Nominations for President

Courtesy of Michael Lovett

Nomination of Ruth Charney

by Michael Davis and Karen Vogtmann

It is with great pleasure and enthusiasm that we nominate Ruth Charney to be President of the American Mathematical Society (AMS). Both of us have been close friends and collaborators with Ruth for many years and feel confident that she would make a truly outstanding President.

Charney is currently the Theodore and Evelyn Berenson Professor of Mathematics at Brandeis University. After earning her PhD in 1977 from Princeton, she took a postdoctoral position at the University of California in Berkeley and subsequently moved to Yale University with an NSF postdoctoral fellowship. In 1984 she accepted a permanent position at The Ohio State University, where she worked until moving to Brandeis University in 2003. She has also held visiting research positions at various institutions including the Institut des Hautes Études Scientifiques in Paris; the Institute for Advanced Study in Princeton; the Mathematical Institute in Oxford; the Université de Borgogne in Dijon; the Institut Mittag-Leffler in Sweden; the Forschungsinstitut für Mathematik in Zurich; MSRI in Berkeley; the Isaac Newton Institute in Cambridge; and Warwick University Mathematics Institute. She is a Fellow of the American Mathematical Society and of the Association for Women in Mathematics (AWM).

Mathematical work. Charney has made important and influential contributions to a wide range of subjects in group theory and topology. Her early results include seminal work on homological stability for linear groups, contributions to understanding the stable cohomology of mapping class groups and work on compactifications of moduli spaces. Subsequently she became one of the pioneers of geometric group theory. She continues to do fundamental work in this field. This work includes developing the theory of Artin groups (especially right-angled Artin groups and their groups of automorphisms) and research on non-positively curved spaces. Her work on non-positive curvature includes: 1) the technique of strict hyperbolization, 2) the criteria for branched covers of Riemannian manifolds to be non-positively curved, 3) a characterization of spherical and Euclidean buildings in terms of their metric properties, and most recently, 4) the introduction of a new type of boundary for CAT(0) spaces. In addition, she has worked on the Charney-Davis Conjecture about the combinatorics of triangulations of spheres, which was motivated by considerations of non-positive curvature.

We will give further details about some of this work below.

Artin groups. Charney is particularly well-known for her work on Artin groups. These are generalizations of braid groups. Every Artin group A has an associated *Coxeter group* W, and if W is finite then A is said to be of *finite type*. In the case of the braid group on n strands, the associated Coxeter group is the symmetric group on n letters, which records the permutation of strands at the end of a braid; in particular braid groups are of finite type. In general a Coxeter group W has a representation as a group generated by linear reflections of $\mathbb{C}^n$. When the Artin group A has finite type, Deligne proved that the complement of the set of reflecting hyperplanes in $\mathbb{C}^n$ has a contractible universal cover, and the quotient of this complement by W has fundamental group isomorphic to A; in other words, this quotient is an *Eilenberg-Maclane space*, or a $K(\pi, 1)$, for A. The problem of whether the same statements hold for an arbitrary Artin group is known as the "$K(\pi, 1)$-Conjecture" for Artin groups. It is considered to be the most important unsolved conjecture in the subject. In 1995 Charney and Davis proved it for a large class of Artin groups of infinite type.

By 1990 the notion of "automatic group" was surfacing in geometric group theory. Roughly, this means a group for which the word problem can be solved by a finite state automaton. Garside had solved the word problem

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for braid groups and Thurston had used this to prove that braid groups were automatic (in fact biautomatic). In his work on the $K(\pi, 1)$-Conjecture, Deligne had shown how to extend Garside's methods to all Artin groups of finite type. The final step was taken by Charney: In an influential 1992 paper she proved that in fact all finite type Artin groups are biautomatic. Much of Charney's work concerns right-angled Artin groups (sometimes called RAAGs). The $K(\pi, 1)$-Conjecture is true for these Artin groups—their natural $K(\pi, 1)$ is a non-positively curved cube complex. During the last ten years the study of RAAGs has come to occupy a central place in geometric group theory. In recent years Charney has written a series of papers with Vogtmann and various other collaborators on the structure of automorphism groups of RAAGs, as well as automorphism groups of other Artin groups. One motivation for this work is that the two extreme cases of RAAGs are free Abelian groups and free groups—and both extremes have extremely interesting outer automorphism groups, namely, $\mathrm{GL}(n, \mathbb{Z})$ and $\mathrm{Out}(F_n)$.

