, science and music. The reasoning behind engaging with the former two disciplines is evident: it is to these fields that Deleuze and Bachelard, respectively but relatedly, devoted the greatest part of their work, through Deleuze's consistent engagement with and reinvention of the history of philosophy and Bachelard's significant reframings of the philosophy of science. Yet while Deleuze, unlike Bachelard, draws heavily from artistic ideas of experimentation, why we should look at music is less obvious. I hope to show, however, that an in-depth consideration of the notion of experimentation in the field of music can tell us much about the divergent tendencies, difficulties and creative possibilities of experimentation in its transdisciplinary applications.

While in Bachelard's case experimentation is associated with the experiments of the scientific laboratory, in Deleuze's it is more often linked with forms of artistic experimentation defined by a rejection of predetermined codes and structures. A distinction hinted at here points towards the initial resource I will be drawing from musical research, namely a distinction outlined and complicated by Lydia Goehr regarding the experiment and the experimental (Goehr 2016). In this work, the experiment concerns closed and controlled environments in which a privileged observer tests predefined hypotheses. The experimental, on the contrary, involves attempts to relinquish such control and to produce open-ended contexts in which the unknown and the unexpected can arise.

Certainly such a distinction is not exclusive to music scholarship, but recent work on music has shown how these tendencies are not so easily separable into 'scientific' on the one hand and 'artistic' on the other, and has elaborated on what happens when the experiment and the experimental are found to meet and comingle. A key aspect of this has been identifying how practices proclaimed to be experimental can inadvertently revert into something like a logic of the experiment. I believe this is a lens through which we can learn much about Deleuze

specificity of this relation to focus on the significance to transdisciplinarity of some other threads passing through Deleuze's work.

and Bachelard, beyond the common images of a Deleuze concerned with unfettered experimental freedom and a Bachelard engaged in a scientistic foreclosure of the role of philosophy under the guidance of the laboratory experiment, common images that may play a role in the relative paucity of work on the relation between these two major figures of the last century of French thought.[2]

More pointedly, the distinction between the experiment and the experimental seems to correspond to a distinction we find in Deleuze's work, a distinction that has produced controversy and confusion. We can witness in the scholarship on Deleuze a significant and productive plurality of ways of looking at Deleuze and science, be it in his references to thinkers of science like Raymond Ruyer and Gilbert Simondon[3] or in influential theorists like Manuel DeLanda taking scientific concepts to be key to unlocking Deleuze's thought (DeLanda 2002).[4] Yet we find in Deleuze's *Difference and Repetition* what seems to be a thorough devaluation of scientific knowledge, and a firm separation between philosophy and science. This leads as astute a reader of Deleuze as Joe Hughes to claim that Deleuze's engagement with science in *Difference and Repetition* is merely metaphorical, and that science 'never leaves the realm of fact, but Deleuze is interested in the constitution of facticity itself' (Hughes 2009: 153). James Williams, by contrast, gives more weight to such scientific ideas (albeit without giving them the priority DeLanda does: see Williams 2006), and suggests that in *Difference and Repetition* Deleuze obscures the relation of his thought to science, arguing that he 'evade[s] legitimate questions concerning the role that science may have to play in the development of his own concepts' (Williams 2003: 36).

These problems are compounded, and raise with them other problems, as Deleuze's work unfolds across the following decades. As noted, Deleuze's encounter with Guattari leads his thought into an especially radical form of transdisciplinarity. 1980's *A Thousand Plateaus* in particular is considered an exemplary transdisciplinary text: its logic of the rhizome, a principle of connection between differing kinds of semiotic chains without reduction to the logic of any given one, is reflected in the text's wildly creative lines of flight across diverse fields, displaying little evident concern for disciplinary propriety (Deleuze and Guattari 1987: 7; Alliez 2011). With this in mind, it is evident why the strict demarcation of disciplinary boundaries between the self-sufficient and distinctly 'modern' triumvirate of philosophy,

[2] Patrice Maniglier (2012; forthcoming) and James Williams (2005: chapter 4; 2006) are two of the few scholars in the Anglophone literature to have indicated the significance of this relationship and the importance of Bachelard to Deleuze's thought. Among the many routes that future research could take, Bachelard and Deleuze's respective work on the concepts of rhythm and of imagination, as well as their shared insights with regards to the limits of phenomenology, seem to me especially rich avenues of inquiry.

[3] A significant amount of work is now available on Deleuze's relationship with these figures, especially Simondon. Some of the most recent of this can be found in a volume of *Deleuze Studies* edited by Andrew Iliadis (2017).

[4] This diversity of positions, readings and uses of Deleuze on and with science can be found in edited collections such as Jensen and Rödje (2010) and Gaffney (2010).

science and art that we find in Deleuze and Guattari's final collaborative text, 1991's *What is Philosophy?* (Deleuze and Guattari 1993), was met by followers including Isabelle Stengers with a sense of 'perplexity and disappointment' and the feeling that 'Deleuze and Guattari seem[ed] to turn their backs against all those who had promoted them as the thinkers of productive connections' (Stengers 2010: 39-40).

By working through the pairing of the experiment and the experimental and their comingling, this chapter will attempt to shed light on some aspects of this passage across Deleuze's thought, and the difficulties that emerge through it. It will ultimately suggest that the foreclosure found in *What is Philosophy?* serves precisely as an attempt to defend the experimental from its reduction to the experiment, though the success of this attempt will remain up for debate, and up for debate in a manner that the transdisciplinary operations of musical practices since the 1960s may illuminate.

Putting Deleuze alongside Bachelard will likewise help us to unpick how the experiment and the experimental relate in Deleuze's thought. The longest period of Bachelard's career was spent developing an ever-more refined philosophy of science, but in a manner distinct from most of what has come under that field of inquiry, especially in Anglo-American philosophy. As a founding figure in what has come to be termed the French epistemological tradition, Bachelard sought not so much to develop a theory of knowledge concerning what makes knowledge scientific, or guarantees its objectivity, as to understand the historical conditions under which things become objects of knowledge (Rheinberger 2010: 2-3; Lecourt 1975: 12). Dominique Lecourt termed this approach 'historical epistemology' (Lecourt 1974), a term that has been revived in the philosophy of science and which Lorraine Daston has argued raises 'the Kantian question about the preconditions that make thinking this or that idea possible' (Daston 1991: 283). This is likewise the kind of transcendental question that is key to Deleuze's investigations in *Difference and Repetition*.[5]

That Bachelard takes such a historical approach, yet deploys it in a method of inquiry that hews closely to the details of laboratory practice, leads to Bachelard producing a body of work in which we find the split between the experiment and the experimental radically reduced: inherent in his work is a recognition of their co-implication in the scientific community's gradual development of its practices. By reading Deleuze alongside this understanding of the experiment and the experimental, I hope to both clarify pertinent issues in Deleuze's thought and indicate the continued relevance of Bachelard's thought, not only in the belated uptake of

[5] While Christina Chimisso is reluctant to incorporate Bachelard's work into Anglo-American philosophy of science frameworks, including that recent work by thinkers like Ian Hacking and Daston which has been named historical epistemology (Chimisso 2008: 143), and Dominique Lecourt rules out such an association on the (perhaps reductive) grounds of Bachelard's materialism opposing the purported idealism of Anglo-American philosophers like Thomas Kuhn and Paul Feyerabend (Lecourt 1975: 10), the work of Hans-Jörg Rheinberger has connected and contextualized these strands of thought in a compelling way (Rheinberger 2010).

his insights in Anglo-American philosophy of science, but also echoing through the last fifty years of French thought.

