The Society for Mathematical Biology

SMB Newsletter

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A Big Year for Mathematical Oncology

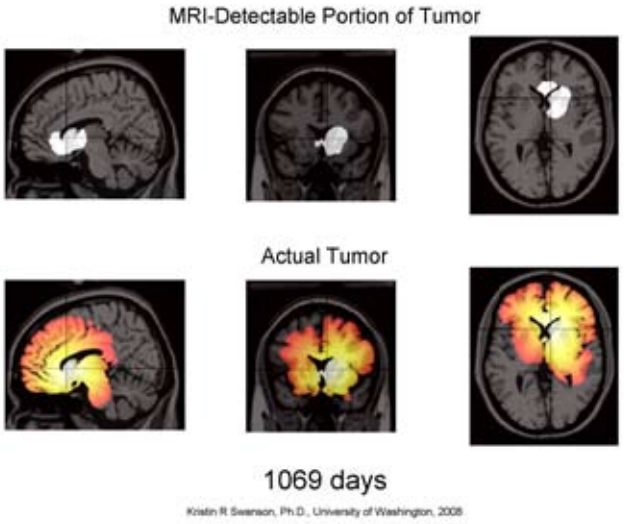
Kristin R. Swanson, Alexander R. A. Anderson & Trachette Jackson

Although the field of Mathematical Oncology is still in its infancy, this area of mathematical biology seems to be coming into its own, if 2008 is any indication.

Funding Agencies Invest: NIH/NCI and NSF continued to offer integrative funding opportunities bridging oncology and mathematical modeling: ICBP Collaborative Research Funding Opportunity (U01) (grants.nih.gov/grants/guide/pa-files/PAR-09-026.html), Predictive Multiscale Models of the Physiome in Health and Disease (R01) (grants.nih.gov/grants/guide/pa-files/PAR-08-023.html), Interagency Opportunities in Multi-Scale Modeling in Biomedical, Biological, and Behavioral Systems (www.nsf.gov/pubs/2004/nsf04607/nsf04607.htm), Short Courses on Mathematical, Statistical, and Computational Tools for Studying Biological Systems (R25) (grants.nih.gov/grants/guide/pa-files/PA-09-002.html), and Mentored Quantitative Research Career Development Award (K25) (grants.nih.gov/grants/guide/pa-files/PA-06-087.html).

Journals Take Action: A new Mathematical Oncology emphasis area appeared in the important biomedical journal, Cancer Research, which included the addition of Dr. Trachette Jackson as a Senior Editor as well as Mathematical Oncology-oriented Associate Editors (cancerres.aacrjournals.org/).

Inside this Issue:



Cancer Centers Commit: A first of its kind, the Integrated Mathematical Oncology (IMO) division was formed at the Moffitt Cancer Center in Tampa, Florida, co-directed by Drs. Bob Gatenby and Sandy Anderson. They bring together a truly interdisciplinary team of scientists including mathematicians, computer, clinical, imaging and biological scientists (www.moffitt.org/IMO/).

Media Takes Notice: Mainstream media has caught the buzz and took note of some of the recent important advances in Mathematical Oncology including, amongst many others, Dr. Kristin Swanson's work on the relevance and application of mathematical oncology in the clinic: Forbes Magazine – October 27, 2008 issue, "Can Math Cure Cancer?" by Robert Langreth (www.forbes.com/forbes/2008/1027/074.html); NBC KING 5 Healthlinks Special – December 2008, "Researcher outsmarts brain tumors with math" by Jean Enerson (www.king5.com/health/stories/NW_122408HEB_brain_tumors_KS.223c0bb.html); Lifeweek News Magazine (China) – December 2008, "Can Mathematics Treat Cancer" by Chen Sai (www.lifeweek.com.cn/2008-12-08/0002423302.shtml, Translation: www.pathology.washington.edu/research/labs/swanson/text/Lifeweek.pdf). Links to these and other recent news can be found here: www.pathology.washington.edu/research/labs/swanson.

Dear SMB Members:

As we approach the final days of 2008, I would like to summarize some of the activities of our Society. Many of you participated in the very successful annual SMB conference held in Toronto last summer. Some of you also took part in the Edinburgh meeting of ESMTB which preceded our Toronto conference, and in the SIAM Life Science conference in Montreal which followed our conference.

The SMB has strong ties with ESMTB; we held a joint conference several year ago in Dresden, and we are planning for another joint annual conference with ESMTB in Krakow, Poland, in the summer of 2010. We also have continuous ties with the Japanese SMB; every two years we jointly award the Okubo Prize. The JSMB will join us in our next annual meeting in Vancouver held July 27-30, 2009.

Plans to hold an international conference of SMB and the Chinese SMB in China are underway. The conference will be held in Hangzhou during June 14-17, 2009 with 15 plenary speakers; for details and applications see http://ibi.zju.edu.cn/biomath/.

There are growing activities in mathematical biology in Africa. Last January, at a conference held in Marrakesh, the African participants announced the formation of the African Society of Biomathematics (ASB). Aziz Yakubu, the Chair of the SMB World Outreach Committee, and I will be going next month to Cape Town for a short initial meeting sponsored by ASB. The first annual meeting of ASB will be held during the period of September-October 2009. In another development in mathematical biology, the NSF has recently funded a DIMACS-MBI proposal to hold 5 workshops in Africa during the next three years. Additionally, each year four students from Africa will be chosen to spend 12 months at these institutes; two at DIMACS and two at the MBI.

I frequently meet mathematicians who are interested in working in mathematical problems that arise in biology. Unfortunately, they often cannot make the time investment necessary to learn and understand how these problems arise and what the challenges and limitations are in modeling the underlying biological processes. There is a great need to develop mathematical biology curricula for a new generation of students. I know of a number of universities that developed good programs, and I am looking forward to hearing about such programs at the next annual conference.

