SCIENTIFIC PLURALISM RECONSIDERED
STÉPHANIE RUPHY

Reviewed by Michela Massimi

Scientific Pluralism Reconsidered: A New Approach to the (Dis)unity of Science
Stéphanie Ruphy
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Scientific pluralism is a timely and important topic in contemporary philosophy of science. Pluralism is generally understood as a reaction against scientific monism, namely, against the view that science aims to establish a single, complete, and comprehensive account of the natural world.

While so much is clear and is shared by anyone who calls herself a pluralist, spelling out the exact nature of pluralism has invited a more nuanced response. Pluralism can be descriptive of scientific practice (I am thinking here of Helen Longino's ([2006]) pluralist analysis of aggressive behaviour, or Carla Fehr's ([2006]) explanatory pluralism in her analysis of the evolution of sex). Or it can have a normative dimension, in asserting the imperative that science pursue multiple lines of inquiry (for example, Hasok Chang's active normative epistemic pluralism).[1] Pluralism can be integrative, in the sense of searching for context-sensitive ways in which multi-level, multi-component causal factors can be integrated into an explanation of a given target system (Sandra Mitchell's integrative pluralism is an example)[2]; or, non-integrative, in taking the context-sensitivity of multi-level explanations as primitive and not amenable to integration (Dupré's ([1995])

promiscuous realism falls into this category). In a highly influential collection of essays entitled *Scientific Pluralism,* Kellert *et al*. ([2006], p. xiv) identified what they call the 'pluralist stance':

> [...] the plurality in contemporary science provides evidence that there are kinds of situations produced by the interaction of factors each of which may be representable in a model or theory, but not all of which are representable in the same model or theory. Each factor is necessary for the phenomenon to have the various characters it has, but a complete account is not possible in the same representational idiom [...] A more complete representation of some phenomena requires multiple accounts, which cannot be integrated with one another without loss of content.

The pluralist stance admits that 'if two models distort some of the same aspects, they might distort these aspects in different ways, giving rise to inconsistencies. This is just one kind of situation in which a plurality of inconsistent approaches might be defended' ([2006], pp. xiv–xv). Thus, the pluralist stance has recently emerged as empirically motivated, non-integrative in nature, and inconsistency-friendly.

In her wonderful book, Stéphanie Ruphy attends to an ambitious task: to show that 'Compatible pluralism should remain our epistemic horizon' (p. 135). In particular, she argues that although philosophy of science has turned the corner when it comes to scientific monism (and rightly so), embracing pluralism in science is not tantamount to embracing metaphysical theses concerning the disordered or dappled nature of the world. To deliver on this ambitious task, Ruphy proceeds as follows: First, she reconstructs some of the historical motivations behind the pluralist, beginning with the Vienna Circle, and Neurath and Carnap in particular (in Chapter 1). Then, in Chapter 2, she assesses the respective strengths of some influential anti-reductionist arguments that have traditionally taken pluralism as a privileged road to some metaphysical theses about the 'patchy' nature of the world (from Dupré's disorder of things to Kitcher's autonomous levels of explanation and Cartwright's nomological pluralism). Finally, in Chapter 3, Ruphy turns her attention to representational pluralism and the aforementioned inconsistency-friendly pluralist stance that seems to be motivated by the widespread use of a plurality of different models for the same target systems. In what follows, I give the highlights of what I take to be Ruphy's important and lasting contributions to this complex set of inter-related topics.

The fine historical analysis of Carnap's pluralism about linguistic frameworks in Chapter 1 might at first surprise the reader. Why go back to the Vienna Circle in a monograph on contemporary pluralism in science? Yet it soon becomes clear that in Ruphy's argumentative strategy, Neurath's and Carnap's kinds of pluralism are more than a historical prelude to the topic. They provide the blueprint for the kind of pluralism that Ruphy is about to defend and champion: what she calls 'foliated pluralism' (building up on some of her previous work). For as in Carnap's theory of linguistic frameworks, the ontological question about reality 'remains relative to the very chosen linguistic framework and cannot be understood in metaphysical terms' (pp. 15–6). Similarly, for Ruphy's foliated pluralism (inspired by Hacking's styles of reasoning), questions about what kind of entities there are remain relative to different styles of reasoning, and how they 'widen and diversify the classes of propositions that can be true or false about them' (pp. 30–1).

