# REPORT ON THE *BIRS* WORKSHOP
## *"CREATIVE WRITING IN MATHEMATICS AND SCIENCE,"*
## BANFF, 2-6 MAY 2010

### Organizers:

*Marjorie Senechal*

Department of Mathematics
Smith College
Northampton, MA 01063
senechal@smith.edu

and

*Florin Diacu*

Pacific Institute for the Mathematical Sciences
and
Department of Mathematics and Statistics
University of Victoria
P.O. Box 3060 STN CSC
Victoria, BC, Canada, V8W 3R4
diacu@math.uvic.ca

June 10, 2010

## 1. INTRODUCTION

The 4th BIRS workshop of *Creative Writing in Mathematics and Science* brought together 19 mathematicians, scientists, and journalists who actively write about mathematics[1] for a general public. Some of the participants had attended at one or several of the previous workshops, but most of them were new to an event of this kind. They were (in alphabetical order):

- Madhur Anand, an ecology professor at the Univeristy of Guelph,
- Steve Batterson, a mathematics professor and historian of science at Emory University,

---

[1]Throughout this report, we use the term "mathematics" inclusively, to encompass the sciences that make heavy use of it.

1

- John Bohannon, a freelance science journalist affiliated with Harvard University,
- Wendy Brandts, a biology researcher at the University of Ottawa,
- Sarah Isabel Burgess, a Ph.D. candidate in physics at the University of Toronto,
- Robin Chapman, a psychology professor (emerita) at the University of Wisconsin,
- Barry Cipra, a freelance mathematics writer based in Minneapolis,
- Chandler Davis, a mathematics professor (emeritus) at the University of Toronto,
- Robert Dawson, a mathematics professor at St. Mary's University,
- Florin Diacu, a mathematics professor at the University of Victoria,
- Adam Dickinson, an English professor at Brock University,
- Philip Holmes, a mathematics and engineering professor at Princeton University,
- Gizem Karaali, a mathematics professor at Pomona College,
- Joseph Mazur, a mathematics professor (emeritus) at Marlboro College,
- Siobhan Roberts, a freelance science journalist affiliated with the Institute for Advanced Study in Princeton,
- Mari-Lou Rowley, an English professor at the University of Saskatchewan,
- Marjorie Senechal, a mathematics professor (emerita) at Smith College,
- Vladimir Tasic, a mathematics professor at the University of New Brunswick,
- Dragana Varagic, an actor and art director of April Productions in Toronto.

## 2. Objectives

The main goals of the workshop were to continue to expand and encourage the small community of writers actively seeking to engage the larger public in mathematics in a broadly creative way, and to increase the cooperation between BIRS and the Banff Center's Writing and Publishing program, to the benefit of both. Since this is the longest direct collaboration BIRS has established with the Banff Centre for the Arts, we aimed to further strengthen the ties.

The sound achievements of previous BIRS/Banff workshops include, in addition to publications of individual participants, the well-attended public reading in Max Bell Hall in June 2006, and playwright Ellen Maddow's math-laced music comedy "Delicious Rivers," written in collaboration with Marjorie Senechal and performed at La Mama Cafe in New York and at Smith College in 2006. The writing of twenty past workshop participants is showcased in *The Shape of Content*, an anthology of creative writing in mathematics edited by the three co-organizers of the third workshop (Marjorie Senechal, Jan Zwicky, and Chandler Davis) and published by A.K. Peters Ltd. in November, 2008. The current workshop aimed to match or exceed the success of these past achievements.

## 3. Workshop Presentations

Each participant in this workshop made a presentation to be critiqued by all the others. The atmosphere was collegial. Each participant received constructive feedback about his/her work and learned from the other critiques as well. These brainstorming sessions matched the spirit of any mathematics workshop held at BIRS.

Madhur Anand, a published poet, presented 10 poems from her first book-length poetry manuscript-in-progress. These poems contain scientific ideas and concepts to varying degrees and in differing manifestations. Ecological objects and systems are used for imagery and to describe narratives that transcend traditional scientific boundaries, in which humans are objective observers of nature to socio-ecological systems, while human stories can find metaphor in ecological histories and be informed by them. In several poems the poet becomes entwined in the narrative through personal experience. The method of inquiry taken in these poems is not unlike those of simulation experiments she conducts in her research in ecological modelling. Some ecological modelling has recently come to be appreciated as a form of experiment. This is particularly true of simulation in which each individual evolves in some computer-generated world according to a set of rules and assumptions as well as parameters that can be manipulated beyond values observed in real data. The poet finds that simulation modelling can lead to realities not originally imagined by the modeler, just as a poem can lead to realities not originally imagined by the poet.

