

technology, but historians of modern America and Britain intrigued by the paradox of one of the most important medical interventions in the early twentieth century will likely find the book immensely appealing, if not somewhat alarming.

doi:10.1017/S0007087423000766

Milena Ivanova and Steven French, *The Aesthetics of Science: Beauty, Imagination and Understanding*

London: Routledge, 2022. Pp. 224. ISBN 978-1-032-33718-0. £110.00 (hardback).

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Edited collections are acts of resistance. We are told that they weigh less in research assessments and that book chapters are not as valuable as articles and monographs, and yet we stubbornly hold on to this enduring academic format for some of our most important publications. Milena Ivanova and Steven French's *The Aesthetics of Science* is a brilliant example of why we do this, why our resistance to institutional pressures is entirely justified, and why we should indeed continue to resist: because edited collections are the materialization of the time and spaces we reclaim as researchers to engage in new conversations that transform our fields.

The Aesthetics of Science consists of nine chapters, authored by leading experts in philosophy of science and aesthetics. The introduction, co-authored by Ivanova and French, sets the agenda for the volume. Aesthetic judgements are ubiquitous in science: scientists often compare their theories to works of art, assume (but rarely justify!) a relationship between the beauty of a theory and its truth, and routinely invoke aesthetic considerations in that contested process that philosophers have come to characterize as 'theory choice'. These judgements, and the aesthetic vocabulary they mobilize, need to be taken seriously – but this does not entail that they can simply be taken at face value. To investigate the work they do in scientific practice, Ivanova and French argue, philosophers of science should stretch beyond epistemology, and join forces with scholars in the field of aesthetics.

Beauty, truth, theory choice: why, readers of the *BJHS* will ask, should historians of science go back to these philosophical debates? *The Aesthetics of Science* reframes these philosophical questions in profoundly novel ways, leaving behind (convincingly – and hopefully for good!) the relics of an older epistemology that contributed to drive a wedge between historians and philosophers of science. Instead, it offers a philosophy of aesthetic *practices* in science that is pluralistic, context-sensitive, and naturally in dialogue with history.

The volume's key themes are captured by its subtitle: *Beauty, Imagination and Understanding*. These three notions intersect in ways that cast new light on the performative aspects of science and the transformative potential of aesthetics. Several chapters position debates across aesthetics and philosophy of science firmly within the tradition of integrated history and philosophy of science. Steven French, for instance, examines the aesthetic properties of theories as properties of scientific practices and performances,

explicitly joining forces with the analyses of historians of science of the public and performative contexts of lectures and presentations. Historians with a soft spot for the philosophy of history (as well as the history of philosophy) will also greatly enjoy French's analysis of R.G. Collingwood's treatment of music in *The Principles of Art*, which underpins his account of the aesthetics of scientific performance. Alice Murphy explores the aesthetic and literary properties of thought experiments, revisiting well-known historical case studies such as Galileo's falling-bodies experiment, and showing that – far from being reducible to logical arguments – thought experiments are characterized by an interpretive flexibility that comes precisely from their aesthetic and literary qualities. Alexander Bird goes back to Kuhn to argue that the standards of explanatory *loveliness*, a term introduced by Peter Lipton to refer to the features of a good explanation (itself wrapped in aesthetic connotations), are acquired through learning from past exemplars, rather than formal rules.

Even from this brief snapshot, it is clear that the volume's interdisciplinary approach traces novel pathways to reframe old debates, while opening entirely new conversations where practice takes centre stage. In the rest of this review, I will focus on how two contributions to the volume connect aesthetic judgements and aesthetic experiences to the theme of scientific understanding, a promising philosophical area of investigation that I hope historians of science will find congenial.

