

Neither Whittle nor von Ohain got their jet engine designs into production. Stories of their importance to the creation of the jet engine were constructed, in part, for political reasons. In post-war Britain, Whittle was consciously turned into the singular inventor of the jet engine by a country relishing its own technological brilliance and by politicians who thought championing him would bring export orders. Von Ohain was brought into a dual-inventor story as Germany sought to normalize its aviation industry and rid it of its Nazi past. Both narratives gain much of their potency from the wider cultural significance of stories about heroic, lone inventors.

Historians should not adopt popular judgements of what innovation is and where it takes place. Such assumptions, as Giffard points out, have produced a great loss of understanding that we can no longer countenance. The first step in building a far richer history of technical change is for all historians interested in invention to look at this book. Perhaps then we will see some more novelty in our histories of innovation.

TOM KELSEY
King's College London

THOMAS W. PATTESON, *Instruments for New Music: Sound, Technology, and Modernism*. Oakland: University of California Press, 2016. Pp. xii + 236. ISBN 978-0-520-28802-7 £32.95 (paperback).

ANDREW J. NELSON, *The Sound of Innovation: Stanford and the Computer Music Revolution*. Cambridge, MA: MIT Press, 2015. Pp. 248. ISBN 978-0-262-02876-9. £29.95 (hardback).
doi:10.1017/S0007087417000772

If there is a field of human culture that is as fixated on novelty as we know the sciences and technology to be, then it may well be music, at least on the evidence of the books under review here. But what may well be of particular interest to members of our discipline is that musicians and composers have so consistently turned to new technology to realize their dreams of new music. In this sense at least, music may well provide an ideal vantage point from which to consider the histories of science and technology in modernity.

For anyone of my generation, who in the 1970s encountered the first waves of cheap synthesizers, Thomas Patteson's *Instruments for New Music* will read like an astonishing counterfactual. This delightful book reveals that the novelty sought and enjoyed by electropop fans of the punk era had its direct antecedents in the high modernism of Weimar and Nazi Germany. As many as 369 novel instruments, it seems, may have been invented between 1929 and the outbreak of the Second World War (p. 151). The composer Busoni, one of the evangelists of the millennium of new sound, wrote in his 1907 *Sketch of a New Aesthetic of Music* that the musical possibilities of symphonic instruments were almost exhausted, and that it was necessary to turn to 'abstract sound, unbounded techniques and technologies, tonal limitlessness. All efforts must push in this direction, in order to bring about a new, virginal beginning' (p. 13).

Composers, musicians, artists and engineers were all to be found pressing new and recent technologies into service to realize new kinds of music. Theremins and ondes martenot are only the remembered tips of the tip of the iceberg of new devices that seized the opportunity presented by vacuum tubes for the making of sound, and Patteson has revealed fascinating examples of what lies below the waterline of historical memory, in devices bearing names such as 'trautonium' and 'partiturophon'. But this book is much more than a prehistory to the conventional accounts of electronic music that start in the late 1940s with Pierre Schaeffer in Paris and Karlheinz Stockhausen in Cologne, as Patteson shows how many new technologies, including sound-on-film equipment, gramophone records and player pianos were put to work by artists seeking to create previously unheard kinds of music. Here we meet the artist László Moholy-Nagy joining composers such as Paul Hindemith, who fancied that, as gramophone grooves can represent any sound, it should be possible for the composer to conjure sound by direct inscription of

discs. Piet Mondrian, meanwhile, was among the prophets of direct music inscribed on cinema film.

But such well-known names are the exception in this book, which concentrates rather on a dramatis personae of long-forgotten figures including Jörg Mager, inventor of the ‘spherophone’ and ‘partiturophon’, and Friedrich Trautwein, with his ‘trautonium’. It is delightful to see the evidence of contemporaries’ willingness to ascribe revolutionary potential to simple devices such as Mager’s spherophone, whose main feature was to enable continuous glissandi over wide pitch ranges, opening up new routes to microtonal music. When this device was presented to a festival in 1926, a journalist commented, ‘we do not wish to abandon ourselves to utopias, but in this case the oft-misused term “epoch-making” seems to be appropriate’ (p. 52).

One of the great strengths of Patteson’s book is that it is sensitive to the soil in which his musical and technical developments were growing; he shows how the proponents of new musics and new musical technologies fared amid the political realities of the transition from Weimar to Nazi Germany. Electronic music was favoured under the Nazi regime, Joseph Goebbels believing that an instrument such as the trautonium had great potential for mass gatherings. Trautwein and his associate Oskar Sala collaborated with the regime, gaining radio broadcasts and enjoying support to mount lecture demonstrations and concerts as late as 1942. Mager had also tried to ingratiate himself to the regime, but without success.

As a *vade mecum* for anyone wishing to enter the world of sonic possibilities that was stirred up by the ferment of the (long) interwar period, it is difficult to imagine a better guide than *Instruments for New Music*. True, Patteson limits himself mainly to Germany and, in that sense, those wishing to gain a sense of how exceptional this story is will do well to dip into Andrey Smirnov’s encyclopedic *Sound in Z: Experiments in Sound and Electronic Music in Early 20th-Century Russia* (2013) to see some parallels in the experiments of Revolutionary Russia. But the revelations of Patteson’s book leave the reader with the fascinating possibility that other nations in modernistic flux must also have responded in an analogous way to that demonstrated by the Busonis and Magers found in the pages of this book. Or, if not, why not? In other words, like all valuable additions to the literature, *Instruments for New Music* whets the appetite for more work in the field.