Steve Batterson, known best for his biography of Steven Smale, presented a chapter from a book he is working on about the changes in American mathematics from 1890 to 1913. At the beginning of this period, pure mathematical research barely existed on campuses in the United States; to obtain graduate level training in the subject, American students typically went to Germany. Over the last decade of the nineteenth century, several of these young scholars obtained positions in United States universities. Despite heavy teaching loads, they managed to transplant the European mathematical ethos to their own country, turning out high level research and creating solid graduate programs. By 1913 mathematical research in the United States was self-sustaining and worthy of international respect. Batterson's book focuses on these intellectual pioneers and the cultural and institutional barriers they overcame.

John Bohannon, who is a frequent contributor to *Science*, presented several short movies he has worked on with the actor and film director Isabela Rosellini. Mostly interested in writing scripts, he sought the workshop's advice on several mathematical and science ideas he is considering.

Wendy Brandts's fiction involves science in two ways. She uses characters who are mathematicians and scientists, and also uses ideas and metaphors from math and science to convey the thoughts and emotions of her characters. The work she presented at the workshop tries to change the general public perception, which sees mathematicians and scientists as nerdy, crazy, or sociopathic. She aims to present us as we really are: people with feelings, but who try to make a difference through their research and teaching. Her manuscript also tries to deepen the understanding of the arrow of time, with the help of a character who has researched that area.

Sarah Isabel Burges presented three poems. The first two are extended sequences based on recollections from her childhood. They focus on her first experiences of "scientific wonder," the fascination with the natural world that led her to become a scientist, and which keeps her in science. The third poem explores her experiences of the relationship and tensions between religion and science, and offers a view of scientific practice as an expression of reverence for the natural world.

Robin Chapman has published several highly acclaimed books of poetry. She presented several poems from a manuscript-in-progress, *The*

*Eelgrass Meadow.* These poems deal with the philosophy of knowing, the science of seeing, and the evolution of the planet and its species.

Barry Cipra presented a short story written—literally—on a Möbius strip (see Figure 1). The idea was to experiment with integrating the mathematical properties of the Möbius strip into the structure of a story. The Möbius strip's endlessly looping nature and the twist that turns the surface's two sides into one suggested, to him, a story about an ongoing love/hate relationship, with no beginning, no middle, and no end, that switches points of view back and forth between the two narrators. This form is also an experiment in the kinesthetic experience of reading: "scrolling" a Mobius strip is a novel tactile sensation that surely influences the reader's reaction to what's written on it.
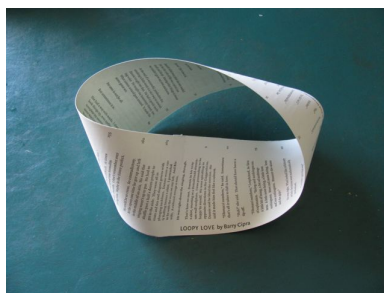


FIGURE 1. A story without beginning or ending, written on a Möbius strip

Chandler Davis, better known for his science-fiction writing, presented experiments in mathematics and music. The musical score in Figure 2, for instance, is based on a mathematical rule. Davis explained in his written piece how this and several other musical pieces work, and played the tunes for us on a piano in the lounge.

Robert Dawson presented a short story initially entitled "The Exam" (the much stronger name "Final Exam" was suggested in the workshop, and he adopted it.) A professor, bitter about the attitudes and behaviour of some of his first year calculus students, sets a more-or-less-impossible final examination (with a twist that is not revealed until the end of the story). The choice of calculus as the subject is not coincidental: outsiders see calculus as obscure and difficult; those familiar with it know its high potential for tricky questions.

Florin Diacu presented a chapter on his book-in-progress on the theory of voting, *Random Democracy.* How fair is our voting system?