With regards to music, we have seen in recent years a distinct plurality of approaches concerned with experimentation. Projects within Ghent's Orpheus Institute have been at the forefront of one such approach, drawing widely on French thought and the philosophy of science to develop a sophisticated discourse on the term 'experimental' in a musical context (Assis 2016: 7). The relevance of this work to the work I am unfolding here is evident, but for the moment I am setting it aside. My key concern is rather with a more historical and sociological grouping of research on 'experimental music' concerned with how this term, which is purported to be characterized by an open-ended inclusivity, has come to produce a set of limits and exclusions, often on political lines.

This, again, is a problem that I believe can be articulated through a distinction between the experiment and the experimental. By exploring contexts in which music has made connections beyond its own disciplinary bounds, including science but extending to the wide range of multidisciplinary and intermedia projects that emerge from the 1960s onwards, I will begin to sketch the transdisciplinary function of experimentation within musical practices. In so doing I will not only use the philosophical insights gained through Bachelard and Deleuze to aid this musical research, but also point to how these concrete instances of transdisciplinary work beginning from a musical perspective can tell us a great deal about the transdisciplinary movement of experimentation. In this respect I wish to leave open, for the most part, the question of the specificity of musical experimentation, in comparison to experimentation in the other arts. Likewise, the important question of how Deleuze and Deleuze and Guattari differentiate between the arts – such as the subtle distinction between music and painting in terms of embodiment in Deleuze's *Francis Bacon: The Logic of Sensation* (2003: 54) – will be set aside for another time. In the meantime, I hope that the set of mutual encounters between three distinct fields that I begin to sketch in this piece can contribute to research between and within each.

To begin, I will follow Patrice Maniglier (forthcoming) by engaging with Bachelard and Deleuze on the notion of the problem, or, more precisely, the problematic. This notion, coined by Bachelard and adopted by Deleuze, helps us see what their work has in common, but in turn reveals some of the areas in which they differ. I will work through a pairing of their shared non-Cartesian approach to thought, and how they use the problematic to formulate this, in order to elaborate on their distinctive understanding of problems.

Non-Cartesianism and the problematic in Bachelard and Deleuze

Significant attention has been paid recently to the conception of the problem in French thought, in a line of research that promises to inform and challenge some of the received theoretical lineages of the last century.[6] While Maniglier has emphasized the significance of Bachelard and Deleuze and the relationship between the two to this discourse, Craig Lundy has downplayed Maniglier's claims for the importance of the French epistemological tradition in Deleuze's conception of the problem. Lundy argues, on the contrary, for the primacy of Bergson as a predecessor to Deleuze on this matter, offering a close reading of Bergson's introductions to *The Creative Mind* and indicating the affinities between not only Deleuze's own book on Bergson, but in the framing of the problem in *Difference and Repetition* (Lundy 2018).

From a somewhat different angle Sean Bowden too suggests a kinship between Deleuze and Bergson that comes at the expense of Bachelard. Following the work of Elie During, Bowden argues that, by placing concepts before facts, the French epistemological tradition takes major steps towards producing an anti-positivist conception of problems, but yet this tradition nevertheless ultimately remains grounded in historical givens and the promise of solutions (Bowden 2018: 47; During 2004: 17). But while During argues that it is in fact Bergson who furnishes us with a fully-developed anti-positivist conception of the problem, Bowden claims that it is not until Deleuze that this is achieved.

That I have outlined these positions should not be seen as a challenge to Maniglier: on the contrary, and as I will develop, Maniglier indicates that there is more to be said of Bachelard's challenge to positivism than perhaps Bowden and During allow. However, I also hope to emphasize that it is important to recognize the richness and the plural basis of Deleuze's understanding of the problem, and that it is a lens through which we can clarify some important questions in French thought. Not least of these concerns Foucault's famous distinction between the philosophy of the concept and the philosophy of experience, which During notes is already complicated by reading Bergson alongside Bachelard (During 2004: 5).[7] Paying attention to the significance but also the limits of this distinction could reframe our histories of French thought and Deleuze's place within them. Such an approach, as I will later allude to, could be especially fruitful in Deleuzian musical research and sound studies, fields where Deleuze has generally been interpreted in terms of a neo-Nietzschean ontology of forces and a neo-Bergsonian distinction between the actual and virtual. Addressing how these no doubt crucial aspects of Deleuze's thought are refigured in the intellectual climate of his emergence into intellectual maturity would add much to these lines of research.[8]

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[6] See the recent special issue of *Angelaki* edited by Sean Bowden and Mark G.E. Kelly (2018).

[7] Bachelard's own reading of Bergson, pitting his own favouring of discontinuity against the Bergsonian continuity that is shared, but complicated, by Deleuze, is another compelling line of engagement between Bachelard and Deleuze (Bachelard 2016; Williams 2005).

[8] On contextualizing Deleuze's thought with regards to the French epistemological tradition and strands of French thought contemporary to it, see Eyers (2013) and Peden (2014).

The problematic, then, arises in Bachelard's work as a specific articulation of what it means to engage with an object of experience. With this comes a complication of how both sides of this relation and the relation itself are to be understood: namely, through an overcoming of the distinction between subject and object of knowledge (Bachelard 1966: 9-10). Maniglier identifies three features of the problematic to bear in mind as we work through how this is achieved.

The first of these is that concerning the problematic the purpose is not to learn the truths of specific objects 'out there' in the world, but to try to solve specific, singular problems (Maniglier 2012: 21). This does not yet disassociate the problematic from the 'technocratic' posing of problems, and as such the second feature is that the problematic does not correspond to 'wonder' or to a Heideggerian sense of questioning, but implies a questioning of our questions themselves, a break with common sensical questions. It is not enough to solve problems, they must also be posed anew in each case (22). This indicates that engaging with problems is a creative and productive act: the given and the immediate gives way to the constructed (Bachelard 1968: 122-23). In turn, the third feature is that the problematic is what Maniglier calls 'an operation on the substance of our ordinary life', a posing and reposing of the structures through which at all levels we engage with the world (23).

Bachelard formulates such an understanding of the problematic in 1949's *Le rationalisme appliqué*.[9] It features here as a development of the non-Cartesian epistemology he articulates especially in 1934's *The New Scientific Spirit* (or scientific mind, *esprit*), but also more generally across his most fruitful period of work on the philosophy of science from 1934 to 1940. In this period, as Christina Chimisso notes, Bachelard developed from the more direct laboratory studies of his earlier work towards using 'history as the laboratory of the philosopher who studies the mind' (Chimisso 2008: 141).

There are multiple aspects to what Bachelard considers the non-Cartesian character of his epistemology, but perhaps key is the notion that under the new scientific spirit of the twentieth century, intuition, or the relation between thinking ego and world, cannot be immediate and direct. Rather than subject and object as such, we must speak of what Bachelard calls 'the dialectic coupling objective knowledge and rational knowledge' (Bachelard 2012: 28-29).[10] On this basis intuition is 'preceded by extended study' (Bachelard 1984: 141), and clarity is the *product* of the work of the scientific mind, not, as for Descartes, at its foundation (24; Lecourt 1975: 63). As Hans-Jörg Rheinberger describes this non-Cartesian relation, '[subject] and object do not face one another directly in the experiment, but are engaged in a

[9] It is worth considering the significance of the fact that this work followed a long detour from Bachelard's work on science into a series of explorations of the imagination. These two aspects of Bachelard's work are often posed as entirely distinct, indeed seemingly by Bachelard himself, but a challenge to this presumption could be productive.