The SMB is continuing to support conferences directly, as well as members who wish to participate in conferences. The Society journal, BMB, is coming along very well due to the hard work and dedication of its editor, Philip Maini, and Springer Verlag. Last summer the SMB Board initiated the Art Winfree Prize; it will be awarded for the first time during the annual conference in July in Vancouver.

If you have any suggestions for new or improved activities of the Society, please write to me or to one of the officers of the Society.

Finally, I wish you all a happy new year and a productive 2009.

Sincerely,

Avner Friedman

SMB President

8th International BIOMAT Symposium

Ray Mejía

The Eighth International BIOMAT Symposium on Mathematical and Computational Biology was held under the auspices of the BIOMAT Consortium and the BIOMAT Institute for Advanced Studies of Biosystems (http://www.biomat.org) on November 22 - 27 in Campos do Jordão, Sao Paulo, Brazil. The organizers (Eduardo Massad, Chair of the Local Organizing Committee and Luis F. Lopez, University of Sao Paulo; João F.C.A. Meyer and Hyun Mo Yang, State University of Campinas; and Rubem Mondaini, BIOMAT President and Program Chair, Federal University of Rio de Janeiro) arranged a comprehensive program of tutorials, talks and posters at an excellent venue. The location was cool and tropical, at 1700 km altitude. With attendees housed together, there was continual interaction.

Tutorials were held on Nov. 22 and 23 for about thirty five students on four topics: Mathematical Modelling of the Interaction of the Immune System with Viruses; Mathematical Ecology - Environmental Impact; Mathematical Modelling of Protein Structure and Amide Planes; and Population Dynamics of Infectious Diseases. These were conducted by Luis F. Lopez (University of S. Paulo), João F.C.A. Meyer (State University of Campinas), Rubem P. Mondaini (Federal University of Rio de Janeiro), and Eduardo Massad (University of S. Paulo) respectively.

A Tropical Paradise with a Swiss flavor

Invited speakers huddle during a reception

On Nov. 24 through 27 there were 10 invited lectures, 26 contributed talks and over 20 poster presentations. The invited talks were by: Nicholas Britton, Evolution in a Host-Parasite System; Frank Hilker, Epidemiological Models with Demographic Allee Effect; Vitaly Volpert, Reaction-Diffusion Waves; Alain Goriely, A Continuous Approach to the Geometry and Mechanics of Proteins with Application to Helical Repeats and Coiled-coils; José F. Fontanari, A Population Dynamics Approach to Language Evolution; Richard Kerner, Internal Symmetry Classes of Icosahedral Viral Capsids; Vittoria Colizza, Network Structure and Epidemic Waves in Metapopulation Model; John Jungck, Genetic Codes as Codes: Towards a Theoretical Basis for Bioinformatics; Raymond Mejía, Mathematical Biology: Some Opportunities in Integrative Biology; Eduardo González-Olivares, Allee Effect in Gause Type Predator-Prey Models: Existence of Multiple Attractors, Limit Cycles and Separatrix Curves.

The complete program, available at http://www.biomat.org/biomat8/program2008.html, shows a broad spectrum of topics in mathematical and computational biology with the relationship between aspects of fitness and population size (the “Allee effect”) a leading topic.

Gaborone Summer School 2008

Abba Gumel (University of Manitoba) and
Edward Lungu (University of Botswana)

The Canada-Africa Biomathematics Network, formed in November 2007 by MITACS (Mathematics of Information and Complex Systems, one of Canada's Networks of Centres of Excellence) in Kampala, Uganda, to foster greater collaboration between mathematical and public health scientists from Canada and their colleagues in Africa in areas pertaining to the use of mathematical sciences to combat the spread of emerging and re-emerging diseases, organized its first summer school at the University of Botswana in Gaborone, Botswana, August 18-29, 2008.

The Summer School was attended by about 30 students from Canada and various African countries notably, Botswana, South Africa and Zimbabwe. Although the vast majority of the participants are graduate students, a few senior undergraduate students also attended the school. The scientific program consisted of lectures followed by tutorials on the design and analysis of models for the spread of emerging and re-emerging diseases of public health importance, research seminars (demonstrating how the techniques used during lectures can be applied to address public health issues, particularly those relevant to Africa and Canada) and group projects. The group projects were carefully designed to ensure that they reinforce and extend the various concepts covered during the course of the Summer School. The first week of the school was focused on providing the participants with basic introduction to mathematical modelling of disease transmission as well as some basic mathematical theories and methodologies used to analyze the resulting models. Some of the main topics covered include: basic overview of nonlinear dynamical systems, discussion of the epidemiology and immunology of some key diseases (particularly HIV/AIDS, malaria, mycobacterium tuberculosis, etc.), classical disease transmission models of Kermack-McKendrick type (SIR, SIS, SEIR), existence and local stability of equilibrium solutions and the role of evolution in disease transmission modelling.

The material covered during the first week was intended to provide the participants (particularly those new to the field) with the necessary preparatory background needed for the more advanced material slated for the second week. The material covered in the second week include: an in-depth discussion on meta-population models, immunology of HIV/AIDS and TB, modelling stochastic processes, branching processes, advanced models for disease transmission, evolutionary aspects of vaccine use, and techniques for proving global asymptotic stability of equilibrium solutions. For the project work, the students were divided into five sub-groups, to work on their chosen research projects. These sub-groups met in the afternoons in the computer laboratory, based in the Department of Mathematics. The students were given almost two weeks to work on their projects. Members of each sub-group presented their results at the end of the summer school. Participants were expected to continue working on their research project when they return to their home institution, under the supervision of a mentor. The main instructors for the summer school were Professors Troy Day (Queen's University, Canada), Abba Gumel (University of Manitoba, Canada) and Edward Lungu (University of Botswana). The following Teaching Assistants helped to conduct tutorials: Drs. Farai Nyabadza (SACEMA: Southern Africa Centre for Epidemiological Modelling and Analysis) and Mtoholdi Kgosimore (Botswana College of Agriculture). The participants visited the magnificent Mokolodi Nature Reserve during the second week of the School.