FIGURE 2. The musical score of a pentacle piece composed with the help of some mathematical rules

Are we electing the leaders the majority wants? *Random Democracy* presents examples from everyday life, ranging from sports to politics, and shows how election procedures influence the course of history. An exploration of voting systems used worldwide, *Random Democracy* concludes that all electoral models distort the voters' message. Fortunately some methods are better than others. The author makes the case for proportional representation methods (in particular the single transferable vote), which—though far from perfect—reflect peoples wishes better than other models.

The project Adam Dickinson was working on for BIRS is part of a book-length poetry manuscript about plastic and plasticity entitled *The Polymers*. Polymers are biologically ubiquitous; and plastic, as a cultural and industrial commodity, is similarly omnipresent. This marks a curious contradictory tension: plastic is at once banal and futuristic, colloquial and scientific, a polluting substance that is also intimately associated with our lives—including our thoughts, given that the brain's polymer structure makes possible conceptual "plasticity." The origins of plastic, as an industrial material, have extended and continue to extend out of attempts to mimic or substitute for materials in

the natural world. Dickinson juxtaposes distant and differing contexts of behaviour and meaning in order to underscore the chains (and repeated units) of unexpected associations that inform contemporary cultural practices and assumptions. His poems employ the discourses and techniques of polymer science as an alternate way of reading the "giant molecules" of cultural formations (memes, styles, ideologies) that might be said to characterize the global plastic of human behaviour.

Phil Holmes read and discussed two new poems ("Minding one's business" and "Gaps") that use mathematical and scientific findings and language to probe the brain and how it creates the mind, i.e., our notion of ourselves. In the latter an exact mathematical construction of a Cantor set serves as a metaphor for gaps, or absences, of memories that constitutes our sense of self. He also presented a translation of a Hungarian poem for children that plays on a single rhyme repeated with minor variations throughout, to illustrate difficulties in preserving both meaning and form in translation of poetry. More generally, he is interested in parallels and differences between the relations between form and content in science and literature.

Gizem Karaali presented an alternative genesis tale, a brief parable of how the universe got started and how its creator, the nameless goddess who is the main protagonist of the piece, got into mathematics. The story line follows her development into a mathematician, from her point of view, as she meets new challenges and learns to resolve them in satisfactory ways. She creates humans on a whim but then is irrevocably changed by her interactions with them. In particular it is her interactions with the human mathematicians that transform her most. The story follows the nameless goddess in her brief encounters with various mathematicians as they tackle issues of mathematical concern, and see her eventually become more and more enthralled with mathematics itself.

Joseph Mazur's manuscript was an exercise in mixing genres. He usually writes nonfiction. In this piece, however, he crosses the boundaries, blending narrative mathematics with fiction. Poincaré returns to Paris after a 99-year absence, marveling at the changed way of life, and explaining, to his fellow denizens of the Academie the recent solution of his conjecture. In this story Mazur explores good and bad aspects of change and progress in human thought and seeks bridges between distant generations.

Siobhan Roberts read an excerpt from the first chapter of her forthcoming biography of the Princeton University mathematician John Horton Conway. The working title is *Making a Game of Life*, and the book will be published by Walker & Company/Bloomsbury USA circa 2012. In the introductory chapter she seeks to draw the reader into the story and establish the style and pace of her narrative. The chapter revolves around Conway's Free Will Theorem, a motley combination of geometry, physics and philosophy. This theorem serves as a leitmotif throughout the biography.

Mari-Lou Rowley's work as a poet has been inspired by science and the researchers she has interviewed in her science writing career. As the most abstract of all sciences, she finds mathematics the ultimate challenge to write about, both journalistically and creatively. Her current manuscript, *NumenRology*, is based on mathematics and mathematicians; at the workshop, she sought advice from experts. The result, as she claims, "was a true interdisciplinary confluence—the poetry of science and the science of poetry."