[10] This piece is an excerpt from *Le rationalisme appliqué*.

process of mutual instruction'. The scientific mind 'exists only as a history of involvement in and entanglement with the phenomena that it investigates' (Rheinberger 2010: 24). In this mutual instruction we will speak less of the well-defined objects of science that are seen in retrospect than of a process of *objectification* (Bachelard 1984: 167).

For this reason, the problematic is also implicated in a critique of a Cartesian method of universal doubt (163). For Bachelard a science founded on universal doubt 'will irremediably pulverize the given into a mass of heteroclite facts' (Bachelard 2012: 27), and such a doubt is no longer appropriate when we think of the problematic as less an isolated object than a relational field of inquiry, and of the problem as an object-bearer that cannot be said to be wholly distinct from the subject. The co-constitutive aspect of this relationship connects the givenness of the objects and the question of doubt on a different level than we find in Descartes. We think here of the object not as a *designated* object but as *instructor* (29). The scientific object becomes an object of *interest*, and one for which objectification has not been wholly achieved. When such an object is posed problematically, we discover a method of doubt that is rationally applied rather than universal, but which yet can be seen as an extension of the Cartesian form (the non-Cartesian is not the anti-Cartesian), insofar as even that which at one time attained certainty can yet, and must, be doubted (Bachelard 1984: 163).[11]

Implied between a method of applied doubt and a problematic understanding of the objects of science, and central to the concerns of transdisciplinary research, is that not only can there be no general method, but further that we discover pluralism at every level. This is a key aspect of Bachelard's response to the supposed crisis of the sciences in the early twentieth century: for Bachelard the splintering of the sciences was not the result of a deficit in scientific method, but an effect of scientific progress at work. This is manifest both internally, for example in the 'coherent pluralism' Bachelard finds in chemistry (Bachelard 1932), and externally, in an irreducibility between the sciences (Bachelard 1984: 14).

This indicates another key aspect of Bachelard's non-Cartesianism: a resistance towards reductionism. For Bachelard, modern science shows us that the path to scientific knowledge is not the reduction of the complex to the simple, but rather "seeking diversity beneath identity" (139), an increase in complexity and detail, a shift from truths that are 'adventitious and clear' to truths that are 'factitious and complex' (Tiles 2005: 16). Here we circle back to our starting point. As the intuition of scientific objects comes only in retrospect, not as immediately given, it is important that while they are in the process of objectification, that is, while they are still *active* objects of inquiry, that they remain in some sense ambiguous. In Bachelard's picture, modern science resists a Cartesian image of the clear and distinct perception of objects for one of inexactness (Bachelard 1928), an inexactness that produces the

[11] Bachelard's depiction of Cartesian doubt may not capture the complexity of Descartes' position, and the precise function of doubt in Descartes' thought and its relation to the constitution of knowledge is still a topic of great debate. See Della Rocca (2005).

dynamism between subject and object, the dynamism of scientific thought and the scientific mind itself, and the dynamism of the process of objectification that scientific practice produces.

Bachelard's reframing of Descartes' famous wax experiment (Descartes Med. 2, AT 7:30-34) vividly displays the non-Cartesian epistemology of modern science. It is worth quoting at length:

> [Descartes] rules out any possibility of what I shall call progressive experimentation, any means of classifying or measuring the diversity of what is observed, any way of fixing the variables of the phenomenon in order to distinguish one from another. Descartes's desire was to apprehend directly the object's simplicity, unity, and constancy, and at the first sign of failure he was plunged immediately into doubt of everything. He failed to see the coordinating possibilities in directed experimentation and did not recognize how theory combined with experiment might restore the organic, and hence entire and complete, character of the phenomenon. What is more, by refusing to submit docilely to the lessons of experience, he condemned himself to overlook the fact that the variability of objective observation is immediately reflected in a corresponding mobility of subjective experience. If the wax changes, I change; I change with my sensation, which is, in the moment I conceive of it, the entire content of my thought; for to feel is to think in the broad sense that Descartes attaches to the *cogito*. (Bachelard 1984: 166-67)

This passage reflects all of the features of Bachelard's non-Cartesian epistemology, and highlights the complexity, the forms of reciprocity and co-constitution, and the project-oriented character of Bachelard's depiction of modern science. By never doubting 'the permanence of the *I* that is the subject of the *I think*' (167), Descartes can neither develop a sense of the co-implication of subject and object—with its corresponding openness to being changed ourselves by the changes we encounter in our objects of inquiry—nor of the progressive objectification of modern science, its form as a project that sets the conditions for the production of the purified materials, in this case wax, suitable for laboratory experimentation (167-68).

Many of the features of this non-Cartesian epistemology are present in Bachelard's work from the very beginning, since his 1927 doctoral thesis *Essai sur la connaissance approchée*. So why does he feel the need to introduce the problematic? One aspect of this is that it goes some way towards refining these thoughts and distancing them further still from the philosophical divisions they are posed against, such as firm distinctions between not only subject and object, but, for example, abstract and concrete (Bachelard 1966: 104). There are concepts that the problematic seems to replace or complement, such as that of the field (56), that perhaps maintained too much of the character of the scientific observer as a distant, arbitrating *cogito*. The problematic is a step further away from such an isolated form of the subject position.

This illuminates also Bachelard's long-standing interest in scientific instrumentation. The scientific observer and scientific thought cannot be located within individual or even collective scientists, but is equally contained within scientific technologies, understood as a kind of materialized form of scientific theory. In *Le rationalisme appliqué* this is expressed in the key coupling between applied rationalism and technical materialism (5). These extra layers of mutual implication that the problematic offers also do much to clarify the relation between scientific progress and the fundamental discontinuity that Bachelard sees as underlying the dynamics of thought.[12] The problematic maintains something traceable through the breaks, something that marks the rightly speaking materialist sense of instruction, practical rather than doctrinal (Maniglier 2017: 31), that occurs in the specification of objects of knowledge, the way in which scientific value 'imposes' itself (Lecourt 1975: 12) in the 'pedagogy of the scientific mind' (Bachelard 2012: 31).

There are many points of resonance between this sketch and the manner in which Deleuze makes use of the problematic in *Difference and Repetition*, not all of which I intend to detail here. However it is useful to bear this depiction in mind when Deleuze, in a short footnote in that text, cites Bachelard as opposing the problem to Cartesian doubt, and to what he calls 'the recognition model of philosophy' (Deleuze 1994: 320n9). Here Deleuze is beginning to develop his notion of the problematic Idea, at this moment being described as an object of encounter 'which can only be sensed' (139) rather than being subject to recognition. For Deleuze recognition ensures that 'the form of identity in objects relies upon a ground in the unity of a thinking subject' (133). This, for Deleuze, like Bachelard, effaces the dynamism of thought, the effects of the result of an encounter with the unexpected and the new. In contrast to such an encounter, 'the form of recognition has never sanctioned anything but the recognizable and the recognized; form will never inspire anything but conformities' (134).