Andrew Nelson’s *The Sound of Innovation* shares some of Patteson’s book’s concern with novelty (clue: it’s in the books’ titles). Here we are on the other side of the Second World War, and on the other side of the Atlantic on the campus of Stanford University. This is a study of that university’s Center for Computer Research in Music and Acoustics, CCRMA, an acronym that is – for its era appropriately enough – pronounced ‘karma’. Both the books under review here started life as doctoral theses, and both demonstrate strong acquaintance with the science studies literature. Nelson’s work is an unusual amalgam of business history, STS and an alumnus’s faithful and loving account of his *alma mater*. The story is a good one: of how computer music took root on this Californian campus, largely because of the good luck of the musician and composer John Chowning in developing the computer music sound creation technique frequency modulation (FM) synthesis. The licensing of the principle to Yamaha Corporation for use in their DX series has ensured a steady income to the university, supporting the continuing health and development of computer music on the campus. (The DX-7 is apparently still the second-best-selling synthesizer ever.) Nelson’s compelling opening sketch, for example, describes a recent performance by the Stanford Mobile Phone Orchestra, conjuring an eight-part opus via the gestures of their iPhone-enabled hands. But it is perhaps strange that an account so well informed by the sociology of technology should read with such a strong implication of teleology, to the extent that Stanford’s circumstances come across as positively Panglossian at points in this text. The tone is set early: ‘the everyday practices at CCRMA are a lauded, albeit still unusual, combination: an energized interdisciplinarity that stimulates creativity and contributions at the intersections of

fields; a fierce commitment to sharing and to “users” ... that defines both priorities and vision’ (p. 3). This reader missed the sense of contention and comparison that is so successfully incorporated in the other text. And, as articles in the latest special issue of the journal *Organised Sound* (*Alternative Histories of Electroacoustic Music* (2017) 22(2)) show, computer music was developing on campuses across the world at the same time as Stanford was blooming. That slight caveat notwithstanding, this is a fascinating book that expresses extensive archive and oral-historical work, and a valuable component in the emerging picture of the relationship between music and technology in modernity.

TIM BOON
Science Museum

ROBERT J. RICHARDS and LORRAINE DASTON (eds.), *Kuhn’s Structure of Scientific Revolutions at Fifty: Reflections on a Science Classic*. Chicago: The University of Chicago Press, 2016. Pp. 208. ISBN 978-0-226-31720-5. £17.50 (paperback).
doi:10.1017/S0007087417000784

History, if viewed as a repository for more than anecdote or chronology, could produce a decisive transformation in the image of Thomas Kuhn’s *The Structure of Scientific Revolutions* (1962) by which we are now possessed. Anyone who gets the reference in that sentence will want to seek out this superb volume. Its distinguished cast of contributors show how instructive Kuhn’s book remains even though no one now accepts his account of scientific change – paradigm shifts and all that – as correct. The key to continuing to learn from *Structure*, we come to see, is to do to it what Kuhn urged us to do to science: historicize it, then put the results to generalizing work.

Since Steve Fuller’s *Thomas Kuhn: A Philosophical History for Our Times* (2000), the Cold War has been conspicuous among the historical contexts in which to place *Structure* and its success. For Fuller, Kuhn’s picture of the self-directing nature of progressive scientific communities, insulated from interference and even criticism, derived from his patron James Conant’s blueprint for post-war American science. George Reisch’s opening chapter offers a partly dissenting and partly complementary response. Yes, when, in 1947, Kuhn first glimpsed the discontinuous character of conceptual change in science – the fundamental insight behind his later notion of paradigm shifts – he was preparing to teach on Conant’s science-by-historical-example course at Harvard. But Conant himself endorsed a continuity-of-knowledge picture. For Reisch, what Kuhn and Conant nevertheless shared was a stress on the phenomenon of the ‘captive mind’, as embodied in the Communist true believer and the brainwashed American soldier. Loyalty to phlogiston chemistry after Lavoisier, in Conant’s view, was down to captive minds. To the alarm of Cold Warriors such as the geneticist–historian Bentley Glass, Kuhn appeared to normalize the captive-mind state as functional for science.

Before Kuhn was a historian–philosopher who put scientific training qua paradigm indoctrination in the spotlight, he had trained as a physicist, specializing in the applied end of mid-1940s quantum mechanics, with a break between his undergraduate and postgraduate studies for war work on radar jamming. In a close reconstruction of Kuhn’s trajectory before *Structure*, Peter Galison reveals how the particular, in some ways idiosyncratic, kinds of physics that Kuhn practised in the mid-1940s – highly individualized rather than team-based, and very loosely constrained by empirical data – predisposed him in his post-physics phase to find the theory-over-experience developmental psychology of Jean Piaget and others attractive in hammering out the details of a discontinuous, schema/crisis/new-schema account of scientific progress. As David Kaiser documents, the borrowings from contemporary psychology did not stop there. Kuhn in the 1950s also drew extensively on the “New Look,” post-gestalt experimental psychology of Jerome Bruner and Leo Postman, and even on psychoanalysis. No wonder that psychologists bulked larger than any other disciplinary tribe as Kuhnian correspondents and enthusiasts throughout the 1960s.