Non-positively curved spaces. In his 1987 paper, *Hyperbolic groups*, Gromov explained how to define non-positive curvature and strict negative curvature for metric spaces more general than Riemannian manifolds, and then he defined the notion of a *hyperbolic group*, the prototypical example of which is the fundamental group of a strictly negatively curved, compact geodesic metric space. Gromov described several general methods for constructing non-positively curved spaces. One method starts with a simplicial complex X and produces a non-positively curved space $H(X)$ called its "hyperbolization." The spaces X and $H(X)$ are closely related, for example, when X is a manifold, $H(X)$ is a manifold that is cobordant to X. It turned out that in dimensions at least four Gromov's non-positively curved hyperbolization procedures failed to produce spaces whose fundamental groups were hyperbolic. This was remedied in the 1995 paper of Charney and Davis, in which they described a modification of Gromov's hyperbolization that always produces spaces of strict negative curvature.

In recent work with graduate students and postdocs, Charney introduced a new notion into geometric group theory, the idea of a "Morse boundary." An important feature of a hyperbolic group is that one can attach to it an ideal boundary and this boundary is a quasi-isometry invariant. Similarly, one can attach an ideal boundary to the universal cover of a strictly negatively curved geodesic space. In the case of strict negative curvature, quasi-isometry invariance is established by showing that geodesic rays satisfy a certain crucial property, first established by Morse for geodesics in the hyperbolic plane. Charney's idea is that by restricting attention to the geodesics which satisfy Morse's property one obtains a partial boundary for the universal cover of any geodesic metric space (indeed, for any finitely generated group). Although this Morse boundary need not be part of a compactification, it is invariant under quasi-isometries. This new notion promises to become an important concept in geometric group theory.

Professional service. Charney has a truly exemplary record of service to the mathematical community. Her work specifically for the American Mathematical Society includes the elected offices of Vice President (2006–2008) and member of the Board of Trustees (2012–2016). She has also served on numerous key committees, including the Executive Committee, the Nominating Committee, and the Committee on the Profession, so she is thoroughly familiar with the structure and the dynamics of the AMS.

Charney has also worked with many mathematics organizations other than the AMS. She was President of the Association for Women in Mathematics in 2013–2015, as well as serving on several AWM committees, including its Scientific Advisory Committee and the Executive Committee. She has also served on the Board of Trustees of the Mathematical Sciences Research Institute in Berkeley and the US National Committee for Mathematics; she is currently on the Scientific Advisory Board of the Centre de Recherches Mathématiques in Canada. She has a good understanding of the workings of various American mathematics departments, having participated in external review committees for a number of universities around the country. She also served as head of her own mathematics departments at both Ohio State and Brandeis. In all of these positions she has shown a real talent for dealing effectively with a broad spectrum of mathematicians and advocating for their interests with the relevant parties.

Charney has served on the organizing committee for well over a dozen workshops and conferences at venues around the world. Together with her many visiting positions abroad, this has given her extensive experience with the international mathematical community, contributing to the strength of her candidacy for President of the AMS.

On a personal level, Charney is open and approachable. She gives clear and compelling lectures, and interacts readily with mathematicians of all ages. In particular we would like to highlight Charney's deep involvement with young people. She has been a very successful mentor of graduate students and postdocs, and has given her time and energy to organizations and events such as the Young Mathematicians Conference at Ohio State, SACNAS, the Georgia Tech Topology Students Workshop, and the Institute for Advanced Study Women and Mathematics (WAM) Program.

Conclusion. Charney is a distinguished and accomplished research mathematician who has been an energetic and effective advocate for mathematics and mathematicians in a wide variety of contexts. She will make an outstanding President for the American Mathematical Society.