Such a notion of that 'which can only be sensed', of an encounter the effects of which are not determined in advance, is key to what Sean Bowden terms Deleuze's anti-positivism (Bowden 2018). However it is likewise central to the connection that Maniglier draws between Deleuze and Bachelard, offering a challenge to the argument that Bachelard reverts to a form of positivism. Maniglier quotes Bachelard:

> The scientific mind forbids us to have an opinion on questions we do not understand and cannot formulate clearly. Before all else, we have to be able to pose problems. And in scientific life, whatever people may say, problems do not pose themselves. It is indeed having this *sense of the problem* that marks out the true scientific mind. For a scientific mind, all knowledge is an answer to a question. If there has been no question, there can be no scientific knowledge. Nothing is self-evident. Nothing is given. Everything is constructed. (Bachelard 2002: 25)

[12] On this discontinuity in relation to Deleuze's primacy of continuity, see Williams (2005).

This phrase, the 'sense of the problem', is one Maniglier focuses on. He construes it as referring to an attitude to problems where they are not readily identifiable objects to be solved, but rather objects of encounter that will force us to break with our presuppositions, or what Deleuze terms 'common sense' (Maniglier forthcoming; Deleuze 1994: 149): the kinds of formulations that Deleuze will characterize with the phrase 'everybody knows…' (Deleuze 1994: 130) and Bachelard the philosopher's 'it is said that…' (Lecourt 1975: 35).

Elsewhere Maniglier speaks of 'positivity', that which for Bachelard 'can impose itself against what seems "thinkable"', 'that which can impose itself against all presuppositions' (Maniglier 2017: 34). For Maniglier this echoes the Bergsonian sense of the problem, pointing towards a 'positive metaphysics' not concerned primarily with truth but with modifying our presuppositions when faced with novelty (28-29). This positivity, then, is far from the positivism that During and Bowden have credited Bergson and Deleuze, respectively, with overcoming, and we find here what we could term a positivity contra positivism, challenging the claims of During and Bowden, and indicating that Bachelard has much to offer to an anti-positivist conception of problems.

Returning to our central topic, Deleuze likewise seems to follow Bachelard in associating this particular dynamic of thought with something called experimentation. We hear, for example, that 'the concepts of the understanding find the ground of their (maximum) experimental use only in the degree to which they are related to problematic Ideas' (Deleuze 1994: 168-69). But we also find Deleuze warning against the dangers of reducing his own formulation of the problematic to a scientific model. The remarkably sophisticated constitution of the problematic Idea in *Difference and Repetition* indicates why this would be, and the secondary literature on the problematic and the problem in Deleuze reflects its status as a complex and multivalent concept. Sean Bowden, for example, identifies two essential moments paired within the problematic Idea, the first making use of differential calculus and the meta-mathematical theory of Albert Lautman, the second a form of intensive individuation drawing from Gilbert Simondon (Bowden 2011: 102). Craig Lundy has argued for the primary importance of Bergson (Lundy 2018), while Audrey Wasser has passed through Heidegger, Plato, Bergson and Nietzsche in order to sketch the characteristics of how Deleuze views an investment in problems (Wasser 2017). Equally we could emphasize the importance of thinkers including Kant, Leibniz and Maimon.

Furthermore, Deleuze will also speak of works of art as being problematic, naming Mallarmé's *Livre* and Joyce's *Finnegans Wake* among such works (Deleuze 1994: 69). Contrary to the model of recognition, 'the work of art appears as experimentation' (68). These problematic works are works that are not susceptible to a single point of view or model of interpretation, and Deleuze associates them with Umberto Eco's notion of the 'open work' (69;

Eco 1989: 8), which is itself an intervention into theoretical structuralism, urging us to consider also Deleuze's ambivalent relationship with that mode of thought.[13]

It is evident enough that we are far from Bachelard's focus on the practical specificities of the scientific laboratory. But we can make an initial statement that Deleuze's aim here, as we will see, is not to deny the validity of scientific knowledge as such, but to restrict the domain of knowledge *per se*. This is marked by the centrality of *learning* in Deleuze's formulation of the problematic Idea: while knowledge 'designates only the generality of concepts or of a rule enabling solution' (Deleuze 1994: 164), learning accounts for the confrontation with the objectivity of a problem, as an encounter. Yet we see here that this form of learning closely matches one that Bachelard identifies with scientific thought, while in Deleuze's case when posed against science it points towards a shift into a more specifically critical register.

In the opening pages of *Difference and Repetition* we find some critical remarks on scientific experimentation, on the basis of how it is purported to understand repetition and generality. Contrary to Deleuze's opening statement that '[repetition] is not generality' (1), the experiment, as Deleuze presents it, is founded on the equation of the two through the production of a form of repetition that erases the difference that underlies it. This obscures, says Deleuze, the distinct singularity of each individual instance of a repetition. The scientific experiment, then, operates in terms of laws. For a given invariable form governing how we expect an object of inquiry to behave, the experiment produces a set of conditions under which the scientist can anticipate the same outcome in each instance, a repetition without variation (3). Outside of the closed environment of the experiment, the form of expectation the law offers cannot be so easily applied, but the structure of the experiment attempts to isolate individual factors and bear witness to them behaving as the law predicts.

A key concern of *Difference and Repetition* is an undoing of the form of generality that law and the experiment attempts to prove. The scientific experiment and its articulation around law provides for Deleuze an exemplary case of a notion of knowledge that throughout history—and Deleuze is broad here, presenting a history spanning Plato to Kant and beyond—has effaced the fundamental difference that Deleuze posits as underlying identity. This is why, when it comes to his use of differential calculus, Deleuze states that 'the many philosophical riches to be found here must not be sacrificed to modern scientific technique' (171), a sentiment in strong contrast with Bachelard's elevation of the scientific mind over the non-scientific or pre-scientific. Despite the adoption of concepts from science and the philosophy of science from thinkers including Bachelard, Simondon, and widely from the field of biology, the

[13] Patrice Maniglier (2019) and Étienne Balibar (2003) are among those who consider Deleuze to be following in a trajectory set out by structuralism, contrary to a narrative that would posit his 'poststructuralism' as marking a radical break with structuralism.

positive role of science, and the means by which scientific concepts can take on this positive philosophical role, remains somewhat unclear.[14]

This takes us back to the trajectory of Deleuze's thought following his encounter with Guattari, from the radical transdisciplinarity of the *Capitalism and Schizophrenia* project to the apparent reversion to disciplinary foreclosure of *What is Philosophy?* and its tripartite scheme of philosophy, science and art. Deleuze, one might have supposed, was freed from his disciplinary home in philosophy and from the imposition of strong disciplinary distinctions like that apparent between philosophy and science in *Difference and Repetition* by his encounter with Guattari, with Guattarian notions like the transversal and the machine serving to motivate Deleuze's thought with a new mobility and mutability.[15] *What is Philosophy?* suggests otherwise.

How to unpick what has occurred across this passage of Deleuze's thought is not obvious. To begin to address this, I turn again to the term experimentation. Certainly Deleuze speaks of experimentation in a positive sense, while speaking of the experiment negatively. What are we to take from this? We can suggest that Deleuze is favouring an artistic form of experimentation, but the diverse and knotty lineages of this term in an artistic context provide no easy route towards clarifying the sense of experimentation in use.[16] But following Deleuze's collaboration with Guattari, and perhaps especially through the distinctive break with psychoanalytical forms of interpretation this produced, Deleuze would go on to develop a distinction between *experimentation* and *interpretation*,[17] which offers us a starting point for exploring these questions further.

