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Abbott, Stephen

The proof stage. How theater reveals the human truth of mathematics. (English)

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The foundations of mathematics and physics were shaken in a turbulent period at the beginning of the 20th century. This revolutionary climate rippled through several of the subsequent decades and affected also the broader society as exposed by its progressive artists. Like the abstraction and formalization of mathematics were removing from our naively observed environment, the avant-garde stage plays involve characters in an absurd un-realistic environment exposing the same alienation. The mathematician Stephen Abbott, with a passion for theater, dissects in this book several stage plays to illustrate how the playwrights, inspired by mathematics, have weaved abstract ideas in the fabric of their plays.

The book opens with a thorough discussion of *Arcadia*, a play by T. Stoppard, where past and present are intermixed. It allows Abbott to refer to Fermat's last theorem, fractal geometry, graph theory, chaos theory, Heisenberg's uncertainty principle, and entropy. It is considered to be one of the best science-related plays as the culmination of Stoppard's previous involvement in some of his earlier plays featuring Zeno's paradoxes, Cantor, Lorenz, Feynman, and quantum physics.

Almost a century earlier, the French A. Jarry and the Polish S.I. Witkiewicz wrote math-inspired surrealist plays. Abbott places these in the context of the discovery of non-Euclidean geometry and Cantor's obsession with infinity, respectively. The surrealistic performances illustrate the importance of following a path that has been generally considered to be absurd.

Several plays by S. Beckett can be connected with the formalization of mathematics as in Whitehead and Russell's *Principia Mathematica* project and the associated incompleteness result by Gödel displaying the problem with self-reference as in Russell's paradox. The latter is easily simulated on stage by setting a play within a play.

Physics is rather explicit in work by B. Brecht (*The life of Galileo*), F. Dürrenmatt (*The pysicist*: in a lunatic clinic three murderous patients believe to be Einstein, Newton, and Möbius), M. Frayn (in *Copenhagen* Heisenberg meets Niels Bohr) while Hardy and Ramanujan feature in S. McBurney's *A disappearing number*.

Then Abbott returns to several of Stoppard's plays explaining the logic of formal systems, self-reference and self-conscious theater and continues in the subsequent chapter with A. Turing as the central figure to introduce Hilbert's *Enscheidungsproblem*, and the halting problem. Turing clearly features in H. Whitemore's biographical *Breaking the code*, but he is also the main character in S. Wilson's more imaginative *Lovesong of the electric bear*, while the Turing test appears in J. Mighton's *Half-life*.

Abbott is assuming that the reader is not a mathematician, so he takes care of introducing the mathematicians and explaining the essentials of their mathematics, just enough to understand the associations made in the plays. But the effort he puts into the details of explaining the formalism of the *Principia Mathematica*, Peano arithmetic, and Turing's universal machine is remarkable. It is somewhat technical but among the best explanations for the non-specialist that I have seen. Since the human brain is nothing but a sophisticated thinking machine, he also contemplates the possibility that, as Turing believed, at some point computers could become self-conscious and be able to have feelings like we do. Perhaps the imagination of the playwrights already suggest that in their plays.

The book ends with a discussion of Auburn's *Proof*, an accessible play that is also turned into a film by which it became better known among a general public. Without giving a proof, reference is given to the beauty of a proof resonating Hardy's "there is no place in this world for ugly mathematics". Just like a good stage setting is simple, concise, and at some points somewhat surprising, this is exactly what a beautiful proof should be.

The book has many notes and references to the origins of the citations and there are photographs of scenes of the plays discussed. Abbott gives a thorough analysis of how the mathematics have penetrated

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the plays and he makes many more connections between the different authors, plays, and mathematical issues discussed. New insights are emerging as one is reading on, which keeps you reading, eager to learn what else to be discovered. The reading may not be easy if you are not a mathematician, but the result is more than worth the effort, and as a mathematician it will probably open a whole new world to you.

Reviewer: Adhemar Bultheel (Leuven)

MSC:

00-02	Research exposition (monographs, survey articles) pertaining to mathematics in general	Cited in **1** Review
00A64	Mathematics and literature	
03-01	Introductory exposition (textbooks, tutorial papers, etc.) pertaining to mathematical logic and foundations	

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