get a glimpse of Emily Hale, but we witness a companionable, mutual renunciation, not the raw emotional fire that must have threatened to scorch Burnt Norton a second time as Tom and Emily peered together "Down the passage which we did not take / Towards the door we never opened / Into the rose-garden" ("Burnt Norton", Section I).

Johns Hopkins Press has adorned the book with a dust jacket bearing a beautiful representation of Gauguin's *Yellow Christ* (1889), which Brooker has expertly built into her argument. But the Press does its readers no favors by having set the type of the running text in 9.5 Calibri, with quotations and notes even smaller. Readers past the age of 40 – in other words, those most likely to care about Eliot – here face a real challenge to their eyesight. The e-book may have adjustable font sizes, but have readers made the full transition to this medium?

In the current renaissance of Eliot studies, marked by the publication of the poet's multi-volume *Letters* (2009–2017) as well as his eight-volume *Complete Prose of T.S. Eliot: The Critical Edition* (2014–2019), Jewel Spears Brooker's new book is decidedly welcome. A lifetime of dedication to arguably the greatest twentieth-century poet in English has enabled Brooker to make sound and considered judgments, offer enlivening readings of his words, and write without fear of new generalizations.

Nina Engelhardt. 2018. *Modernism, Fiction and Mathematics*. Edinburgh Critical Studies in Modernist Culture. Edinburgh: Edinburgh University Press, 200 pp., £ 75.00.

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https://doi.org/10.1515/ang-2019-0030

In the graphic biography of Bertrand Russell, *Logicomix*, the authors suggest that "Mathematics and Comics, like oil and water, don't ever mix" (Doxiades et al. 2009: 200), and the same could well be assumed about mathematics and fiction. There are a few mathematical novels that actually present mathematical problems and their solutions, e.g. Gaurav Suri and Hartosh Singh Bal's *A Certain Ambiguity* or Yōko Ogawa's *The Housekeeper + The Professor*, but they obviously address the fairly limited number of readers who will regularly abandon the

story in favour of solving the respective mathematical puzzles. There are, however, also those texts that discuss mathematics not in the form of formulas or specific problems but rather as a field of knowledge, an approach to physical reality, an abstract language of logic, a self-contained system of well-formed – and arguably tautological – statements, or even as an expression of the culture in which it is embedded.

Literary criticism struggles with such topics and their appearance in novels, poems or plays. In the winter of 2009, *Configurations, A Journal for Literature, Science, and Technology* published an issue on "Mathematics and the Imagination". Fiction or poetry are, however, hardly discussed in the articles in this volume, only one of which explores a literary author, Ezra Pound, and the links it manages to establish are fragile, to say the least. It seems to be far easier to discuss mathematics in the visual arts than in literary texts. In this respect, Nina Engelhardt's book is a welcome exception. It does not force mathematical concepts on literary works, but analyses texts which are deeply concerned with mathematics and its role in our approach to physical reality, but also as a cultural expression and even moral guideline. It is truly interdisciplinary, i.e. it does not rely on popularizations of science or previous works in the field of 'science and literature' but turns to the original source texts and to research from historians of science for the reconstruction of the relevant mathematical concepts and theories. Still, it manages to maintain the very fine balance between the complexity of the literary and mathematical issues it addresses and the accessibility for an interested but not mathematically trained audience. A glossary with the most important mathematical terms and concepts further facilitates the understanding.

Modernism, Fiction and Mathematics focuses on four novels that thematize a particular moment in the history of mathematics, the time between the late 19th century and the 1920s. Two of these novels, Hermann Broch's *The Sleepwalkers* and Robert Musil's *The Man Without Qualities* (both of which are quoted in translation), were written in the 1930s and thus the period directly following this crucial time of transition; the other two, Thomas Pynchon's *Gravity's Rainbow* and *Against the Day*, were published in 1973 and 2006 respectively and thus from a considerable temporal distance.

The first chapter traces the developments in mathematics and demonstrates that modernism was not only a momentous phenomenon in realms traditionally considered as High Culture – literature, the fine arts, architecture etc. – but also in the sciences and mathematics. In mathematics, it was the response to a foundational crisis resulting *inter alia* from explorations and discoveries in non-Euclidean geometry, imaginary numbers and multiple infinities, and the subsequent notion that the previously assumed direct link between mathematics and accurate descriptions of the physical world had to be questioned and qualified. Modernism in

mathematics thus challenged cherished beliefs in the practical applicability of mathematics, in its relation to nature, but also in its internal consistency. It required a rigid revision of its foundations in order to assess its relevance, truth and meaning. One of the results of this crisis was a proliferation of theories pointing to various solutions, a division into the different and conflicting schools of logicism, formalism and intuitionism, the latter two of which can be seen as modernist and counter-modernist movements. Each of these once more had to face serious challenges, and while the intuitionists clashed with well-established theorems and mathematical practices, the formalist movement received a severe blow with Gödel's incompleteness theorem, which proved that the establishment of a complete and fully consistent axiomatic system as the foundation of mathematics was impossible. Within these discussions, some dichotomies are recognizable, e.g. reason vs. intuition, pure theory vs. applicability and a relation with nature, freedom vs. restrictions, abstract detachment vs. involvement with the human world and even a moral perspective. In consequence, mathematics was hardly a monolithic body of strictly rational knowledge, and the internal conflicts between the factions were then addressed in the literary works with respect to philosophical questions of epistemology and truth, to assessments of our mental faculties, to political concepts of freedom and control, and, of course, to the discussion whether human affairs ought to be governed by pure rationality or intuition including emotions and a dose of irrationality.

