Renaissance Banff

Mathematics, Music, Art, Culture

2005

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Conference Proceedings
2005

Reza Sarhangi and Robert V. Moody, Editors

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Preface

Mathematics has periodically been employed not only to interpret and analyze art and architecture, but also to directly integrate with artistic products. During the European Renaissance, art, mathematics, architecture, science, and music flourished side by side. This is no longer the case, and although many artists and scientists are calling for ways to regain the lost mutual understanding, appreciation, and exchange, it has been hard to know how to create environments in which this can happen in a meaningful way.

No less a divide exists between mathematics and the general public. All human beings are fluent in recognizing and appreciating patterns, and are able to deal effortlessly with the abstractions of language, music, visual art, and theatre. Yet most people think that they have a latent aversion to mathematics and are largely unaware of how deeply embedded it is in the world around them. Still, we have seen over and over again how fascinated and excited people become when mathematical connections are presented in ways which relate to their experiences and trigger their natural curiosities and aesthetic sensibilities.

The Bridges Conferences, created in 1998 and running annually since, have provided a remarkable model of how these divides can be crossed. Here practicing mathematicians, scientists, artists, educators, musicians, writers, computer scientists, sculptures, dancers, weavers, and model builders have come together in a lively and highly charged atmosphere of mutual exchange and encouragement. Important components of these conferences, apart from formal presentations, are gallery displays of visual art, working sessions with practitioners and artists who are crossing the mathematics-arts boundaries, and evening musical or theatrical events. Furthermore a lasting record of each Bridges Conference is its Proceedings, the latest of which you are holding now, – a beautiful resource book of the papers and the visual presentations of the meeting.

The Banff Centre is Canada's only leading center dedicated to the arts, leadership development, and mountain culture. The Centre is also home to a world-class conference facility. The convergence of the resources, multidisciplinary programming, and a spectacular physical location affords all the requirements for an inspirational learning experience. The Banff International Research Station (BIRS) is a component of the Pacific Institute for the Mathematical Science (PIMS) that is located at the Banff Centre. BIRS organizes over forty mathematics research workshops at the Banff Centre each year. Yet even at its inception, the directors of the PIMS and the Banff Centre were aware of the potential disconnection between this mathematics research station and the rest of the Banff Centre. They felt that they should go into a venture to connect all the different components at the Banff Centre. But how and what? The then Scientific Director of BIRS, Robert Moody, was left to struggle with this question.

As it turned out the catalyst for the conference was one of the founding members of BIRS, David Eisenbud (Director of MSRI and the President of AMS) who put the two editors of these Proceedings together. The chemistry matched and, voilà, the idea of bringing Bridges to Banff was born.

With the encouragement of Nassif Ghoussoub, who was Director of PIMS at the time, and Ivar Ekeland, its new Director, an organizing committee was struck that included the directors of PIMS and BIRS, and the creator and director of the Bridges conferences, Reza Sarhangi. When Christiane Rousseau, who was the President of the Canadian Mathematical Society, learned about the intention to have a mathematics-arts conference, she immediately came up with the idea of extending it to include a day devoted to Donald Coxeter, who was passionately devoted to the artistic side of mathematics and whose passing was still fresh on everyone's mind. With the addition of Christiane our Scientific Organizing Committee was complete. This is the first time a mathematics/arts event of this magnitude has been brought to Canada and in particular to the western Canadian community.

The conference title "Renaissance Banff" sums up its objectives in a nutshell. Renaissance Banff provides the first fulfillment of the expectations of the founders of the BIR-Banff Centre partnership in that it would foster a new era for drawing the worlds of the arts and the sciences closer together. In addition, the value of such a conference for teachers of mathematics in providing new ideas and methods for conveying the beauty, relevance, and ubiquity of mathematical ideas to their students cannot be overstated.

The four-day Renaissance Banff conference consists of two parts: A three-day Bridges Conference and a final day, organized in cooperation and with the support of the Canadian Mathematical Society, set aside for geometry-arts connections that are either related to or inspired by the life and work of Donald Coxeter. H.S.M. (Donald) Coxeter was one of the foremost geometers of the 20th century. His work and writing not only played a significant role in mathematics, but also touched innumerable people in the arts and other areas of science. A section of this Proceedings includes the articles that were presented in his honor. In order for the conference to meet the needs of K-12 teachers, a section of teacher workshops was scheduled. The last section of this book consists of the workshop articles that were presented in the meeting.

The refereed Renaissance Banff Proceedings has attracted even more quality authors from around the world than ever before. This forced us not only to be more sensitive to the selection of papers, but also to limit the number of pages for each article. Even with that we had to admit a significant growth in the number of papers accepted for publication. The increase in submissions, of course, caused more work for the referees. This Proceedings reveals not only the quality of work of its authors but also the hard work of our referees. No words can express our appreciation for the work the referees have done to enable publication of the proceedings you have in your hands. Please note that in order for the readers to locate an article in the book faster, an index of the author's names, which have been sorted alphabetically, has been added to the end of this publication.

The cover, *Van Gogh meets Riemann*, gives a view on the painting "Café Terrace at Night" by Vincent van Gogh (1853 - 1890) through a conformal transformation: the logarithm of the zeta-function of Bernhard Riemann (1826 - 1866). On the right we can see the pole at 1 and on the left a trivial zero at -2. The non-trivial zeros, which are the subject of the most important open problem in mathematics today, are outside the picture frame.

The *Bridges Visual Art Exhibit* is the result of Robert Fathauer's hard work in communicating with a large number of artists in order to carefully select the artwork and properly set them up for the exhibit. The CD that accompanies this book presents the images presented at the Bridges Visual Art Exhibit.

Special thanks must be given to the administrators and the staff at the Banff Centre for their key roles in organizing the conference in Banff. In particular we would like to acknowledge the support of the CEO of the Banff Centre, Mary Hofstetter and the then Vice-President for Artistic Programming, Joanne Morrow, as well as the on-going efforts of Luke Azevedo, who came especially to the previous Bridges Conference in Kansas as an observer and who has been our liaison with the Banff Centre throughout the development of this Conference. We also should thank Nicole Neubauer for her time and effort to organize the registration process, to Audrey Cutler of the Center for Instructional Advancement and Technology at Towson University for her technical support, and to Chris Palmer for his effort in updating the Bridges website, creating the 2005 Renaissance Banff CD, and for laying out the proceedings cover.