Not only did the summer school provide opportunities for interaction between students and researchers from Canada and Africa, it also provided an opportunity to review the activities of the Network since the Kampala meeting and to plan for future activities.

Although the Gaborone summer school was quite a success, future activities will inevitably depend on funding. For the Gaborone summer school, the Canadian participants were all funded by MITACS of Canada, the Zimbabwean participants (including one tutor from South Africa) were funded by a grant from the World Outreach Committee of the Society of Mathematical Biology (SMB), five South African participants were funded by SACEMA, while four other South African participants were funded by the Nelson Mandela Metropolitan University.

The school introduced the students to basics since some of the participants were new to the field of mathematical biology. It was, therefore, quite gratifying to see how enthusiastic these students (and all the participants) were and also to see how quickly these students were learning, to the extent that some of them were able to formulate their models and embark on some model analysis with confidence. The participants have been encouraged to continue working on their projects and to remain in touch by email and hopefully publish their work.

The organizers are very grateful to MITACS Canada, SACEMA, SMB and the University of Botswana for their generosity.

Further details about the Gaborone Summer School are available at the website: http://home.cc.umanitoba.ca/~gumelab/Botswana.

Symposium on BEER-2008 participants

Illinois State University Hosts Biomathematics Symposium

Olcay Akman

About forty mathematicians and biologists participated in a symposium held on the Illinois State University campus September 6-7. The symposium, on Biomathematics and Ecology Education and Research, focused on bringing biologists and mathematicians together with students and faculty in a stimulating environment. In addition to contributed talks, plenary talks were given by William Mitchell of Indiana State University, Jeffrey Lucas of Purdue University, Martin Bohner of Missouri University of Science and Technology, and Unal Ufuktepe of Izmir University of Economy. The organizers included Drs. Olcay Akman of Mathematics Department, Steven Juliano of the Biological Sciences Department, and Tim Comar of Benedictine University. Tim Comar has also held a workshop focusing on biomathematics education, in which participants explored sample computer laboratory programs using Excel and Maple. The symposium was sponsored by the Departments of Mathematics, Biological Sciences, College of Science, and the Office of Research and Sponsored Programs. The symposium has also benefited from a travel grant from the SMB to help defray travel costs of some participants.

Those who made BEER-2008 possible: From left Emily Walker (student helper), Olcay Akman, Steven Juliano, Tim Comar (organizers), with (not pictured) Adam Pettinger and Debra Witczak

Springer Press Release
Heidelberg / Toronto, 10 October 2008

New awards established by Springer in association with the Society for Mathematical Biology

First Lee Segel Prizes awarded at the annual Society for Mathematical Biology Conference in Toronto

To honor the enormous contribution that the applied mathematician Lee Segel made to the Springer journal Bulletin of Mathematical Biology (BMB) and the field of mathematical biology as a whole, Springer, in partnership with the Society of Mathematical Biology (SMB), is funding a series of prizes based on papers published in the BMB. This year's prize for the best original research paper has been awarded to Tomas de-Camino-Beck and Mark Lewis for their paper, "A new method for calculating net reproductive rate from graph reduction with applications to the control of invasive species"[1]. The prize for the best student research paper went to Emma Jin and Christian Reidys for their paper, "Asymptotic enumeration of RNA structures with pseudoknots"[2]. The awards were presented at the annual conference of the SMB, which took place in Toronto, Canada, from 30 July to 2 August 2008. The winner of the prize for the best review paper will be announced at the 2009 SMB conference.

In their winning paper, Tomas de-Camino-Beck, currently a postdoctoral fellow at the Pennsylvania State University, USA, and Mark Lewis, Senior Canada Research Chair in Mathematical Biology at the University of Alberta in Edmonton, Canada, present a newly discovered, simple method to calculate the net reproductive rate of a population using life cycle graphs.

The best student research paper, submitted by Christian Reidys, Professor for Mathematics at Nankai University in Tianjin, China, and Emma Jin, a PhD student of mathematics also at Nankai University, covers a novel approach for categorizing RNA (ribonucleic acid) pseudoknot structures in terms of the maximal number of mutually intersecting base pairings. It also develops a general framework for their exact and asymptotic enumeration.

"We are delighted to sponsor the Lee Segel Prizes in cooperation with the Society for Mathematical Biology," said P.K. Maini, Editor-in-Chief of the BMB. "This prize honors outstanding contributions to the field of mathematical biology and will help to promote and advance important research findings in this promising scientific area."

The BMB is the official journal of the Society for Mathematical Biology. It is devoted to research at the junction of computational, theoretical and experimental biology. The articles published in the journal offer a combination of theory and experiment, documenting theoretical advances with clear exposition of how they further biological understanding. The journal aims to be of major interest to theorists as well as to experimental biologists.

The Lee Segel Prizes were established this year by the Bulletin of Mathematical Biology in association with the Society for Mathematical Biology. A $5,000 prize for the best original research paper and a $3,000 prize for the best student research paper are awarded every second year; a $4,000 prize for the best review paper is given every third year. A committee appointed by the SMB Board of Directors and the Editor-in-Chief of the BMB judges and gives out the prizes, taking on board advice of referees and referee reports. For this year's awards, all articles accepted from January 2006 were considered.