Again in *Anti-Oedipus* we find the formulation 'art as experimentation' (Deleuze and Guattari 1983: 371), but in this context we find a fuller sense of how this experimentation is to be understood. We hear of an art that rejects aims and concepts, recodings and axiomatics, 'art as *process* without goal, but that attains completion as such'. They speak again of literature, here of Artaud and Burroughs, and painting, Turner. However, for a precise definition drawing from the arts, they turn to the composer John Cage. Citing Cage, 'experimental' is to be understood 'not as descriptive of an act to be later judged in terms of success and failure, but

[14] Mary Beth Mader has convincingly argued that at least one such concept, that of intensity, is better read as a philosophical concept than a scientific one (Mader 2017). The means by which she makes this argument, posing the intensity of philosophical concepts against the necessity of extensive expression in scientific inquiry, provides an illuminating angle for some of the movements in Deleuze's thought across his works with Guattari that I will be discussing here.

[15] Guattari's text 'Machine and Structure', a response to *The Logic of Sense*, paved the way for Deleuze and Guattari's collaboration by arguing that what Deleuze credited to a structuralist understanding of structure could only be understood through the immanently practical and political concept of the machine (Guattari 1984).

[16] Its literary use traces back to, at least, Émile Zola's 1880 text 'The Experimental Novel' (1893), though it is not until the twentieth century that it gradually accumulates more widespread and conceptually refined meanings.

[17] See, for instance, Deleuze and Parnet (2006: 41).

simply as an act the outcome of which is unknown' (370; Cage 1961: 13). It is a model of art that does not find itself axiomatically grounded: the experiment cannot be taken as a 'method', if method is taken in terms of a 'premeditated decision' regarding the approach towards an object of study.[18]

Here Deleuze tacitly reiterates the position outlined in the opening pages of *Difference and Repetition*: the experimental is posed in strong opposition to the scientific experiment. But it is the effects of such a distinction that leads to the disappointment felt regarding the splits introduced in *What is Philosophy?*: if philosophy and art are the realms of the experimental, and science the realm of the experiment, what is the relation between them to be if not only separation? To work through this question, I will first turn to the contextual source of Deleuze and Guattari's definition of the experimental, to music, and consider how the practical and historical manifestations of this term complicate such a precise distinction or opposition. Engaging with recent work on the experimental in musical research, I will refine the conceptual and practical terms of the distinction between the experiment and the experimental, and move on to considering how this can offer us a route into reappraising Deleuze's thought.

The experiment and the experimental

Cage's definition of the experimental has often been taken as a general characterization of that which falls under the term 'experimental music', but recent work has elaborated on how this term is much more contested and conflicted than is immediately apparent. One narrative that has been dominant since at least the 1970s but which stretches back to the 1950s is a strong distinction between American experimental music and the European avant-garde. In 1959 Peter Yates first speaks of the 'American experimental tradition' in his lengthy and generally pluralistic bibliography of twentieth century composers, including figures such as Cage, Henry Cowell and Edgard Varèse (who lived in the United States from 1915 until his death in 1965) (Beal 2008), but it is with Michael Nyman's 1974 text *Experimental Music: Cage and Beyond* that the term's widely recognized taxonomical form began to solidify. Nyman posits a strong distinction between an American experimental tradition, stemming from Cage, and the post-serialist music of the European avant-garde. Contrary to the latter's posited overriding concern with the exclusively musical factors of form and structure, explored through the careful management of the parameters of sound (Nyman 1999: 61), experimental music takes an interest in chance, process, unpredictability, playfulness, an independence from institutional

[18] This definition is used by Deleuze in two similarly-worded passages in *Nietzsche and Philosophy* and *Difference and Repetition* (Deleuze 2006: 108; Deleuze 2004: 165). Despite this rejection of such an understanding of 'method', the question of method remains an important one when engaging with Deleuze, and considering how this 'method' differs from, for example, Bachelard's understanding of scientific method, will be key going ahead.

form and tradition, and an opening towards music's outside, all features of Cage's composition that have been elaborated on by others (ibid.: chapter 1). No doubt there are real distinctions to be made, but Nyman's formulation has also served to obscure both the internal heterogeneity of 'experimental music' and important connections between North American and European music in the twentieth century.[19]

One terrain this distinction has been articulated across is that of the scientificity of approaches to music. The formal, parameter-oriented work of musical serialism and related musical approaches was well-suited to developing a theoretical discourse comparable to that of the sciences, and such an orientation towards scientific rigour was emphasized by significant European journals like *Die Reihe* (Mauceri 1997: 192). This approach had North American equivalents, such as through the journal *Perspectives of New Music*, favouring the serialist-inspired music of composers like Milton Babbitt and Elliott Carter (both featured in Yates' bibliography but who go unmentioned by Nyman).

The examples of Babbitt and Carter indicate that this is far from a neat geographical split, and it is complicated further still by what seems to be a third position. The French *musique concrète* pioneer Pierre Schaeffer formulated his own understanding of 'experimental music' through his laboratory-like investigations into sound in the context of the *Groupe de Recherche de Musique Concrète* (GRMC), later renamed the *Groupe de Recherches Musicales* (GRM) (Schaeffer 1957), binding musical innovation with technological progress in the use of turntables, magnetic tape and other electrical and electronic devices (Schaeffer 2012). Yet Schaeffer, drawing from phenomenological approaches, criticized the scientific character of serialist approaches to sound and music, terming these 'abstract' music in distinction to his 'concrete' music (222). Attacks on the perceived scientism of his former collaborator (and, incidentally, former student of Bachelard) Abraham Moles' work on music and information theory (Moles 1966) form a persistent subtext of his major work on sound and music, *Traité des objets musicaux* (Schaeffer 1966).

This points towards an aspect of Cage's work that seems at odds with the 'experimental' attitude outlined above, namely his own attitudes towards new technologies. In his early text 'Future of Music: Credo', Cage emphasizes the use of technological advances in the service of producing 'new sound experiences' (Cage 1961: 4), and we see this exhibited in the coming decades through his use of emerging sound reproduction technologies. How are we to understand the relationship between these technologies that are the result of scientific research and an artistic inclination that seems to strongly dissociate itself from the methods of science? In Cage's case the tensions and contradictions this connection produces become profoundly manifest towards the end of the 1960s.[20]

[19] Not least through the figure of Cage himself: see Iddon (2013).

[20] Branden Joseph compellingly details the difficulties and contradictions present in Cage's engagements with technology throughout Joseph (2016).

Even before their collaboration on the 1969 piece *HPSCHD*, the work of Lejaren Hiller provided an intriguing counterpoint to Cage's. Hiller too termed his approach to music 'experimental music', but in Hiller's case this term referred to the experiments of the scientific laboratory (Hiller and Isaacson 1959). Hiller took his training as a chemist and applied it to the realm of music, drawing up carefully defined experimental contexts and conducting tests within them. Aesthetically, Hiller's early work did not seek the formal and practical advances of either North American experimentalism nor the European avant-garde, assuming instead well-established principles of music theory as a standard against which to measure his tests (Brooks 2012: 41). As William Brooks describes the method of Hiller's works modelled with his ILLIAC computer (some of the earliest research in computer music), 'experiments are conducted—notes, sketches, "integers" are tested—and the results are kept or discarded depending on whether they conform to a preestablished set of desires, expectations, or theories' (42). With such a strong contrast to Cage's work, it is then of some surprise that they would choose to collaborate, though some of this could be credited to a shared 'outsider' status (Cage's persistent refusal of convention alongside Hiller's lack of formal musical training) that Yates credits as a key feature of the 'American experimental tradition'. As Brooks suggests, what we see here in this collaboration is perhaps cultural and biographical factors overcoming technical and aesthetic differences (56).