Courtesy of Dusa McDuff

Nomination of Dusa McDuff

by Yakov Eliashberg and Helmut Hofer

It is a great honor and pleasure for us to nominate an outstanding mathematician and person to be the President of the American Mathematical Society.

Dusa McDuff has made groundbreaking contributions to different areas of mathematics, especially to symplectic geometry and topology. However, her contributions to mathematics go well beyond her mathematical discoveries.

Here is how David Eisenbud, the director of the Mathematical Sciences Research Institute (MSRI) in Berkeley describes her contributions to the Institute:

Dusa McDuff has been a mainstay of MSRI's structure for a very long time: She has been a member of several programs; a program organizer; the Chair of the Scientific Advisory Committee, which determines the major programs at MSRI. She was the Chair of the Board of Trustees at the time of MSRI's first big fundraising project, resulting in the major expansion of MSRI's facility in 2006. She has remained on the Board of Trustees ever since, contributing to the governance of MSRI in many ways. Because of her mathematical eminence, her long experience, and her evident good sense, she has tremendous influence on the Board, much to MSRI's benefit.

She also currently serves on the Diversity Committee of the School of Mathematics at the Institute for Advanced Study (IAS), Princeton.

McDuff has been a tremendous role model for many. Besides the fact that she advised many PhD students, it is impossible to overestimate her role in bringing and nurturing outstanding women to the mathematical profession. We were told by several accomplished women mathematicians that to a large degree they owe their career success to Dusa's advice, example, and help.

Professor Peter Sarnak of the IAS said that *as the Chair (since 2016) of the Program Committee of the Women and Mathematics Program at the IAS, Dusa McDuff has led by example, guidance and participation in the yearly programs. Thanks to her efforts the program is thriving and it will continue to do so under her leadership*.

Margaret Dusa Waddington (now Dusa McDuff) was born in London, England, and grew up in Scotland. Her father Conrad Waddington was a professor of developmental biology genetics and one of the forefathers of systems biology. Her mother, Margaret Justin Waddington, was an architect and town planner. She designed council housing in Edinburgh and researched efficient designs for emergency rooms in hospitals. In fact, many women in her maternal line were absolutely remarkable. Her grandmother Amber (also called Dusa) was a writer and a philosopher, and after World War II taught philosophy in Morley College (now part of the University of London). Dusa's great-grandmother Maud was an author and political activist. She was part of a group of women who won voting rights for women in New Zealand in 1893, the first country in the world to achieve this. Her book written in 1911 about the working class poor in London is still used as a textbook. As McDuff writes in her autobiography, *"I am convinced that it is only because there was such a strong academic tradition in my family (among both women and men) that I survived as a mathematician."*

As an undergraduate she studied in Edinburgh and for her graduate study went to Cambridge where, under the direction of G. A. Reid, she solved a well-known problem about von Neumann algebras, constructing infinitely many different II_1 factors. Her paper was published in *Annals of Mathematics*. She then went to Moscow, following her husband who needed to work in the Soviet archives. She used her six months in Moscow to study with I.M. Gelfand who had an enormous influence on her mathematical interests and career. She spent the following early years as a postdoctoral fellow in Cambridge, followed by a lectureship at the University of York, visiting positions at MIT and the Institute for Advanced Study, and a lectureship at the University of Warwick. Her research at the time focused on questions in algebraic topology. It included a joint paper with Graeme Segal on the group completion theorem and a series of papers on the homology of groups of volume preserving diffeomorphisms. In 1978 she moved to SUNY at Stony Brook, where she rose through the ranks to become a distinguished professor. In 2007 she moved to Barnard College, Columbia University, where she now holds the Helen Lyttle Kimmel '42 Chair in Mathematics. She is also a Professor Emeritus at Stony Brook.

In the early eighties her interests shifted toward symplectic geometry and the emerging field of symplectic topology. In 1985 McDuff visited the IHES, where she had a chance to interact with Mikhail Gromov who had just written his paper on pseudoholomorphic curves which revolutionized and essentially created the subject symplectic topology. McDuff actively joined this revolutionary development and herself made many remarkable discoveries. Since that time she is one of the mathematicians whose work, over a period of more than thirty years, has shaped the subject of symplectic topology, and her work continues to shape the subject today.