These are, then, the topics explored in the four novels, and while Broch and Musil experienced the developments in mathematics at first hand and were also part of the modernist movement in literature, Pynchon looks on the history from a detached future and a postmodern perspective. The books are not analysed chronologically; instead the latest novel, *Against the Day*, takes the first position, as it offers a broad perspective on the historical developments that can later be used as a foundation for the discussion of *The Sleepwalkers*, *The Man Without Qualities*, and finally *Gravity's Rainbow*. Of course, it is not possible to offer a complete account of the analyses and insights presented in this study, and so rough outlines of the arguments and results will have to suffice.

In all his major works, Pynchon evokes nodal points in history that offered new possibilities and paths towards liberation, diversity and the full potential of creative human imagination, and he usually draws on scientific concepts from thermodynamics to quantum theory to metaphorize the various positions and agents in developments that ultimately end up in 'roads not taken'. In *Against the Day*, pre-WWI politics and developments in mathematics are matched, and Quaternions are an important motif: in these real and imaginary numbers are combined – a phenomenon that troubled mathematicians and led some of them to deny their validity. Engelhardt carefully traces the controversial discussion of

Quaternions in mathematics and the knowledgeable employment but also highly imaginative transformation of the concept in the novel, in which it is advocated by anarchists in 'Quaternion Wars' against their rivals, the vectorists, who ultimately succeed because their mathematical tools prove to be more manageable for scientists – and politicians – who prefer unified governing viewpoints over multiplicity and the creation of alternative realities (39). Moreover, this controversy also touches upon issues in our own field and the creation of imaginary alternative worlds. As Engelhardt points out:

> At the same time as celebrating the world-building potential of maths, [...] *Against the Day* also emphasises its restrictions, and, taken together, the possibilities and limits of mathematical creations provide a mirror to the novel's revaluation of the powers and responsibilities of art in the twenty-first century. (39)

Thomas Pynchon, the postmodernist, favours diversity, anarchic disorder and creative irrationality over unified perspectives, restrictive order, and what Michel Serres and Roxanne Lapidus described as the terror of rightness (Serres and Lapidus 1989: 4), but this view was hardly to be expected from those who actually experienced the crises of the early 20th century and WWI. In Hermann Broch's *The Sleepwalkers*, the notion of disorientation and loss of values is reflected through the three protagonists, but here the anarchist Esch, midway between Pasenow, the romantic, and Huguenau, the realist, is also a bookkeeper who feels the necessity to match his orderly calculations with reality. To balance the disparity between the numbers and the world, he introduces as a "new entry" his own willingness to sacrifice himself, indicating that "Esch's moral demands triumph over calculations and alter the system of accounting" (68). This, however, culminates in a form of bookkeeping that no longer matches reality – or is it reality that no longer matches the book of numbers and thus needs to be forced into conformity with the new calculations? In contrast, Huguenau, the third protagonist, is fully self-centred, does not follow any values beyond his own egotistical perspective and thus represents a disintegrating world and a purely self-referential formalist mathematics without any meaning or connection to external reality. The personifications of the different approaches to mathematics and the world ultimately culminate in an allegorical conclusion, in which the pre-modern Pasenow is no longer able to act and also injured in the war, Esch in a self-sacrificial act tries to save him and is murdered by Huguenau, who then uses Pasenow for his own ends. The persistently thematized loss of a unifying order is also reflected in the form and structure of the novel, the third part of which disintegrates into various subplots and a mixture of narration, poetical chapters, or philosophical essays; the disintegration of the world, of values and of mathematics as described in the novel, finds its counterpart in modernist literature.

According to Engelhardt's diagnosis, however, the essayistic chapters on the "Disintegration of Values" offer a possibility to escape the purely rational view of mathematics as the language of science and money by a turn from formalism to intuitionism, including the ineradicable element of irrationalism in mathematics, but also in language and literature. "Presenting maths as addressing the non-rational along with questions of representation, language and form that similarly animate modernist literature, the trilogy considers it as part of the crisis of the period and of determining possible futures" (88).

