

BOOK REVIEW

The aesthetics of science: beauty, imagination and understanding

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The publication of *The Aesthetics of Science* invites us to reflect, beyond the range of individual arguments advanced in it, on the general aims that motivate the production of an edited volume like this.

There seems to be a spectrum of possible commitments when one addresses the role of aesthetic values in science. At one extreme, the spheres of the aesthetic and the epistemic are completely separated from one another, with no meaningful interaction between them. So if allusions to the beauty of a theory are to be found in science, these should be understood as merely subjective, emotional responses of scientists in the context of discovery, without standing on the epistemic justification of the theory. At the other extreme, aesthetic and epistemic values belong to the same kind; they are indistinguishable from each other in practice. In this view, references to the beauty of a scientific theory are understood as entailing an epistemic assessment—that is, they are taken as appraisals of the good performance or empirical adequacy of the theory. These two extreme views have something important in common: they render the project of further examining the role of aesthetics in scientific practice a futile task. As one disregards aesthetic considerations and the other translates them into epistemic assessments, they fail to recognize as a genuine philosophical problem the fact that, throughout the history of science, model evaluation and theory choice have been persistently formulated in terms of elegance, harmony, beauty or the capacity to inspire awe.

This collective volume, edited by Milena Ivanova and Steven French, does not endorse either of these

two extreme views. Its publication is justified by the belief that the place where our debate should be located is somewhere between them in the spectrum. Namely, the contributing authors agree that the aesthetic and the epistemic are two distinctive kinds, and they acknowledge that philosophers have so far struggled to fully make sense of why and how they come to be interrelated in scientific practices. Accordingly, the volume attempts to bring further light into this matter, while pressing to reconsider the aims of science itself in light of the aesthetic judgements involved in contexts of justification.

The range of proposals that we find in the volume is, besides the shared general aims, ample. Some of the articles focus on creativity and the imagination, some address the problem of understanding, some discuss particular values and virtues, and some examine the qualities of scientific artefacts such as thought experiments, models and pictures. In the introduction, the editors offer a good overview of the arguments found in each of the papers. Here I would like to, instead, highlight some especially stimulating suggestions that emerge throughout the book. This should give us, I believe, some indication of where the debate will be heading in the coming years.

The beauty of a mathematical proof, an astronomical theory or a formula in physics have been the object of philosophical analysis for a long time. In the Platonist view, mathematical beauty is described as the insight into the fundamental structures of the universe;¹ for Poincaré, experiencing beauty in the harmonious accommodation of phenomena is the reason why scientists study nature;² in recent times, James McAllister

1 In Breitenbach (2013), p. 956.

2 See Poincaré (2001). For an insightful account of Poincaré's conception of beauty in science, see Ivanova (2017).

has advanced an inductivist account of the changes in beauty canons in science, and Angela Breitenbach (2013, p. 956) has offered a Kantian reading of the beauty of mathematics as experienced through a creative act of the imagination.

The contributors to this volume bring to the fore more explicitly than previous works³ the need to endorse aesthetic pluralism, and treat beauty only as one among the varied array of aesthetic values that play a role in science. Margherita Arcangeli and Jérôme Dorik, for instance, propose to consider a whole set of aesthetic values in science associated to the sublime, distinct from the set that relates to beauty. Sublimity experiences occur when we confront something that overwhelms us, either the grandeur of a natural scene or the grasping of a scientific theory that discloses new levels of reality (e.g. General Relativity). Whereas regularity and unity are values tied to beauty, complexity, irregularity and the feeling of vastness are characteristic of the sublime. If the former group contributes to science by enhancing the internal structure of theories and models, the latter motivates scientists to form novel judgements that push the limits of human understanding. Important for what concerns aesthetic pluralism is that the

tension between aesthetic values pulling in different direction raises a genuine concern only if we think that they belong to the same aesthetic type. ... Acknowledging that the aesthetic domain encompasses more than the beautiful opens up new paths of enquiry in the domain of aesthetic values involved in science. (Arcangeli and Dokic, p. 110)

Following a somewhat different line of argument, Catherine Elgin's article also leaves beauty to one side, given its elusiveness, and focuses on aesthetic factors that are more clearly a matter of form: symmetry, simplicity, systematicity, elegance, as well as their opposites. These factors work as gatekeepers

of acceptability in science; that is, they play a regulative rule insofar as they function as initially tenable commitments in the network of beliefs that a community holds. For instance, scientists are initially committed to the belief that an elegant experiment is epistemically advantageous because it makes manifest what it achieves and how it does it. So they would be reluctant to abandon this commitment unless they find good reasons to think that inelegant experiments are equally or more epistemically satisfactory. For values like simplicity, things get more complicated, as there can be different contrasting types of simplicity (ontological, axiomatic, syntactic) in the same practice. Far from this being an objection to pluralism, it only reinforces Elgin's claim that deviations from initially tenable commitments, including those concerning aesthetic values, demand an explanation, which, in the case of being satisfied, would prompt the replacement of an old commitment by a new one.

