2011 Conant Prize

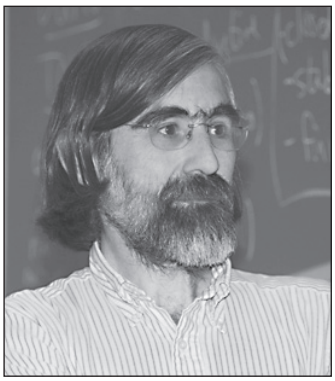
DAVID VOGAN received the 2011 AMS Levi L. Conant Prize at the 117th Annual Meeting of the AMS in New Orleans in January 2011.

Citation

The Levi L. Conant Prize for 2011 is awarded to David Vogan for his article, "The character table for E_8" (*Notices Amer. Math. Soc.* **54** (2007), no. 9, 1122–1134). The Lie group E_8 was discovered in 1887 by Wilhelm Killing in the course of his project to determine all of the simple real Lie groups, whose theory had been initiated shortly beforehand by Sophus Lie. This project was completed in the 1890s by Elie Cartan. However, E_8 remained in many ways an "unknown" known Lie group or, at least, a poorly understood one. It has no clear connection to classical geometry, and its smallest faithful linear representation is the 248-dimensional adjoint representation on its own Lie algebra. The mist has cleared slowly in the course of the twentieth century through the efforts of Weyl, Tits, Harish-Chandra, and many others. Yet many open questions remain.

Vogan's article reports on a recently completed project to determine the set of irreducible unitary representations of the split real Lie group of type E_8. These representations are described by giving a character table. Naively, a character is the trace of a representation and is constant on the conjugacy classes of the group. This makes sense for finite groups and even for compact groups, but it requires some deep mathematics to give even a coherent meaning to the phrase "character table of split E_8". Part of Vogan's achievement is to provide the reader a good understanding of what that means, as clarified by the theorems of Harish-Chandra, Langlands, and Knapp and Zuckerman, culminating in the fact that the necessary data is encoded in a finite set of integer matrices. Vogan's next accomplishment is to give the reader insight into how these integer matrices can be computed. The answer begins with an algorithm of Kazhdan and Lusztig for computing intersection homology inductively. Next the story shifts to the challenge of converting this algorithm into a computer program. Obstacles here include the problem of storing 6 billion polynomials with about 120 billion coefficients, many of them extremely large. A clever idea of Noam Elkies—using the Chinese Remainder Theorem—helps save the day.

Vogan describes this work with great verve, as a saga of wildly oscillating emotions. He closes by affording us some inkling of the insights afforded by this mass of data, as well as the ongoing goals of the project. In conclusion, he pays touching tribute to the many brilliant mathematicians who have brought their disparate skills and insights so fruitfully to bear on this problem.



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David Vogan

Biographical Sketch

David Vogan graduated from the University of Chicago in 1974 and earned a Ph.D. under Bertram Kostant at MIT in 1976. He joined the MIT faculty in 1979 and served as department head from 1999 to 2004. Since 1996 he has been a fellow of the American Academy of Arts and Sciences. His research concerns infinite-dimensional representations of Lie groups; it has been carried out with too many collaborators to remember, although it is always a pleasure to try. He gave an invited address to the International Congress of Mathematicians in Berkeley in 1986 and the Hermann Weyl Memorial Lectures at the Institute for Advanced Study in the same year.

Response from David Vogan

I am honored and gratified to receive this recognition, which is for work done by many wonderful mathematicians and dear friends. First among these is Fokko du Cloux, who never allowed any trace of imprecision or sloppy thinking. Our conversations were usually meant to be about my

explaining something to him, but most often they ended with his explaining that I did not yet really understand.

I am grateful also to all of the great teachers from whose (perfect) examples I learned (imperfectly) to explain mathematics: Richard Beals and Paul Sally at the University of Chicago, Sigurdur Helgason and Bertram Kostant at MIT, and Armand Borel and Anthony Knapp after I was supposed to be done with being a student.

I am grateful to Dan Barbasch, who for more than thirty years has always known just a bit more than me about the problems we both study; he has never hesitated to share that knowledge with anyone who asks.

Finally, I am grateful to Jeff Adams, whose mathematical vision and leadership is the heart of the collaboration whose work I wrote about. He is the best herder of cats I have ever met.

About the Prize

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 US$1,000.

The Conant Prize is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2011 prize, the members of the selection committee were Georgia Benkart, Jerry L. Bona, and Ronald M. Solomon.

Previous recipients of the Conant Prize are Carl Pomerance (2001); Elliott Lieb and Jakob Yngvason (2002); Nicholas Katz and Peter Sarnak (2003); Noam D. Elkies (2004); Allen Knutson and Terence Tao (2005); Ronald M. Solomon (2006); Jeffrey Weeks (2007); J. Brian Conrey, Shlomo Hoory, Nathan Linial, and Avi Wigderson (2008); John W. Morgan (2009); and Bryna Kra (2010).