HPSCHD, then, combined Cage's and Hiller's methods into a large-scale multimedia piece, composed over two years. Despite the success of the piece, its production was troubled: Cage found the ILLIAC supercomputer ill-suited to his methods, and, while once stating that the production of computer subroutines could be construed as not an individual achievement but an achievement on the part of society, would later state that the aesthetic character of *HPSCHD* was produced not through, but despite its computerized elements (Joseph 2016: 179-80).

Following *HPSCHD*, in the final two decades of his life, Cage would gradually withdraw from his concern with technological innovation and enter into a more insular, retrospective mode of composition. Cage also generally departed from the large-scale collaborative multimedia works of the 1960s like that of *HPSCHD* or the *9 Evenings* performance of his *Variations VII* (Silverman 2010: 229). We see in Cage's move not only an apparent unwillingness to engage with the methods of others, but a pull away from the kind of collective, institutional work that was increasingly at the forefront of new musical research, from Hiller's University of Illinois Experimental Music Studio, to the San Francisco Tape Music Center (Bernstein 2008), to France's GRM and, later, IRCAM.

How does Cage's apparent reluctance to put his work into communication with that of others conform with the openness to the unexpected and to change suggested in his understanding of experimentation? Some recent musical research on the topic of

experimentation may suggest a route into engaging with this question, and orient us back towards the theoretical crux of my argument.

Cage scholars including William Brooks and Christopher Shultis have emphasized the importance to Cage of what Brooks terms a 'pure observation' in contrast to the designed and delimited test (Brooks 2012: 49), and what Shultis calls a 'transparent I' (Shultis 2013: 62) or a self 'among things' (75) in contrast to a projected self that moulds nature under its own terms (65). These figures put Cage in the camp of the experimental versus that of the experiment. But we cannot be so quick with this distinction. Donna Haraway is among those who have noted that such a pure observer or 'transparent I' is a grounding figure in the birth of modern science. Haraway speaks of a 'modest witness', an inhabitant of an 'unmarked category' that renders itself invisible in its observations, living in a 'culture of no culture' that conceals this scientific subject's social constitution, namely as European man (Haraway 2004: 223-24), hiding in turn the constitutive exclusions this entails.[21] As Haraway vividly describes this modest witness:

> the modest witness is the legitimate and authorized ventriloquist for the object world, adding nothing from his mere opinions, from his biasing embodiment. And so he is endowed with a remarkable power to establish the facts. He bears witness: he is objective; he guarantees the clarity and purity of objects. (224)

Benjamin Piekut translates Haraway's modest witness directly into a critique of Cage, speaking of Cage as a purported 'sound's modest witness' (Piekut 2012). Piekut argues that Cage's work is premised on 'an absolute ontological distinction between an objective natural world and a subjective social world' (3), and, for Piekut, Cage's call for listeners to 'let sounds be themselves' (Cage 1961: 10) makes a claim to lay nature bare, 'to see things directly as they are' (Piekut 2012: 12). Piekut's argument, following Haraway and Bruno Latour especially, is that Cage can hold such an objective sense of nature only by eliminating 'the contingencies of the social, the subjective, the human'. In so doing, for Piekut, following Haraway, the self-abnegation and 'modesty' of Cage's position serves only to reproduce the modern, European, masculine power dynamics of science's modest subject (15).

I am not inclined to accept the full force of Piekut's argument, and believe that the fundamental pluralism and complexity of Cage's work and thought offers means to respond to this critique. For instance, I do not believe that Cage has a substantive, contentful notion of nature that would accommodate such a rigid distinction between the subject and its object that is nature. However, Piekut nevertheless diagnoses at the very least a significant tendency in

[21] We could align this with Joseph's remarks on Cage putting aside 'affect, emotion, desire, and any other irrational or ego-motivated aspects of human behavior' (Joseph 2016: 187), which Joseph associates with an evacuation of the political from Cage's work.

Cage's work, and a tendency that can be found elsewhere within what has fallen under the banner of experimental music.

Other recent work has pointed to the ways in which the ostensibly open-ended and inclusive form of 'experimental music' has served to limit and exclude. A founding text here is George E. Lewis's 'Improvised Music after 1950: Afrological and Eurological Perspectives' (Lewis 1996). Lewis here elaborates on how a racial space has been delineated through the theorization of 'experimental music', such as through the formulation of Cage's 'indeterminacy' in contrast to the 'improvisation' of traditionally black practices like jazz (97). For Lewis, a technical vocabulary and set of qualifiers to the word 'music'—not only 'experimental' but also 'new', 'art', 'concert', 'avant-garde', 'contemporary' and so on (102)—have served to render blackness the other of this music, in so doing revealing 'whiteness as power' (99-100).

With pointed relevance to Deleuze, Marie Thompson has recently argued that the erasure of the social and political and the obfuscation of subjective situatedness that Piekut diagnoses in Cage's work has been reproduced in what has been termed the 'ontological turn' in sound studies, with Thompson naming an uninterrogated whiteness as underlying this turn (Thompson 2017). This orients us towards debate concerning what has been named 'Deleuzian sound studies': this ontological turn, like the modest witness, makes a claim to an immediate, affective immersion in a notion of sound that is paired, in thinkers including Christoph Cox and Greg Hainge, with the Deleuzian notion of the virtual.[22]

As suggested by my earlier remarks on Bachelard and Deleuze's non-Cartesian thought, I do not follow Cox and Hainge in associating Deleuze's virtual with immediacy. I do, however, believe that the risk of making such a claim, and of naturalizing the virtual in a manner that obscures social and political questions, cannot be reduced to a misreading of Deleuze's work, but is rather immanent to what I believe are some key turning points in Deleuze's thought and more generally to the formulation of the experimental. To begin to articulate this, I turn to a refined conceptual elaboration on the distinction between the experimental and the experiment I have been engaging with here, that offered by Lydia Goehr.

Goehr engages with the thought of Theodor Adorno and Max Horkheimer to draw a connection between the beginning of modern science, through the figure of Francis Bacon, and the beginning of modern art, through Cage (Goehr 2016: 16). In the opening pages of *Dialectic of Enlightenment*, Adorno and Horkheimer speak of the Enlightenment, and Bacon, in terms of domination, a scientific domination of nature that is coupled with a domination of man (Adorno and Horkheimer 1997: 4). Goehr notes that the manner in which Adorno and Horkheimer speak of Bacon here closely matches remarks of Adorno's on Cage elsewhere, as in his ambivalent discussion of Cage's 'catastrophe music' (Adorno 1998: 257). Having

[22] I make an intervention into this debate, suggesting that Cage and Deleuze could be read differently than is suggested by Piekut and 'Deleuzian sound studies', respectively, in Campbell (2017).

established this connection, Goehr then elaborates on how while in modernity the experiment and the experimental become competitor concepts (19), the commonly conceived divides between the two are not always so easy to determine. For Goehr, via Adorno and Horkheimer, Bacon and Cage share an attitude of 'nobility and respect' rather than 'violent intervention' towards nature, yet this is not something they easily maintain: they both promote the experimental, open-ended, revisable and incomplete (Goehr 2016: 23), but for Adorno both ultimately walk the 'more dangerous path' (18) of the control and domination of the experiment.

