

ranging,” a French idea of listening to the sound of gun firings to determine the location of the hidden German weapons that were devastating Allied forces on the western front. Against all odds he succeeded, and sound ranging played a crucial role in the subsequent Allied victory. Lawrence was awarded a Military Cross and elected as an officer of the Order of the British Empire, but the story has been unappreciated until recently.

Good news arrived in the midst of the war: Lawrence and his father were awarded the 1915 Nobel Prize in Physics. However, the war would also claim the lives of Lawrence’s younger brother, Bob, and best friend, Cecil. Furthermore, it is now recognized that pretty much anyone close to the front line for an extended period, as Lawrence was, experienced war trauma that had ongoing consequences. Later he had several nervous breakdowns, and he was diffident and insecure in personal relations. I have found no indication that Lawrence was accorded any understanding for his condition.

For those times he underwent a nervous breakdown, he relied greatly on his wife. They met at Cambridge; Alice completed her studies before she accepted Lawrence’s proposal. She recalled that he was shy and serious minded but had a subtle sense of humor. Lawrence’s mother warned Alice that “life would not always be easy. You must make the running, my dear . . . as I have always had to do with Dad [William].”

An inexperienced professor, Lawrence succeeded Ernest Rutherford at the University of Manchester in 1919. The demobilized students were difficult, and a vile series of anonymous letters drove Lawrence to a nervous breakdown. However, time healed those wounds. He was elected a fellow of the Royal Society, his Manchester School was born, and his staff was supportive. There were also lighter moments, as when Alice put a goldfish in each finger bowl at dinner. Lawrence also provides extensive accounts of family holidays, research on the silicates, another nervous breakdown, and much more.

When Rutherford died unexpectedly at Cambridge in 1937, Lawrence again succeeded him, this time as Cavendish Professor. But again he was unwelcome, for crystallography was seen as an unacceptable replacement for nuclear physics.

And again Lawrence would ultimately triumph. After World War II, subjects hitherto attention-starved began to prosper: among them, radio astronomy, electron microscopy, and metal physics. “But probably the work which in future years will be regarded as the outstanding contribution of the Cavendish Laboratory in these after-war years was the start of the investigation of biological molecules by X-rays” by Max Perutz, John Kendrew, Francis Crick, James Watson, and others. Family matters and delightful sketches about Lawrence fill the subsequent pages, until Lawrence’s final appointment as director of the Royal Institution.

But this account “remained unfinished,” the editors write, “probably because when he subsequently moved to the Royal Institution in 1954 he walked into a maelstrom left by the departure of [Edward] Andrade.” Lawrence had to work hard to sort out the problems, which he did to great effect, although he sometimes found himself snubbed by members of the Royal Society, which greatly upset him. Lawrence retired in 1966 and died in 1971.

John Jenkin

*La Trobe University
Melbourne, Australia*

Introduction to the AdS/CFT Correspondence

Horațiu Năstase

Cambridge U. Press, 2015. \$79.99 (438 pp.).
ISBN 978-1-107-08585-5

The anti-de Sitter/conformal field theory (AdS/CFT) correspondence, also known as holographic duality, is a conjectured relation between quantum field theory and a higher-dimensional gravity theory. It was proposed in 1997 by Juan Maldacena in the context of string theory.

Since then, the correspondence has been extensively checked and generalized. It serves as a strong-weak coupling relation that maps a strongly coupled problem in quantum field theory to a weakly coupled problem in classical gravity. Some calculations that are hard on the field-

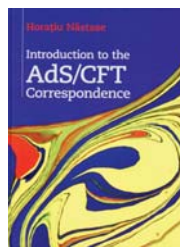
theory side of the duality are easy on the gravity side. The AdS/CFT duality establishes an unexpected relation between high-energy particle physics and condensed-matter physics on the one hand, and general relativity on the other, and it is a new manifestation of the fundamental unity underlying the different subfields of physics. A pedagogical book on this sophisticated and rapidly developing subject is clearly welcome.

Horațiu Năstase’s very readable *Introduction to the AdS/CFT Correspondence* is such a book. Written by a well-known expert on the AdS/CFT correspondence and its applications, the book is intended for graduate students and researchers who want to be acquainted with the new holographic techniques. Readers are assumed to understand basic notions of quantum field theory and have some familiarity with general relativity.

The book is organized into three parts. In the first, Năstase introduces the necessary concepts to formulate the correspondence. In the second, he gives the formulation and applies the duality to maximally supersymmetric gauge theories in four spacetime dimensions. The last part of the book deals with advanced topics and applications. That natural organization is, not surprisingly, similar to the one adopted by Martin Ammon and Johanna Erdmenger in their text *Gauge/Gravity Duality: Foundations and Applications* (Cambridge University Press, 2015).

One of the most difficult aspects of writing a book on the AdS/CFT correspondence is deciding how much string-theory background to include. Clearly, minimizing the string-theory content would help to reach a wider audience. Too much string theory and you may lose readers. Less string theory will keep the readers but may cause them to miss the depth of the subject and see the holographic rules as arbitrary and unjustified.

Part 1 of *Introduction to the AdS/CFT Correspondence* achieves that balance, which makes it suitable for teaching the subject starting from well-defined string theory solutions. The opposite, phenomenological approach has been followed by Jan Zaanen, Yan Liu, Ya-Wen Sun, and Koenraad Schalm in *Holographic Duality in Condensed Matter Physics* (Cambridge University Press, 2016); that text



focuses on the application of AdS/CFT to condensed matter. An intermediate point of view can be found in the monograph *Gauge/String Duality, Hot QCD and Heavy Ion Collisions* (Cambridge University Press, 2014) by Jorge Casalderrey-Solana and coauthors, which is more centered on the themes mentioned in the title.

Part 2 of the book contains an account of the original formulation of the correspondence; part 3 deals with the extensions of the holographic duality to models in different numbers of spacetime dimensions or with fewer symmetries. The content of that third part reflects Nästase's preferences and will not please some advanced readers. I appreciated the sections devoted to a particular model—the so-called ABJM model—developed by Maldacena and colleagues; many details presented by Nästase are not available in existing books. Unfortunately, the book only briefly covers (in chapter 21) the addition of flavor fields to the correspondence; a better treatment can be found in the text by Ammon and Erdmenger and in the monograph by Casalderrey-Solana and company.

Nästase's book is written in a student-friendly style with detailed explanations and many worked-out calculations. Each chapter ends with a summary of important concepts and a set of exercises. It will certainly be of great help both to those teaching an advanced graduate course on the AdS/CFT correspondence and to students or researchers planning to learn it by themselves. *Introduction to AdS/CFT Correspondence* is a valuable addition to the small set of existing books on the topic.

Alfonso V. Ramallo

*University of Santiago de Compostela
Santiago de Compostela, Spain*

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