The dichotomies of rationality and irrationality, formalism and intuitionism, unity and disintegration, precision and uncertainty are also addressed as crucial aspects of the times and our approach to reality in Robert Musil's *The Man Without Qualities*. The protagonist Ulrich worked as a mathematician concerned with new foundations and the philosophy of mathematics, and once more mathematics may also be linked to moral values. The book also introduces some new key terms and ideas, which again capture the familiar polarities, e.g. the Prussian intellectual and the Austrian emotional frame of mind, and the 'ratioïd' which describes whatever can be approached with rational and systematic science, vs. the 'non-ratioïd', embracing mental constructs and abstract concepts like values, ideas and aesthetics, which escape such investigation. Moreover, mysticism is presented as another topic in opposition to mathematical certitude and rationality. But then, as in Pynchon and Broch, mathematics again turns up on both sides of the various polarities, and instead of a mutual exclusion, Ulrich strives for a synthesis of the seemingly contradictory concepts. Engelhardt suggests that in the novel this includes a kind of crisscrossing and "at least two states of transition: mathematical exactitude draws on intuitive and mystical elements, while linking individual cases to the regularity of a general law marks the corresponding transition from mysticism to rational maths" (109). Similarly, literature appears as Janus-faced: "Taking positions between the rational and the irrational, the individual and the general, the exact and the vague, literature does not emerge as a synthesis of fundamental elements of life but, like maths, as a way to explore aspects from different perspectives" (111–112). The attempt to resolve the dichotomies ultimately fails, but then another concept is introduced to overcome the incertitude and loss of confidence that mark the times. Qualified faith, belief, or critical trust may help to regain confidence and 'credit', financial and spiritual, and establish the imaginary and illusionary as valid approaches to truth; fiction, then, may be regarded as "a moral force for change" (119).

While the first three novels discussed by Engelhardt are focused on the developments in the late 19th and early 20th centuries, *Gravity's Rainbow* is famed for its encyclopaedic scope, which embraces Western history and science since the Enlightenment, including not only developments in physics, chemistry, phar-

macology, economics, psychology and a host of other fields of inquiry but also Puritan dogma and various other religious and occult belief systems, early cinema, music and popular culture. All of these are intricately interwoven, and thus mathematics is not only closely connected to physics and the sciences but also to religion or the experience of hallucinogenic drugs. Engelhardt carefully follows some of these connections with particular attention to the transitions from constructions of stable and deterministic visions of reality to uncertainties, unpredictability, probabilistic concepts, and ultimately the turn towards randomness in quantum theory. The origin of the inherent problems of a systematic scientific approach to reality can already be located in Newton's inability to account for the source of gravity, which thus appeared to be an occult force; in the words of Leibnitz which Engelhardt quotes: "it is a strange fiction to regard all matter as having gravity" (132). The close link between a deterministic worldview in mechanistic physics and a similarly deterministic theology in Calvinism is then constantly undermined by challenges to the very foundations of the respective concepts, e.g. by Einstein's theory of relativity, which suggests that gravity is not a force but results from the geometry of space-time; by highly improbable and unpredictable 'Kute Korrespondences'; or by intrusions of alternative realities. Once more, mathematics is presented as ambivalent, as it can support systems of order and control, but also allow for resistance and revolutionary disorder:

> In this way, the novel's presentation of mathematical functions and, in particular, the infinitesimal calculus works to propose possibilities inherent in Enlightenment maths, pointing to a path that does not lead to the disaster of a fully enlightened earth but, including uncertainty and fiction at its core, towards possibilities of freedom. (138).

The plurality of perspectives and the co-existence of different realities mark the turn from epistemological to ontological concerns and thus also to the shift from modernism to postmodernism; *Gravity's Rainbow* is, of course, one of the foundational texts of postmodern literature.

Modernism, Fiction and Mathematics is a very knowledgeable study within a field that is still under-researched in literary criticism. The careful appraisal of the discussions in modernist mathematics demonstrates that mathematics was no longer unanimously regarded as the epitome of scientific rationality and certainty, but also included conflicting concepts and allowed for unresolvable internal contradictions. The close analysis of the novels then shows how the crisis in mathematics was employed by the authors to discuss and question our ability to approach and represent reality, but also as a model for their own work. Thus, Engelhardt's book is of particular relevance for literary criticism, and it is also highly rewarding for those who are willing to engage in interdisciplinary research.

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https://doi.org/10.1515/ang-2019-0031

The socio-political climate in the early American republic was certainly one of transition and nation-making. The Founders were first struggling to create a national republic and then witnessed it growing both more democratic and more separated than they possibly could have imagined. Wrenching conflicts and inevitable change were daily business in these formative years, in which the Northern states created industrial order that, however, brought about its own problems and the Southern states tenaciously defended their plantation slavery. In the West, conflicts over land between American settlers and Native Americans raged bitterly, while in other parts of the country numerous groups of people were fighting for equality.

The early American republic thus was a time of drastic changes and influential in how we see democracy and nationhood today. It expanded the Founding Fathers' ideals of equality and extended its borders beyond what had been conceivable before 1776. A new nation materialized by the end of the era, one that was focused on industrialization, giving rise to a capitalistic economy. It was also a time of many advances, e.g. notable inventions such as the suspension bridge, the mechanical reaper, or Ben Franklin's bifocals. The nation's arts, on the other hand, were still in their baby shoes as American artistic creations were trying to find independent ground, yet not completely rejecting European aesthetics. The