Goehr's reading of Bacon puts into question some common conceptions of his scientific approach to nature: Bacon ultimately does not seek to 'torture' nature as he has been commonly accused of doing, but rather to urge it towards disclosure (29). Bacon becomes a kind of modest witness. For Goehr it becomes clear that modern science, society, philosophy and art share a set of concerns to the extent that any common sensical association of the experiment with science and the experimental with art would be mistaken (31). In Adorno's case, the result of this is that Bacon and Cage's ultimate meeting in the overlap of the experiment and the experimental is in a position of complete control, an authoritarian space. Goehr is not so harsh. Rather she seeks only to note that, on one hand, the experimental and the experiment both lose their effective power when they move too far in the direction of their respective exclusive tendencies (38), and on the other hand to warn that '[truth] is fragile and has only the smallest chance of survival. An experimental act usually ends up as an experiment' (37).

Goehr's engagement with Bacon and Cage shows that any distinction between the experiment and the experimental should not be drawn too quickly, and can indeed be dangerous if either side is embraced at the expense of the other. Experimentation, in either sense, is a precarious practice, one that cannot presume its essential character in advance and must carefully navigate these questions as it proceeds. This is an elaboration of the experiment-experimental relation we must keep in mind as we move on.

Practicing transdisciplinarity

Let us return now to *What is Philosophy?*, first to offer a defence of that text's apparent regression into disciplinary isolation, and then, drawing on Bachelard and the musical research detailed above, to suggest some reasons why this defence may yet not satisfy.

While we have seen that *What is Philosophy?* seems to replicate the strong distinction between philosophy and science from *Difference and Repetition*, what is striking is that the apparent normative aspect of this in the earlier text, where science is devalued in favour of philosophy, is largely absent in the later work. Science is even named as a creative discipline in its own right (Deleuze and Guattari 1994: 127), and Deleuze and Guattari criticize the 'bad

caricature' of science that Bergson and phenomenology (and perhaps, implicitly, Deleuze himself) offer in suggesting that it refers only to the 'already-made' (155). In *What is Philosophy?* we do not find such a philosophical critique of science, and indeed the concepts of philosophy, the affects and percepts of art and the functions of science generally do not encroach upon one another: the disciplines 'approach chaos in a completely different, almost opposite way' (118), they are of different natures (127).

Where we do find such a normative aspect is when Deleuze and Guattari discuss logic, and more generally speaking analytic philosophy.[23] For Deleuze and Guattari logic is necessarily reductionist, it 'wants to turn the concept into a function' (135). This points towards the purpose of the redisciplinarization of *What is Philosophy?* following the transdisciplinary adventure of *A Thousand Plateaus*. The premise of *What is Philosophy?* is a 'lack of resistance to the present' (108), the difficult, near hopeless sense of the political context in which it was written. In this it echoes the near-contemporary Deleuze text 'Postscript on Societies of Control', which elaborates on a new modulatory form of control that reads almost like a self-critique of *A Thousand Plateaus*, the modernist freedoms named in that text having been readily adopted into the control mechanisms of the state (Deleuze 1992).

Philosophy, science and art, in their proper functions, are what Isabelle Stengers terms 'endangered practices' (Stengers 2010: 42). Just as for Deleuze and Guattari philosophy risks being lost by having the concept replaced by the function, science too may be lost when the act of creation that is the production of a scientific function is replaced by science in the service of industrial innovation (49). *Doxa* threatens each of philosophy, science and art, it threatens their contact with chaos, it threatens to replace the specificity of their functions with a stultifying circulation of dogmatic 'information'. *What is Philosophy?*, then, takes as its starting point a group of historically engrained disciplinary conditions, but disciplinary conditions that, from Deleuze and Guattari's perspective, hold within them something that could allow us to resist the present, an act that without these disciplinary conditions would be impossible.

The disciplinary divisions of *What is Philosophy?* are also not as rigid as much of the text suggests. In its concluding section, 'From Chaos to the Brain', Deleuze and Guattari provide many rich images of the relationship between the disciplines. At the junction of the three planes these disciplines produce is what Deleuze and Guattari term 'the brain' (Deleuze and Guattari 1994: 208), and they speak of the forms of 'interference' that can take place between these planes (216).[24] With extrinsic interference, the philosopher can attempt to create concepts of a sensation or a function (Deleuze could be said to be doing this with his own use of artistic and scientific terminology), or the scientist functions of sensations, like colour. With intrinsic interference, there is a more thorough slippage, a departure from one's own plane to

[23] Deleuze and Guattari's conception of analytic philosophy is sweeping and would benefit from more nuance. Jeffrey Bell's careful reading is useful in this respect (Bell 2016).

[24] Deleuze also uses this term in his discussion of cinema (Deleuze 2005: 268).

navigate through the others (217). Deleuze and Guattari name Nietzsche's Zarathustra as an example, but we could equally speak of the transdisciplinary lines of flight of *A Thousand Plateaus* in this manner.

But something remains elusive about these descriptions, more evocative than a catalyst to resistance. Part of the persisting dissatisfaction lies in how, despite the relative contingency of these disciplinary conditions as the forms of creation that happen to have survived, and that offer us tools to escape the present, there is a sense of something essential about them, each discipline marking an unchanging form. An aspect of this lies, I believe, in how Deleuze and Guattari note that it is in the 'full maturity' of concepts, functions and sensations that they can intersect (161). As Stengers notes, this puts Deleuze and Guattari's understanding of science in the realm of what she terms, following Bruno Latour, 'bearded science', the system of science and its recognized functions, rather than of science 'in the making' (Stengers 2010: 42-44). As Stengers notes, this puts the science of *What is Philosophy?* firmly in the camp of what *A Thousand Plateaus* names 'royal science', asking, '[why] do nomad sciences appear nowhere in *What is Philosophy?*' (42). This question allows us to take a final turn back to Bachelard.

In *A Thousand Plateaus*, Deleuze and Guattari distinguish between 'royal' science and 'nomad' science (Deleuze and Guattari 1987: 367). The former consists in 'reproducing', the latter in 'following' (372). What this means is that royal science, in a description recalling the opening pages of *Difference and Repetition*, works on the basis of law, treating differences of time and place as variables to be placed under this constant form. Like Haraway's modest witness, this reproductive mode of science assumes 'the permanence of a fixed point of *view* that is external to what is reproduced'.

Nomad science, on the contrary, is 'ambulant': it follows flows, searches for 'singularities', engages in 'a continuous variation of variables' rather than extracting constants. We will recall here the distinction between the experiment and the experimental. Yet in *A Thousand Plateaus* this distinction is not oppositional as such. Certainly the royal sciences tie up the movements of the nomad sciences under its laws and, at worst, its state utilization in the form of 'technologies' or 'applied science' (372-73), but this formalization is a necessary feature of the existence of nomad sciences. The nomad sciences invent problems for the royal sciences to solve, and these solutions depend upon the formal structures of state science (374).