1. de-Camino-Beck, T. and Lewis, M.A.: A new method for calculating net reproductive rate from graph reduction with applications to the control of invasive species. BMB, 2008, Issue Volume 69, Number 4 / May, 2007, DOI 10.1007/s11538-006-9162-0, Pages 1341-1354.

2. Jin, E.Y. and Reidys, C.M.: Asymptotic enumeration of RNA structures with pseudoknots. BMB, 2006, Issue Volume 70, Number 4 / May, 2008, DOI 10.1007/s11538-007-9265-2, Pages 951-970.

ECMTB 08

Report on the European Conference on Mathematical and Theoretical Biology Edinburgh, June 29-July 4, 2008

Scott Graybill

On 29th June, I travelled to Edinburgh, Scotland to attend the European Conference on Mathematical and Theoretical Biology (ECMTB). I left Christchurch, New Zealand on a cold winter night, and after 28 hours of cramped legs, multiple airline meals and numerous movies I arrived at Heathrow to a glorious summer afternoon. After the long journey I needed some substantial food and to let off some pent-up energy.

"Right", I thought to myself, "a quick jaunt across London to my friend's place in Brighton and I'll be able to relieve these effects".

One bus, two trains, a couple of missed opportunities, and 5 hours later I arrived at my mate's place and collapsed on the couch in a travel-induced stupor. Thankfully the trip to Edinburgh the following day was an extremely comfortable and scenic 5 hour train ride (with free WI-FI!).

The ECMTB is a prestigious event bringing together over 450 of the world's best mathematical modelers and theoretical biologists. There were presentations on an extremely wide range of topics including cancer, evolution and developmental biology. This conference expertly showcased the extremely wide range of biological problems that mathematics can provide valuable insight on.

Personal highlights included the plenary talks by Frank Tobin and James Sneyd and discussions on epidemiology and biofilms. The most difficult part of the event was selecting which of the nine streams of contributed talks and mini-symposia to attend. As a young researcher I highly valued the opportunity to present my research to an international audience and the highly beneficial feedback I received.

This was my first trip to the UK and it was great to get out and about to see some of Edinburgh. Memorable experiences include the 1pm gun firing at Edinburgh Castle, the conference dinner at the S table which included some delicious haggis, and having the perfect viewing spot to see the Queen ruined by her security guard's SUV moments before she arrived.

I would like to acknowledge the Society for Mathematical Biology, the European Society for Mathematical and Theoretical Biology, the New Zealand Mathematical Society, the University of Otago Renal Research Theme and the University of Canterbury Department of Mathematics and Statistics for their generous funding that enabled me to attend this conference.

Cannons at the Edinburgh Castle

The Royal Company of Archers
(Sovereign's Bodyguard in Scotland)

My Career in Mathematical Biology
A Personal Journey

Mark Chaplain

I first became aware of Mathematical Biology in the third term of second year of my undergraduate degree in applied mathematics at Dundee University. There was a course called "M21" which was a mixture of a wide variety of topics including group theory, geometry, topology, combinatorics, classical mechanics and last, but not least, in the final term a section on "mathematical biology". It consisted of an introduction to phase plane analysis, the then hot and sexy "catastrophe theory" and the more mundane applications of ordinary differential equations to selected topics from "biology". The course was based around the book "Differential Equations and Mathematical Biology" by D.S. Jones and B.D. Sleeman, both professors at Dundee. The course was given by Prof. Brian Sleeman (cf./viz. B.D. Sleeman) who in the best possible time-honoured academic tradition had recommended his own book as the course text-book. Of all the topics covered in M21, mathematical biology was definitely the most interesting and exciting (enhanced further by the genuine interest and passion shown by Prof. Sleeman) and in my final year I was able to take an advanced course in mathematical biology which further stimulated my interest in the subject.

During my final year as an undergraduate, I set about trying to find a job in the "real world". I successfully interviewed for a post in the Meteorological Office (the "Met Office") and was offered a job as a modeller – however, since the Met Office was part of the Civil Service, the pay was shockingly low and, even worse, I would have had to work and live in Bracknell… I next thought about becoming a high-school mathematics teacher, but a few days in a local secondary school quickly changed my mind… Finally, I was offered a job as a trainee actuary, working in Edinburgh for the insurance company "Scottish Widows" (in spite of the name, being Scottish or a widow or both was not a necessary condition of employment) and started there in August 1986.

Unfortunately, the job did not turn out to be what I was expecting. In fact it turned out to be mind-numbingly boring and during the Christmas holiday, I paid a visit back to Dundee and spoke with Prof. Brian Sleeman to find out if there were any PhD opportunities. Of course, Brian had a number of potential topics for research ("Inverse scattering from eminently forgettable shapes", "Integrable, non-integrable and somewhere-in-between Hamiltonian Systems" to name a few), but the one title that caught my eye was "Mathematical Modelling of Solid Tumour Growth". So I started my PhD in September 1997 under Brian's inspirational supervision and modelling cancer growth has been a major focus of my research ever since.

After completing my PhD in May 1990, I took up a lectureship in the School of Mathematical Sciences at the University of Bath. After spending six years there, I returned to Dundee in September 1996 to take up a Senior Lectureship, attracted back by the excellence of the biomedical research in Dundee and the possibility to continue my cancer modelling research with experimentalists and clinicians. I currently hold a personal chair in mathematical biology and my main research interests are in modelling cancer growth and treatment, and theoretical ecology. Recently I have been very fortunate to be awarded a European Research Council Advanced Investigator Grant on the topic of multiscale modelling of cancer and this will

enable me to devote most of my research over the next 5 years to this area.