Marjorie Senechal presented a 7-page account from the scientific biography she is writing about Dorothy Wrinch (1894–1976), a controversial mathematician/philosopher/protein-chemist/crystallographer. A student of Bertrand Russell, Wrinch was the first woman to receive a D.Sc. from Oxford. (Fittingly, Senechal's book will be published by Oxford University Press.) Wrinch's geometrical model for protein structure (the first ever) catalyzed research in the 1930s on both sides of the Atlantic. But "mathematical biology" had yet to be coined, and she herself was pushed out of the field. The controversy is still discussed by chemists today with much heat but little light. (True, she was her own worst enemy, but so were they all.) To shed real light on this story, Senechal walks in Wrinch's footsteps as well as her own. The 40 papers in applied mathematics and scientific method Wrinch wrote before turning to proteins show where she was coming from. Senechal's presentation dealt with Wrinch's fascination with repeating patterns, and the thread of the story was structured as a repeating pattern.

Vladimir Tasic presented an excerpt from a book he is writing about the French philosopher Alain Badiou. Many consider Badiou to be the greatest living philosopher in France; others think he spouts nonsense. All agree, however, that mathematics plays a central role in his work.

He relies on nontrivial results of mathematical logic and category theory; his understanding of sophisticated mathematics and his emphasis on what he calls "mathematical truth-procedures" make him a rarity in contemporary philosophy. At the same time, his system places equal importance on art, especially poetry, and he is rebuilding the common ground that has been damaged by the so-called science wars. Thus, writing a book about him is a multidisciplinary project, which poses the usual problem of boundaries between disciplines.

As a theatre practitioner who plays with mathematical and scientific principles as metaphors in her drama work and teaching, Dragana Varagic presented a play in progress about Mileva Einstein, Albert Eistein's first wife and the mother of his two sons. The play includes ideas from Solomon Marcus's book "Poetica Matematica," originally published in Romanian, the translation of Albrecht Folsing's "Albert Einstein," some material on neurolinguistics, and an ecological model for simple interactions between populations. Varagic keeps a Greek tragedy structure for her piece, but breaks Aristotelian time-space principles, and plays freely with the theatrical notions of time and space.

## 4. Breaking Barriers

One highlight of the workshop was a public reading and panel discussion, on the evening of May 5, 2010 at the TransCanada PipeLines Pavilion, called *Breaking Barriers: Writers, Scientists, and Mathematicians in Conversation.* The auditorium was packed, and an internal TV system was needed to accommodate the overflow.

The event, a collaboration between our workshop and the Literary Arts Programme (LAP) at the Banff Centre, consisted of two parts: (1) readings by Don McKay (LAP), Siobhan Roberts, and Adam Dickinson and (2) a panel discussion among Joseph Mazur, Don Mckay (LAP), Philip Holmes, Stephanie Bolster (LAP), and Elena Johnson (LAP). Steven Ross Smith, the director of the Literary Arts Programme, posed general questions and moderated the discussion:

- where do science and literature meet and what are we trying to break?
- are the barriers real?
- do the different languages of mathematics and literature create barriers or provide opportunity?

• is the resultant collaboration or cross-disciplinary thinking creating something else?

At the end, the panel took questions from the floor.

To our pleasant surprise, no one on the panel or in the audience believed there are any barriers at all. Instead, the questions and answers explored the wide and deep relations between C.P. Snow's supposed "two cultures" and encouraged participants in our workshop and the Banff Literary Arts program to keep up their good work.

The success of this event prompted the group of writers-in-residence at the Banff Centre to invite all BIRS participants to an impromptu reading in their lounge on the next evening. About 20 people from both groups read 5-minute excerpts from their published pieces or work-in-progress. Lively group discussions followed the readings.

## 5. Conclusions

When the first BIRS creative writing workshop was held, in 2003, writing (plays, poems, fiction, nonfiction) about mathematics was rare. Today, just seven years and four workshops later, mathematics is becoming a popular theme in literature and on the stage. By encouraging mathematicians in their creative writing, and professional writers to adopt mathematical themes, BIRS is playing a catalytic role to influence this growth. The location of BIRS at the Banff Centre also allows a rich exchange of ideas between professional writers-in-residence and BIRS participants in the creative writing workshops.

The 4th BIRS workshop of *Creative Writing in Mathematics and Science* not only succeeded to achieve its goals, but also exceeded the expectations. We believe there is enough material sprouting from this event to plan a new anthology of mathematical writing. One publisher has contacted us already.

We would like to use this opportunity to thank BIRS for the excellent working conditions provided before and during the meeting, for its continuous support, of which we hope to further benefit in the future towards making mathematics understood and appreciated by the general public.

Marjorie Senechal and Florin Diacu