Here are just a few of of McDuff's outstanding results in symplectic topology:

- She constructed the first examples of non-diffeomorphic symplectic forms in the same co-

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homology class and which are deformationally equivalent; i.e., can be connected by a family of symplectic forms with varying cohomology classes;

- Via a fine analysis of singularities of J-holomorphic curves in a 4-dimensional symplectic manifold, she extended Gromov's theorem proving that a symplectic 4-manifold which asymptotically is the standard $\mathbb{R}^4$ is symplectomorphic to the standard symplectic $\mathbb{R}^4$ up to blow-ups;
- She gave a complete symplectic classification of ruled and rational symplectic 4-manifolds;
- Jointly with Polterovich she advanced the symplectic packing problem in a remarkable way;
- Jointly with Lalonde she established the existence of a bi-invariant (Hofer) metric on the group of symplectomorphisms of an *arbitrary* symplectic manifold;
- Jointly with Abreu and partially other co-authors she completely described the homotopy type of the group of symplectomorphisms of $S^2 \times S^2$ and some other ruled surfaces;
- Jointly with Lalonde and Polterovich she developed the theory of symplectic fibrations and proved groundbreaking results towards the "flux conjecture;"
- Partially jointly with Tolman she classified Hamiltonian S^1-actions on a large class of 6-manifolds;
- Jointly with F. Schlenk she developed revolutionary new techniques for symplectic embeddings which in combination with results of Michael Hutchings yielded a complete solution of the symplectic embedding problem for 4-dimensional ellipsoids.

Collaborating with K. Wehrheim she also invested a lot of time and work toward the building of foundations of the theory of holomorphic curves.

McDuff authored (jointly with D. Salamon) two fundamental textbooks on symplectic topology and the theory of pseudoholomorphic curves. One is a more introductory text *Introduction to Symplectic Topology* (which is now in its third edition) and the other an advanced book *J-holomorphic Curves and Symplectic Topology* for which McDuff and Dietmar Salamon received the 2017 Leroy P. Steele Prize for Mathematical Exposition.

It is difficult to overestimate the influence and importance of these books. Quoting the prize citation, *while being among the main contributors to this development, McDuff and Salamon spent nearly a decade assembling the foundations of this subject into a mammoth 700-page book. It has since served as the most standard and undisputed reference in the field and as the main textbook for graduate students and others entering the field.*

Salamon described his collaboration with McDuff on these books in the following words: *The process of writing these books did not go without extensive arguing about style and content, and what seemed like endless discussions about consistent choices of signs. We often had very different points of view in our approach to the subject, which one might describe as more geometric (Dusa) versus more analytic (myself). After some back and forth we did, however, always manage to find a compromise and in the end this process turned out to be very fruitful and inspiring. We learned a lot from each other and none of us could have written these books by ourselves.*

For her outstanding contributions McDuff received many honors. She was twice an invited speaker at the International Congress of Mathematicians in 1990 and 1998 (plenary lecture) and gave numerous prestigious lectures around the world. She was elected as a Fellow of the Royal Society in 1994, as a Fellow of the American Academy of Arts and Sciences in 1995, as a Member of the National Academy of Sciences in 1999. She is an Honorary Fellow of Girton and King's Colleges, Cambridge, an Honorary Member of the London Mathematical Society, a Member of the American Philosophical Society, a corresponding member of the Royal Society of Edinburgh, and a foreign member of Academia Europaea. McDuff holds honorary degrees from the University of Edinburgh; University of York; University of Louis Pasteur, Strasbourg; University of St. Andrews, Scotland; University Pierre et Marie Curie, Paris; and Warwick University. Besides her joint AMS Steele Prize with Salamon, McDuff was awarded the inaugural Ruth Lyttle Satter Prize of the AMS, and the Senior Berwick Prize of the London Mathematical Society.

We are convinced that if elected Dusa McDuff would be an outstanding President of the AMS.