Over the years it has been a privilege to serve on the Boards of both the European Society for Mathematical and Theoretical Biology (ESMTB) and the Society for Mathematical Biology (SMB), and act as ESMTB Secretary and Treasurer and serve as SMB President. During this time, I have benefitted greatly from the advice and wisdom of Vincenzo Capasso, Wolfgang Alt, Lou Gross and Avner Friedman. Over the last 8 years, I have also been involved in two EU "Research Training Networks" concerned with cancer modelling and I am indebted to Nicola Bellomo and Luigi Preziosi for their collaborations and advice.

What do I like about my job? I enjoy "mathematical biology research". I very much enjoy finding out new things about biomedical systems and the thrill of developing a new model and gradually understanding the dynamics and solution behaviour. Trying to make predictive mathematical models that generate experimentally-testable hypotheses is a real challenge, but very rewarding when it happens. I also enjoy lecturing and trying to convey the beauty of mathematics to both undergraduate and postgraduate students. Travelling and attending conferences is also a real fun part of the job. Of course, as well as attending conferences, workshops and summer schools, over the years here in Dundee it has been a lot of fun and hard work to organize them too… D'Arcy Thompson 1998, SMB2003, ECMTB08… I also like Google, The Web-of-Science and the H-index.

What don't I like about my job? Internal university politics, needless bureaucracy, university administrators who don't realise that it is the academics who pay their salaries, perpetual and unnecessary assessment.

What about the future? I think the future for mathematical biology is really exciting and this is a great time to be involved in the subject. More and more biologists and clinicians are seeing the value of using and applying mathematics (and I use this term in its broadest sense to encompass statistics, pure mathematics, applied mathematics, computational mathematics, computer science, bioinformatics…) to study biomedical problems. In my personal experience, it has become apparent over the last 5 years, that biomedical scientists really think about involving mathematicians in their work right from the outset, and that "card-carrying mathbiologists" are now finding jobs in experimental labs and making an impact there. From a personal point of view, it is very rewarding and pleasing to see former post-docs and PhD students take their own careers to greater heights in medical and clinical settings (Dr. Sandy Anderson at The Moffit Cancer Research Institute and Dr. Heiko Enderling at Tufts University School of Medicine).

Overall, I think that being a university academic is a great privilege – and I would have said this anyway, even had Philip Maini not said it first in his "Personal Journey"!!! I have personally benefitted from and learned a lot from working with people who are a lot smarter than me. The one thing that has remained right from the first day of my PhD is that mathematical biology is exciting, challenging, stimulating and lots of fun. I am sure it will continue to be so, in which case I am happy to stay on the ride.

Selected Publications of Mark Chaplain:

M.A.J. Chaplain and B.D. Sleeman, "Modelling the growth of solid tumours and incorporating a method for their classification using nonlinear elasticity theory" (1993) J. Math. Biol. 31, 431-479.

M.A.J. Chaplain and A.M. Stuart "A model mechanism for the chemotactic response of endothelial cells to tumour angiogenesis factor" (1993) IMA J. Math. Appl. Med. Biol. 10, 149-168.

M.A.J. Chaplain "Avascular growth, angiogenesis and vascular growth in solid tumours: The mathematical modelling of the stages of tumour development" (1996) Math. Comp. Modell. 23(6), 47-87.

A.R.A. Anderson, M.A.J. Chaplain "Continuous and discrete mathematical models of tumour-induced angiogenesis" (1998) Bull. Math. Biol. 60, 857-899.

J.A. Sherratt, M.A.J. Chaplain (2001) "A new mathematical model for avascular tumour growth" J. Math. Biol. 43, 291-312.

Chaplain, M.A.J., Lolas, G. (2005) "Mathematical modelling of cancer cell invasion of tissue: The role of the urokinase plasminogen activation system" Math. Modell. Methods. Appl. Sci. 15, 1685-1734

Chaplain, M.A.J., McDougall, S.R., Anderson, A.R.A. (2006) "Mathematical modelling of tumor-induced angiogenesis" Annu. Rev. Biomed. Eng. 8, 233-257

Gerisch, A., Chaplain, M.A.J. (2008) "Mathematical modelling of cancer cell invasion of tissue: Local and non-local models and the effect of adhesion" J. Theor. Biol. 250, 684-704

Starting Careers in Mathematical Biology
A Young Researcher's Journey

Rebecca Tyson

I like to say that "I became a mathematician and research professor by accident". In fact, when I graduated from high school, what I wanted to study was biology. But my father made some denigrating comment about biology being a soft science, and so, to please my father and myself I ended up double majoring in Physics and Physiology at McGill. I enjoyed the degree, and was fortunate to work for several years under Mike Mackey, who has probably been my most important mentor throughout my career.

My undergraduate degree turned out to be about equal parts math, physics and physiology. By the end of my four years I had decided that I really didn't like the physics part all that much. This was probably largely due to the fact that most of my friends were honours physics students who wanted to talk physics all the time. I was nowhere near as interested in the subject, and so decided that I probably wasn't cut out to be a physicist. That left mathematics and biology, so I studied Mathematical Biology with Jim Murray at the University of Washington in Seattle. By the time I was more than halfway through my PhD, I realized that I was well on my way to becoming an applied mathematician with no biology training to speak of. I tried to remedy the situation and get a minor in botany, but Jim felt it important that his students concentrate on one degree and finish it quickly. So, in 1996 I graduated with a PhD in Applied Mathematics, thereby becoming a mathematician by accident.

Then followed a bewildering time. Once I obtained my PhD, I realized that I had never thought beyond that milestone, and I really had no idea what I wanted to do next. I applied for and obtained an NSERC PDF as it seemed the next logical step, but I didn't have any real goals. I remember talking with Gerda de Vries some time during those years, and being very impressed that she had had the self-confidence to apply for a tenure-track position, and even obtain one! That was amazing to me. To complicate matters, my postdoc was in the same city as my fiance, but I ended up cancelling our wedding because I had fallen in love with someone else back in Seattle.