Milena Ivanova's chapter explores scientists' judgements of beauty in relation to understanding. She notes that philosophers have prioritized the epistemic role of beauty, by relating it to the truth or empirical success of scientific theories. This relationship has been developed through realist arguments, which claim that the aesthetic qualities of a theory objectively latch onto beauty in the world, as well as empiricist ones, which claim that our confidence in beautiful theories is inductively justified by their past empirical success. Ivanova reframes the terms of this debate completely. Following Henri Poincaré's insight that in science there is a 'more intimate beauty, which comes from the harmonious order of its parts, and which pure intelligence can grasp' (p. 87), she suggests that science has many aims, one of which is understanding. Aesthetic values are mobilized when scientists attempt to understand phenomena, even in the absence of truth or any indications of past empirical success. This account of understanding as interpretive sense-making, initially developed by Catherine Elgin (herself a contributor to the volume with an inspiring chapter on the regulative role of aesthetic features in scientific practice), is construed as an ability or skill to grasp how facts or concepts fit together – precisely as in Poincaré's 'more intimate' sense of beauty. When placed in relation to understanding, Ivanova argues, beauty is no longer a reflection of objective properties, but of scientists' own choices and abilities to construct their theories in ways that allow them to intervene in the world and make sense of it. This explains also why aesthetic criteria and judgements are ubiquitous in science, and yet they change: because they are contextual and dynamic conduits to understanding.

Margherita Arcangeli and Jérôme Dokic's chapter weaves understanding into a fascinating discussion of scientists' experiences of the sublime – a feeling of awe, being drawn to mysterious aspects of phenomena or their vastness – which serve as a counterpoint to the positive and pleasurable connotations associated with experiences of beauty in science. In an argument for aesthetic pluralism, Arcangeli and Dokic show that beauty and the sublime are aesthetic experiences which enable different kinds of understanding. In fact, sublime experiences may serve as conduits to understanding the very limits of scientific understanding, as when scientists face complexity, or when theories push us beyond what we can cognitively handle as human beings.

The shift to understanding is liberating a growing number of philosophers from the formal prison of older propositional accounts of knowledge, opening the way to a

philosophy of scientific practice that is naturally in dialogue with history through a common emphasis on skills, performance, abilities, activities and the cultural and social contexts in which interpretive sense-making unfolds. Exploring the trading zones between aesthetics and philosophy of science is thus a strategic entry point to building a new space where practices can genuinely feed into analytical and conceptual categories. And it is precisely in this way that *The Aesthetics of Science* takes the form of a collective act of resistance, setting a standard for what all edited collections should be: by taking philosophers of science outside their comfort zone, the volume reclaims – and puts to work – the time and space we need to engage in that very aesthetic experience of thinking about the multiple roles of aesthetics in science.

doi:10.1017/S0007087423001024

Fanny Gribenski, *Tuning the World: The Rise of 440 Hertz in Music, Science, and Politics, 1859–1955*

Chicago: University of Chicago Press, 2023. Pp. 280. ISBN 978-0-226-82326-3. \$55.00 (cloth).

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Fanny Gribenski asks what happens when standardization efforts move beyond tangible materials, technologies or infrastructures to an object that is notoriously intangible. Musical pitch, more than an object, is in fact a product of tuning practices and long-standing musical traditions, saturated with aesthetic judgement and valuation. Combining perspectives from musicology, history of science and transnational history, Gribenski investigates a fascinating *longue durée* of musical pitch standardization. Over a century-long period that ranges from the Second French Empire to after the Second World War, she expertly traces how standard pitch (the tuning calibration for A above middle C) shifted from A435 to (the now-standard) A440 vibrations. Although this may be a negligible difference in terms of hearing, this shift (and its aftermath) was fraught with cultural tension in an increasingly interconnected world.

Readers in history of science and technology may well be familiar with the tensions that often characterize standardization processes; universalizing aspirations frequently meet with material indifference, social and political resistance and innumerable logistical complexity. As Gribenski shows, such tensions were greatly amplified in this case, if only because the subject of musical pitch introduced a fascinating new cast of actors – cabinet members, composers, conductors, performers, instrument craftsmen and radio broadcasters – with whom scientists or engineers shared authority and expertise or forged practical alliances. *Tuning the World* shows the diplomacy of national and international standard-setting to be a product of a remarkably stable set of concerns, such as singers' health, the preservation of artistic heritage, industrial interests and global cultural exchange (or dominance). But at the same time, attending to these interlocking interests in fine detail, the book traces the changing networks and influences that established such standards, as the initiative to standardize shifted from France to Germany and the United