Insightful remarks on aesthetic pluralism can be also found in Milena Ivanova's paper. Here the focus is still on beauty, but she acknowledges the plurality of ways in which a scientific theory can be beautiful. This idea follows up from Ivanova's previous work on Poincaré, who reduces beauty to simplicity and unity.⁴ Also Matthew Kieran's article advances a complementary viewpoint to the debate, by calling attention to the plurality of virtues and vices that exist at the background of the encompassing concept of creativity, as much in science as in art.

Linked to the issue of pluralism, an unsettled debate that arises throughout the volume concerns the subjectivity of aesthetic values. If philosophers of science have for quite some time unproblematically admitted the existing trade-offs between different epistemic values (observational accuracy, fruitfulness, consistency, precision, unification, etc.), when it comes to the role of aesthetic values in science, recognizing their plurality has triggered worries about their contingent and unaccountable character. An important benchmark in this debate was McAllister (1996). His

3 Comparable previous works can be found in the edited volumes: Frigg and Hunter (2010) and Bueno et al. (2017).

4 See Ivanova (2017).

inductive view on how scientists' training affects their aesthetic appreciation aimed to break with the unfruitful objective–subjective opposition. Alexander Bird builds on this same idea here, but instead of appealing to enumerative induction, highlights the importance of scientists' exposure to exemplars to acquire standards of explanatory goodness. Meanwhile, Steven French's solution consists in reorienting the analysis to the performative dimension of science, where scientists' preferences are neither subjective (given that there are intracommunity agreements) nor objective (given that scientific theories are not objects in French's conception, but sets of practices). In general, the proposals in this collection show that the objective–subjective debate has moved forward in the last years, and that there are ways to account for the historical changes and disciplinary diversity of aesthetic preferences without falling into intractable subjectivity.

One further theme in the volume that I would like to call attention to concerns the thesis that understanding, instead of knowledge, is the central aim of the scientific enterprise. This idea is fairly popular in philosophy of science today, and it is widely accepted by the contributors in this collection too (Elgin, Ivanova, Meynell, Arcangeli and Dokic, Todd), probably because studying the aesthetics of science reveals ways in which models and theories can be enhanced without increasing their probability of being true.

Especially intriguing, as well as open to dispute, is Letitia Meynell's article, where she argues that the characteristic content of understanding is pictorial. The two-dimensional nature of pictures, in contrast to the linearity of propositions, promotes understanding because scientists need to actively order their content, compare their parts—shown all at once in space—and unify them to produce a cognitively accessible whole. This is an appealing suggestion, especially because Meynell offers a concrete way of showcasing the singularity of scientific understanding in practice. However, her account directly clashes with other proposals, such as Alice Murphy's in this volume, which do not endorse a pictorial type of account and can, nevertheless, enrich our views on the importance of aesthetics for scientific understanding.

Murphy makes a convincing case for why we should pay attention to the literary qualities of thought experiments. These qualities are 'linear' in Meynell's sense, as they entail linguistic, narrative formulations. Still, Murphy shows that the type of (non-pictorial, literary) formulation typical of thought experiments, involving anecdotes and familiar objects, licenses the understanding of scientific theories, helps explain them and persuade of their validity, and, importantly, also demands an active role from the recipients, given the flexibility of interpretation that thought experiments allow. This stimulating controversy, which could have been more openly problematized in the volume, shows that there is scope for future discussion about the aesthetics of different formats and genres in science, as well as about the role of cognitive agents in the reception of scientific products.

As a concluding remark, I would like to mention two aspects of the debate on the aesthetics of science that are not addressed in this collection and could help advance more comprehensive proposals in the coming years. The first one is the attention to the relation between aesthetics and philosophy of science in the opposite direction—that is, by incorporating the study of the 'epistemics of art'. Catherine Elgin and Nelson Goodman have defended the need to emphasize this side of the debate, given that the arts can also function cognitively and be epistemically rewarding.⁵ If this is right, considering this side of the debate could reorient the whole discussion because the distinction between the epistemic aims of science and arts would to a large extent blur.

The second aspect has a methodological character: it would be highly beneficial for the debate to explicitly state what the integration of views in philosophy of science and aesthetics brings to the discussion. If we claim that some parts of science are *like* some parts of art (i.e. that thought experiments are like fables, scientific theories like musical works, or models like paintings), what is exactly our epistemological commitment with these claims? Are we comparing examples in the two fields only anecdotally? Contrarily, are we endorsing

5 See Elgin (2017), Goodman and Elgin (1988), and Goodman (1968).

an all-encompassing theory of representation or understanding that equates scientific and artistic cases? Are we arguing for the shared goals of art and science but distinct ways of achieving them? There is plenty of ground for further conversation here, but only the openness about our underlying commitments can facilitate it.

This collection explores some promising ways of continuing our conversation about the aesthetics of science, and reveals once more the benefits of the collaborative endeavour of philosophers that have traditionally worked in separated areas.

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