I then essentially stepped out of research for the next 6 years, though I had to keep working because my new sweetheart wasn't earning much as a graduate student and then later as a postdoc. I honestly think that if my partner had been someone with a bigger income, I would most likely have become a homemaker and stay-at-home mother. I will never know what it would have been like to stay home with my children though, as finances kept me working. I continued to think I wasn't clever enough to be an academic, but my earning power was greatest in academic settings. So I held instructional positions for three years (teaching math to football players!), Then a visiting faculty position in Arizona for a year where my husband (I married my new sweetheart in 1998) had a postdoc. During that time our two children were born - at the same time!

In 2001 my husband obtained a tenure-track position at a small university college called Okanagan University College (OUC) in south central British Columbia. OUC had a strong teaching focus, and only some of the faculty there engaged in active research. I applied for and was offered a part-time faculty position in the math department there. I was

delighted: I would be able to earn some income but be home with the children part-time. By the time we arrived in Kelowna however, the new tenure-track hire in mathematics had fallen through and I was needed full time. I didn't think it would be a good idea to turn down full-time work at that point, so I accepted a temporary 2-year appointment. I quickly learned that under OUC union rules, no one could work in a temporary capacity at OUC for more than two years. I also quickly realized that we needed both my income and my husband's in order to pay the bills. So I needed a full-time tenure-track position at OUC. My department was, and still is, a pure math department, and so the chances of my getting a tenure-track position were slim. Fortunately for me, the University Faculty Award (UFA) program from NSERC program was still in existence, and I managed to win a Discovery Grant and a UFA.

So in 2003 I held a tenure-track position at OUC: a small university college with a focus on teaching. Then, fate took over again, and UBC made a successful bid to take over my campus of OUC (the remaining campuses became a college). Faculty already at OUC had to be given positions at UBC, according to British Columbia labour laws. Thus, in 2005 I found myself tenure-track at a big research institution: a research professor by accident!

By then I had a family, a mortgage, and my husband and I had solved the two body problem in a beautiful part of the world. So I screwed up my courage and kept doing my best, now under UBC tenure-track rules. I haven't achieved tenure yet - one of the costs of my circuitous route to that goal - but it turns out that I can write papers on my own, that I can come up with research ideas on my own, and that I can teach graduate students. Furthermore, I have received a great deal of support from the mathematical biology community, for which I am very grateful, and was even elected to serve on the SMB board. I have indeed been fortunate in all of the mentors I have had. In addition to Dr. Mike Mackey, I wholeheartedly thank Dr. Leah Keshet, Dr. Mark Lewis, Dr. Gerda de Vries, Dr. Thomas Hillen and Dr. Pauline van den Driessche in particular. When I first started working at OUC, I phoned up all of these people to tell them that I was back in Canada. Each one of them welcomed me and then invited me to conferences and helped me write my first research grants. Their support was invaluable. Prof. Jim Murray was also very helpful, extremely prompt in producing reference letters, which were always glowing, and full of confidence in my ability to succeed. So after assiduously avoiding professorship for so many years, I am now fairly confident that I will obtain tenure at UBC some time in the next three years.

My story I think is really one about self-confidence. My own self-confidence was never strong enough to put me in a career as a research professor, and it was finances and quirks of fate that kept pushing me. I don't know why my self-confidence was so low: I had straight A's in all of my courses, lots of scholarships and research awards, and supportive faculty who believed in me. I was convinced however, that I wasn't really as smart as everyone thought I was and that someday someone would discover that I was a fake. Apparently however, many people feel this way, in spite of all sorts of evidence to the contrary. While I was a student at McGill University, the Physics department was in the habit of every year inviting a Nobel prizewinner in physics to come and give public and specialised lectures, and also to meet with the undergraduate and graduate students in the Physics department. I will never forget sitting in the back of a very crowded room, full of eager students asking all sorts of physics questions, when the conversation turned towards employment. The speaker, a Nobel prizewinner mind you, admitted that when he had been a graduate student he had been certain that someday someone would figure out that he wasn't as smart as everyone seemed to think. It gave me great comfort to know that someone as bright as a Nobel-prize winning physicist could suffer from lack of self-confidence too!

While I do occasionally envy my stay-at-home-mother friends - I think their lives are considerably less complicated than mine - I also find a great deal of fulfillment in my work, and feel very lucky to be able to do something that I enjoy so much. I also think that I am still doing a good job as a mother and wife. I am grateful to fate for the twists that made it necessary for me to hide my fear and step into the scary world of professorship. It is a fun and exciting career, and is a constant source of inspiration for me and my family!

Math Bio Education

Thoughts, trends and topics

Current Trends in Undergraduate Biomathematics Education

Timothy D. Comar

Undergraduate education in mathematical biology is flourishing. In particular, many new courses and activities are being developed at Primarily Undergraduate Institutions. To exemplify some of these recent activities, there was a minisymposium focusing on undergraduate education entitled, "Current Trends in Undergraduate Biomathematics Education," at the 2008 Annual SMB Meeting in Toronto. The minisymposium was designed to discuss the issues of the preparation of undergraduates for biomathematical research and the implementation of undergraduate research activities at different types of institutions. As many potential future researchers in mathematical and computational biology attend teaching oriented undergraduate institutions, the session included perspectives from these institutions in addition to the undergraduate activities that occur at research oriented universities. The speakers came from a variety of different types of institutions. Two came from research institutions; three came from undergraduate institutions; and one came from a community college.