We find here a more creative and dynamic image of science than is present in *What is Philosophy?*, and it is striking to note that it again begins with a brief reference to Bachelard. Deleuze and Guattari credit Bachelard's *Essai sur la connaissance approchée* as being 'the best study in the steps and procedures constituting the rigor of the anexact, and of their creative role in science' (555n32). The anexact, drawing also from Husserl, concerns essences that are not of the precise, ideal form that we commonly associate with science, but are vague, 'vagabond or nomadic', yet nevertheless rigorous: '*anexact yet rigorous*' (367). It is with such essences that the nomad sciences engage.

Bachelard's own conception of the inexact reinforces much of what was earlier discussed under the terms of his non-Cartesianism. It concerns the fact that reality can never be fully known, and that this incompleteness is a catalyst to further investigation, the discovery of new structures and new levels of complexity (Tiles 2005: 161-62). Indeed, Bachelard, like Deleuze and Guattari, affirms that this level of activity works in a somewhat different sphere than that of the utility of technological goals, and the two levels work together to determine the 'importance' of how this inexactitude is to be interpreted (163): comparable to Deleuze and Guattari's discussion of the 'safety' for which nomad science relies on royal science (Deleuze and Guattari 1987: 374).

Yet Bachelard feels no need for a distinction like that between royal and nomad science. The only comparable distinction in his work is that between 'regular' and 'secular' science, the former being of the laboratory and the latter 'find[ing] its disciples among the philosophers', that is, those who seek to reduce science to their philosophical abstractions (Bachelard 1984: 145-46). What differentiates Bachelard from Deleuze and Guattari here? I would like to suggest that one key aspect of this differentiation, and one that is greatly amplified in *What is Philosophy?*, is *practice*.

Bachelard's work on science reads to the modern eye somewhat curiously, with what seems like a strong form of social constructivism coupled incongruously with a scientistic rationalism. Yet, as Mary Tiles notes, when putting forward a social constructivism of science Bachelard cannot be read as taking a side in the 'science wars' of half a century later. He must rather must be seen to be responding to a context in which other philosophers of science 'were talking about foundations, simplicity, and observation protocol statements' (Tiles 2005: 157). Bachelard's concern was not aligned with the later anthropological and sociological concerns of Bruno Latour, and this is why, albeit, as Patrice Maniglier notes, harshly on Bachelard (Maniglier forthcoming), Latour firmly distances himself from Bachelard and any notion of an epistemology, naming epistemologies as having 'always been war machines defending science against its enemies' (Latour 1988, 6). On the contrary, Bachelard positions himself immanently to science, to its institutions, its modes of knowledge and, most precisely, its practices.

For this reason Bachelard's picture of science works at many levels, from the minutiae of laboratory procedures and the development of theories, to pedagogical practices and the form of scientific libraries, to the contention with the imposition of philosophical abstractions; albeit, notes Dominique Lecourt, with less concern for question of ideological or political determinations (Lecourt 1975: 14). Such an investment in practice poses a challenge to, and offers the opportunity to reframe, some paths through Deleuze's thought. As Alberto Toscano notes, the 'place' where the 'universal ungrounding' of *Difference and Repetition* occurs is unclear, and indeed seems to lie in the experience of the philosopher-individual (Toscano 2006: 199), and Antonio Negri asks, referring to the difficult notion of 'practice' in Deleuze's 'How Do We Recognize Structuralism?', '[where] is the "structuralist Hero"?' (Negri 2011: 157),

the actor who can enact a change from one structure to another? The encounter with the practically- and collectively-oriented Guattari softens this difficulty, certainly, and in Guattari's individual work we do not feel the threat of either disciplinary or individual closure. Furthermore, such a practical orientation is one of the aspects of *A Thousand Plateaus* that most allows for its experimental, transdisciplinary character, *pragmatics* being one of the terms that is used to describe the creative character of this text (Deleuze and Guattari 1987: 2), and one that requires a close examination if we are to understand the meaning of practice in Deleuze and Guattari's thought. Yet at points in Deleuze's later work, most of all in *What is Philosophy?*, an opaqueness of the practical may linger on.

I do not wish to push this apparent favouring of Bachelard too far. While Patrice Maniglier readily extends the 'positivities' that Bachelard attributes to science out into 'other activities, like arts, politics, games, techniques, passions, etc.' (Maniglier 2017: 34-35), I am inclined to be more cautious. Bachelard's elevation of the scientific mind over the non-scientific mind is exceedingly strong, speaking, for instance, of 'the enormous superiority of the *scientific object* over the object of everyday experience for metaphysical instruction' (Bachelard 2012: 28). Lacan would criticize Bachelard's severe distinction between ordinary and formalized languages (Eyers 2013: 58), and indeed Bachelard argued, even, that mathematics is not a language, but a thought, thought itself (Lecourt 1975: 56-58).

In addition, Alison Ross has recently pointed to some important distinctions between Bachelard and Foucault that are significant in this case also. As Ross notes, Foucault departs from the French epistemological tradition that precedes him in terms of the status of knowledge. For Foucault epistemology is an object of study, while for Canguilhem and Bachelard alike it is a practice (Ross 2018: 144). I seek to value this practical element, but with a careful concern for the issues that led thinkers like Foucault to seek alternatives to it.

A renewed concern with the practical will, I believe, help us to engage with key concerns that the disciplinary boundaries of *What is Philosophy?* seem to, or indeed explicitly, exclude. For example, where do the social sciences sit in Deleuze and Guattari's schema (Brown 2010)? How can we appreciate the impact of conceptual art beyond Deleuze and Guattari's quick dismissal of it on account of its apparent confusion of sensation with concept (Deleuze and Guattari 1994: 198)?[25] We lose much of the richness of contemporary art, and indeed of music, the transdisciplinary modes of practice that music has discovered by opening its boundaries to its outside, if we cannot find the value in this artistic moment. The practical challenge may have a major effect on the framework of *What is Philosophy?*, and would raise new difficulties of its own, but this is something that will only be navigated with careful, open-ended, and, indeed, transdisciplinary work.

With a focus on practice, Bachelard may help us with our musical problems too. How is the experimental to be reconciled with a concern with technological innovation? For

[25] Or perhaps this is only Deleuze's dismissal: we find elsewhere that Guattari is much more sympathetic.

Bachelard such a pairing is key to his understanding of laboratory work. The 'phenomeno-technology' (Bachelard 1984: 13; Rheinberger 2010: 23; Chimisso 2008: 143) that couples applied rationalism and technical materialism undoes any division between the adventure of the experimental and the results of the experiment. It is a lens that may help us navigate between the poles of musical primitivism and technologism.

What Bachelard and recent musical research on the question of experimentation show us is that when engagement takes place at an immanent, practical level, received distinctions between the experiment and the experimental no longer hold so readily. Involvement in either side is risky, and requires the careful, constant evaluation of its relationship with its counterpart. For this reason, the apparent foreclosure of *What is Philosophy?* cannot be easily dismissed: it is evidence of one aspect of the fragility and the danger of experimental work. Just as philosophy can only be saved from a reduction to logic by carefully navigating its own form of experimentation, perhaps so too may 'experimental music' act as a mode of resistance towards the commodification or scientification of music only if its experimentation is carefully measured. This is inconclusive, and it need be: while experimentation cannot be a general method, its transdisciplinary passage across disciplines, invested in new ways in each, may help us map out and draw divergent relations between philosophy, science and art, transforming each and itself throughout the process.

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