To explain this point, Ruphy introduces the notion of 'ontological enrichment' of the objects studied by science: an open-ended and never complete process whereby asking ontological questions about what cats, dogs, electrons, or galaxies might be is to ask specific questions about how different styles of reasoning (the style of hypothetical modelling, the statistical style, the taxonomic style, and so forth) 'enrich' our ontological repertoire of scientific entities. In the case of galaxies (one of Ruphy's areas of expertise and case study), the style of hypothetical modelling delivers propositions about non-observable physical parameters; the statistical style introduces additional propositions about, say, the intrinsic luminosity of galaxies; and the taxonomic style enriches our notion of 'galaxy' by offering different taxonomic classifications, depending on the specific interests at hand (namely, whether we are interested in the evolution of galaxies or something else instead).

Foliated pluralism amounts then to the radical (somewhat Carnapian) view that styles of reasoning contribute '*to constructing the object qua scientific object* [...] several styles may be mobilized to study a given type of objects (forest fires, galaxies, etc.) *and the domain of application of a style is not ontologically marked out'* (p. 32-3). The transdisciplinary nature of styles of reasoning (for example, the statistical style applies to galaxies as much as to population genetics, water molecules, and economic systems, just to mention a few examples), their synchronicity, and their cumulative nature across the history of science all explain why our scientific objects are subject to this ontological enrichment over time. And ontological enrichment plays a central role for Ruphy's foliated pluralism, for it immediately sets it aside from traditional 'patchwork' forms of disunity' (p. 33) whereby pluralism is often embraced because different kinds of things can only be known in different ways and via different methods.

Two immediate consequences of Ruphy's foliated pluralism follow. First, her foliated pluralism is not a metaphysical thesis about what the world is like or what kind of entities there are. Such questions, Ruphy argues along similar lines to Carnap, are external, and our philosophical attention should be confined to internal questions that are answerable within the bounds of our linguistic framework or styles of reasoning. Unsurprisingly, Ruphy is not persuaded by influential varieties of pluralism that, in the name of anti-reductionist arguments (against the logical positivist's physical imperialism or otherwise), have ushered in metaphysical images of a disordered, patchy world. Her Chapter 2 is a sustained criticism of three such views —Kitcher's, Dupré's, and Cartwright's—which I do not have the space to explore here.

The second immediate consequence of Ruphy's foliated pluralism is a new take on the ongoing debate about natural kinds, which Ruphy discusses at the end of her Chapter 3. She reviews the interesting and somehow under-explored case study of stellar classification. In discussing kind-membership for stellar groupings, Ruphy's foliated pluralism translates into cross-cutting kinds, whereby current classifications (based primarily on visible spectral features of stars, such as wavelength; or structural properties that are related to the manifest ones via theoretical models) are the product of historical contingency (including resolution-dependency on the astrophysical instruments available to a community at any given time). More to the point, stellar classifications depend on our epistemic interest in distinctive ways (UV-classifications are preferred over infrared-classifications if our epistemic interest concerns stellar winds rather than star evolution). And, Ruphy argues, they exhibit a level of 'taxonomic nomadism' (p. 122) that does not find any counterpart in the biological realm if one considers, for example, the evolution of the life of any ordinary star like our Sun (from G2V to red giant, and finally to white dwarf). Foliated pluralism translates, ultimately, into a distinctive conventionalist anti-realism about stellar kinds. While the taxonomic features are real and mind-independent, the fuzziness of the boundaries and their sensitivity to specific epistemic interests makes untenable the whole notion of stellar kinds as natural kinds.