Raina Robeva (Sweet Briar College) described how a Boolean network model of the lac operon easily can be incorporated into an undergraduate course. John Jungck (Beloit College) presented two new software packages that can help students and researchers visualize complex patterns in nature. These packages are 3D Fractal Tree and Ka-Me': Voronoi Image Analyzer. Mike Martin (Johnson County Community College) addressed how to attract and encourage students interested in the life sciences in the community college environment with rich learning materials. Glenn Ledder (Univ of Nebraska at Lincoln) highlighted his post-calculus I course geared for biologists focusing on the mathematics needed to study mathematical models in biology. Tim Comar (Benedictine Univ) described activities in a second semester biocalculus course that can help first year undergraduates prepare to engage in research in mathematical biology. Olcay Akman (Illinois State Univ) highlighted a student research program in which graduate and undergraduate students work together on research projects.

Highlights in Mathematical Biology

Mathematical Insights into Biological Processes

Submit your story to editor@smb.org

Therapeutic Use of Oxygen for Chronic Wounds

by Richard Schugart

Chronic wounds, like venous leg and diabetic foot ulcers (see Figure 1), are wounds that do not heal in a timely fashion, generally two-to-four weeks. Chronic wounds can cause pain and discomfort and also limit mobility. They are often a consequence of a more serious health problem, such as diabetes, heart disease, or blood circulation disorders. Left untreated, chronic wounds can lead to problems like infection, amputation, or even death. At the same time, the cost of treatment can be staggering, estimated to be $5 - 10 billion annually effecting more than one million Americans.

Wounding disrupts the vascular network at the wound site, which causes the wound microenvironment to be hypoxic. The lack of oxygen in the wound can cause the wound to become chronic. Low levels of oxygen can increase the risk of infection, limit fibroblast growth and growth-factor production, and impair angiogenesis, which in the formation of blood vessels from existing vasculature. To promote the healing response of the tissue, doctors increase the oxygen concentration in the wound by administration of hyperbaric oxygen and by application of topical oxygen gas. Yet, ways to optimize the use of hyperbaric or topical oxygen, such as levels of oxygen concentration and frequency and duration of administration, are poorly understood as clinical success of these treatments varies.

In a collaboration between MBI Postdoctoral Fellow Richard Schugart, MBI Director Avner Friedman, and Director of the Comprehensive Wound Center at The Ohio State University Medical Center Chandan Sen, they have sought to find optimal oxygen-dosing strategies to best promote dermal wound angiogenesis. Through this collaboration, a mathematical model was developed, which consists of seven partial differential equations. The model takes into account many of the established biological components that contribute to the complex nature

of wound healing, including the recruitment of inflammatory cells, chemoattractants, endothelial cells, oxygen tension, and the build up of extracellular matrix in the wound region.

Simulations from the model (see Figure 2) agree with a variety of experimentally-observed results, which include: (i) extreme hypoxia cannot sustain the growth of functional vessels; (ii) hyperoxia promotes wound angiogenesis and healing; (iii) extreme hyperoxia derails tissue repair and causes oxygen toxicity; (iv) intermittent oxygen treatment may stimulate an angiogenic response. Ongoing and future work includes further exploration for optimal treatments with oxygen and expansion of the list of factors as the biological complexities continue to be experimentally unveiled.

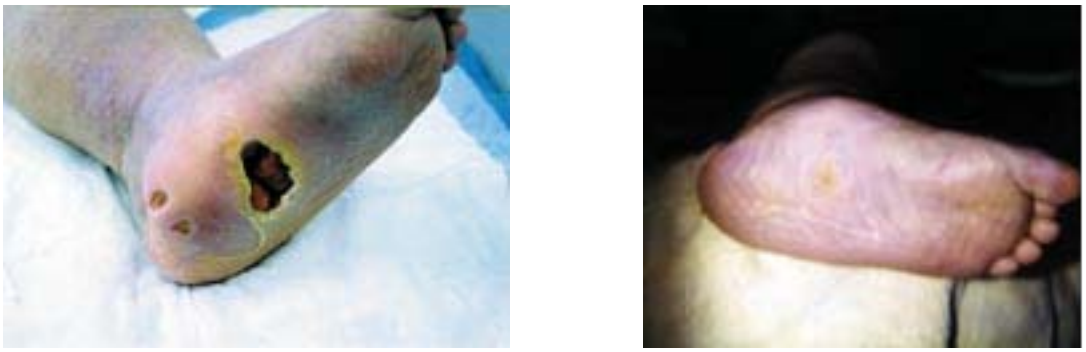


Figure 1: A diabetic foot ulcer before (left) and after (right) treatment.

