2004 Conant Prize

The 2004 Levi L. Conant Prize was awarded at the 110th Annual Meeting of the AMS in Phoenix in January 2004.

The Conant Prize is awarded annually to recognize an outstanding expository paper published in either the *Notices of the AMS* or the *Bulletin of the AMS* in the preceding five years. Established in 2001, the prize honors the memory of Levi L. Conant (1857–1916), who was a mathematician at Worcester Polytechnic University. The prize carries a cash award of $1,000.

The Conant Prize is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2004 prize the members of the selection committee were: Anthony W. Knapp, Brian J. Parshall (chair), and Carl Pomerance.

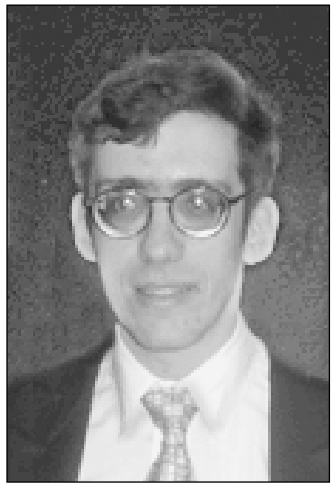
Previous recipients of the Conant Prize are: Carl Pomerance (2001), Elliott Lieb and Jakob Yngvason (2002), and Nicholas Katz and Peter Sarnak (2003).

The 2004 Conant Prize was awarded to NOAM D. ELKIES. The text that follows presents the committee's citation, a brief biographical sketch, and the awardee's response upon receiving the prize.

Citation

The Levi L. Conant Prize in 2004 is granted to Noam D. Elkies for his enlightening two-part article "Lattices, Linear Codes, and Invariants", *Notices of the AMS* **47**, nos. 10–11 (2000): Part I, 1238–45; Part II, 1382–91.

Part I, which is of prize-winning quality by itself, begins with the problem of finding the densest packing of 24-dimensional marbles whose centers are placed at the points of a lattice. It carries the reader effortlessly along a journey through the space of lattices, through the subject of theta functions and modular forms, through classical number-theoretic identities, through sporadic finite simple groups, and finally to some hints of an exceptional 24-dimensional lattice known as the Leech lattice. Elkies keeps the reader's attention throughout, judging well which points to expand upon and which points to skip over. It is hard to put the article down as it takes unexpected turns and weaves together different areas of pure mathematics.



Noam D. Elkies

In Part II, Elkies avoids the temptation to expand this development further, in a way that might tire the reader, and instead he develops an ostensibly different topic, stressing a detailed analogy with the material in Part I. Here the topic is one in applied mathematics, specifically that of linear error-correcting codes. He introduces "Hamming space" as the space of ordered n-tuples from a finite alphabet, especially from the elements of a finite field. Error-correcting codes become the analog of sphere packings. Linear error-correcting codes become the analog of sphere packings with centers at the points of a lattice. "Weight enumerators" play the role of theta functions, and he pursues the topic through the same kinds of twists and turns as in Part I. Eventually he arrives again at the Leech lattice, and this time he constructs the lattice and examines some of its remarkable properties.

The article leaves the reader with a good feeling about the unity of mathematics, and its underlying beauty. It is a masterful exposition.

Biographical Sketch

Noam D. Elkies is a number theorist whose work mostly concerns Diophantine geometry, computational number theory, and connections with other fields such as sphere packing and error-correcting

codes. He also publishes occasionally in enumerative combinatorics and combinatorial games. He twice represented the United States at the International Mathematical Olympiad, winning gold medals both times, and was a Putnam Fellow in each of the three years he took the Putnam examination. He has been at Harvard since coming there as a graduate student in 1985; after earning his Ph.D. there under Barry Mazur and Benedict Gross, he was a junior fellow, then associate professor, and was granted tenure in 1993 at age twenty-six, the youngest in Harvard's history. His work has also been recognized by awards such as a Packard Fellowship and the Prix Peccot of the Collège de France.

Elkies's main interest outside mathematics is music, mainly classical piano and composition. Recently performed works include a full-length opera, *Yossele Solovey*; Brandenburg Concerto no. 7, commissioned and performed by the Metamorphosen Chamber Orchestra; and several other orchestral compositions, one of which had Elkies playing the solo piano part in Boston's Symphony Hall. He still has some time for chess, where he specializes in composing and solving problems; he won the world championship for solving chess problems in 1996 and earned the Solving Grandmaster title in 2001.

Response

I am honored and grateful to receive the 2004 L. L. Conant Prize for my article "Lattices, Linear Codes, and Invariants" in the *Notices of the AMS*. I also thank Tony Knapp for soliciting the article and for working with me on the mathematical writing. It was already gratifying to have the opportunity to introduce the *Notices* readership to a beautiful circle of mathematical ideas whose continuing vitality is exemplified by such recent work as the unified treatment by Nebe, Rains, and Sloane of various generalizations of the MacWilliams identity and Gleason's theorems, and the proof by Cohn and Kumar that the Leech lattice yields the densest lattice packing of spheres in dimension 24. I am delighted that my exposition was selected for the Conant Prize and hope that this additional exposure will entice more mathematicians to learn about the invariants associated with lattices and codes.