While some of the consequences of foliated pluralism resemble the nominal stance on natural kinds of Hacking, or even of LaPorte, there is one aspect of Ruphy's account that, in my view, is the most strikingly novel, namely, her attack on what she calls 'representational pluralism' as an argument for inconsistency-friendly scientific models. As mentioned at the beginning of this review, the pluralist stance presented in Kellert *et al.*'s ([2006]) introduction, is grounded on the existence—in a variety of situations and conditions—of a plurality of different representational models for the same target system. Situations of this nature are familiar in nuclear physics where, as Morrison ([2011]) has argued, several incompatible models for the atomic nucleus are present. And different epistemic attitudes can be envisaged to deal with them, from Giere's ([2006]) perspectivism to Longino's non-integrative strategy.

Ruphy, in her substantial Chapter 3, adds to the ongoing debate a wealth of new details concerning novel examples of permanently incompatible models, namely, the computer simulation (Millenium Run) for the evolution of the structure of our universe, and the two rival models (SKY and Besançon) for our Milky Way. These two case studies reveal what Ruphy calls the 'path-dependency' and 'plasticity' of computer simulations that account for the persistent plurality of incompatible but 'equally empirically successful models' (p. 94). By 'path-dependency', Ruphy means the specific modeller's choices that are made in building sub-models for a given computer simulation. For example, the Millenium Run takes a specific path via Friedmann–Lemaître that, along with the assumption of inflation, takes us to the so-called LCDM model. From there, via semi-analytical galaxy formation simulations, it reaches the final outcome, namely, producing a simulation of the evolution of structure. But Ruphy reminds us that 'there exist alternative submodels with similar empirical support and explanatory power' (p. 98), and alternative paths that modellers could have chosen (rivals to Friedmann–Lemaître models, rivals to inflation, rivals to the LCDM model). Ruphy concludes: 'There are thus no good grounds to exclude the idea that had the cosmologists the resources to fully develop alternative paths, they would have come up with different, but equally plausible, representations of the evolution of the universe' (p. 101).

The net outcome of these case studies is that the empirical success of computer simulations is a poor guide to representational accuracy. Worse: 'the more composite a model gets, the more one loses control of its validation' (p. 106). Computer simulations then should not be confused with reality. They also show the limits of the well-trodden analogy with maps and cartography in the literature on scientific modelling. By contrast with idealized maps, computer simulations 'can in fact represent only a highly simplified and stylized version of what *possibly* is' and 'acknowledging this "modal" character of the knowledge actually delivered by these simulations invites a reconsideration of the very notion of incompatibility between them' (p. 110). I take this modal feature of the knowledge delivered by seemingly incompatible models to be a very important insight that should force philosophers to completely re-think the emphasis placed on the supposedly representational nature of some of these incompatible models (something I am not sure Ruphy would agree with, but whose spirit she certainly shares in the emphasis placed on plasticity and path-dependency).

To conclude, Ruphy has written a marvellously clear and tremendously engaging book that one could read over summer holidays and yet think about for years to come. By grounding philosophical discussion of scientific practice in cosmology and astrophysics, and using detailed philosophical arguments, Ruphy has set a high bar for what reflections on scientific pluralism should aim to achieve. While being a pluralist is trendy today, spelling out exactly the epistemic and metaphysical implications of the pluralist commitment can prove a challenging and daunting task, but one that Ruphy has taken up and successfully delivered on in a novel and distinctive way.

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Notes

[1] Chang ([2012], p. 260) defends 'active normative epistemic pluralism' as 'the doctrine advocating the cultivation of multiple systems of practice in any given field of science'.

[2] Mitchell ([2009], p. 114) defends an approach to complex systems where the emphasis is on 'how multiple explanatory factors operating at different ontological levels enter into explanation in the biological and psychological sciences'.