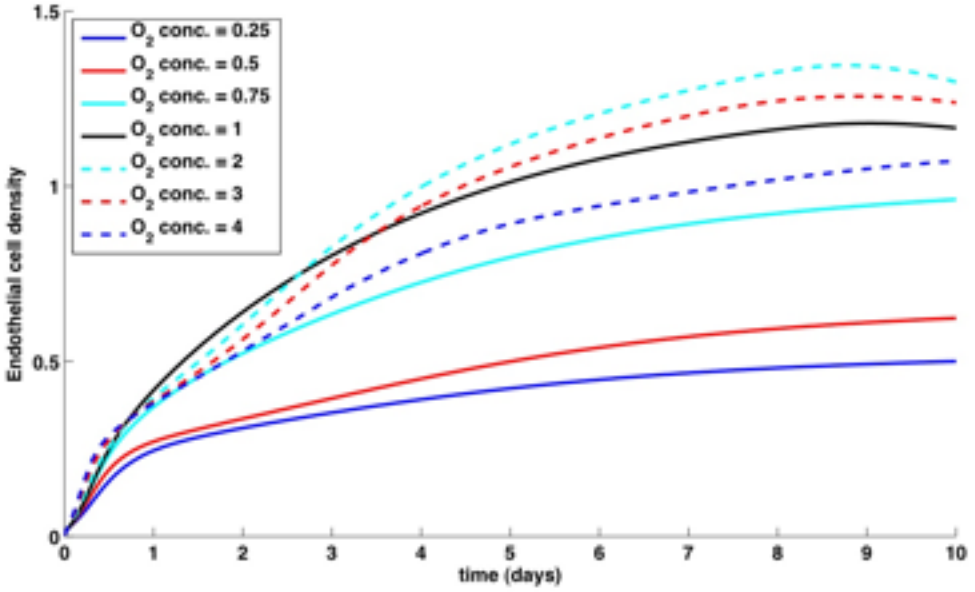


Figure 2: Endothelial cell density for different normalized oxygen concentrations through use of a hyperbaric oxygen chamber. Oxygen concentrations less than one are hypoxic, while oxygen concentrations greater than one are hyperoxic. The figure shows that the average endothelial cell density increases with oxygen level from hypoxic concentrations above 0.5 to hyperoxic concentrations below 2. When the hypoxic level is below 0.5, the wound is sufficiently hypoxic and vessel growth does not occur. When the hyperoxic level is above 2, the wound becomes extremely hyperoxic and derails tissue repair. (From Schugart, R.C., Friedman, A., Zhao, R., Sen, C.K., Wound angiogenesis as a function of tissue oxygen tension: a mathematical model, PNAS USA 105: 2628 - 33, 2008.)

Positions Available

Postdoc in Systems Biology, Luxembourg

The University of Luxembourg has a vacancy in its Faculty of Science, Technology and Communication for a Post Doc in Systems Biology (Reference: F1-080013). Within the systems biology group mathematical models (mainly ODE based) of different mammalian signaling pathways are developed. One main focus currently lays on pro- and anti-apoptotic signaling. In addition projects concentrating on JAK/STAT and PGDFR signaling will further characterize their relevance in inflammation related diseases and cancer. Regarding the analysis of the systemic characteristics of the underlying networks, a key position of an Assistant-Chercheur is open for application. This theory-trained person shall provide a profound support of the necessary analyses, e.g., focusing on global sensitivities, identifiability, robustness, modularity and others. Based on the analyses results future experimental strategies shall be suggested in close collaboration with the experimental partners. Interested candidates are asked to send their full application (letter of motivation, detailed CV, copies of diploma, photo) until February 28th, 2009 by e-mail to thomas.sauter@uni.lu. For further information, please contact: Prof. Thomas Sauter, thomas.sauter@uni.lu, http://www.isr.uni-stuttgart.de/~sauter/

PhD Position in Pharmacometrics, PharMetrX, Germany

The Graduate Research Training Program PharMetrX: Pharmacometrics & Computational Disease Modelling invites applications for the PhD program PharMetrX is a joint graduate program of the Martin-Luther-Unversitaet Halle-Wittenberg and the Freie Universitaet Berlin, bridging pharmacy and mathematics. It offers its graduate students a unique opportunity to experience research in drug development and optimising drug therapy jointly within academia and industry. PharMetrX is supported by six research-driven pharma companies. The interdisciplinary PhD program is designed as a 3-year research program including a structured research training curriculum of advanced academic and industrial modules and a competitive research fellowship. We are currently inviting applications to start the PhD program in March 2009. For details see http://www.pharmacometrics.de.

Postdoc in Cell Differentiation, Dundee

The appointed postdoctoral scientist will be part of an interdisciplinary team and will develop a multi-scale modelling approach to address, at the systems biology level, how biofilm formation is controlled. This will lead to a better understanding of microbial community dynamics with longer term impact on applications to health and industry. Informal enquiries can be made to Dr. Fordyce Davidson (Division of Mathematics) or Dr. Nicola Stanley-Wall (College of Life Sciences), e-mail: fdavidso@maths.dundee.ac.uk; n.r.stanleywall@dundee.ac.uk (applications sent to either of these addresses alone will not be considered). Applications in the form of a CV and covering letter, including the names and addresses of 3 referees, should be sent to HR-LifeSciences@dundee.ac.uk quoting LS/2505. Closing Date: 16 January 2009

Postdoc in Systems Biology, Centre for Plant Integrative Biology, Notingham

A five year programme within the Centre for Plant Integrative Biology (CPIB) at the University of Nottingham aims to create a virtual root which will serve as an exemplar for using Integrative Systems Biology to model multi-cellular systems. CPIB is jointly funded by the BBSRC and EPSRC as part of their Systems Biology Initiative to establish a number of Centres or Integrative Systems Biology. This project brings together biologists, engineers, mathematicians and computer scientists to generate new data, biological resources and virtual models that will aid understanding of how plant roots grow and develop. Applications are invited for an applied mathematician on the above Virtual Root project to undertake deterministic modelling of gene and signalling networks involved in lateral root emergence. Informal enquiries may be addressed to Professor J King, School of Mathematical Sciences, Email: John.King@Nottingham.ac.uk. For general enquiries regarding CPIB contact Professor C Hodgman, School of Biosciences, Email: Charlie.Hodgman@Nottingham.ac.uk. Further details are available at: http://jobs.nottingham.ac.uk/. Candidates should send a detailed CV, together with the names and addresses of two referees, to Mrs M Axinte, School of Biosciences, The University of Nottingham, Mirela.Axinte@Nottingham.ac.uk. Please quote ref. SCI/543X1. Closing date: 21 January 2009.

PhD Position in Population Genomics, Max-Planck Institute

A 3-year PhD student position in Mathematical Modeling and Population Genomics is available in the newly formed lab of Dr. Oskar Hallatschek at the Max-Planck-Institute for Dynamics and Self-Organization in Göttingen. The student will join a young and interactive research group in evolutionary dynamics and biophysics, including theoreticians and experimentalists. We cultivate an international atmosphere and the everyday working language is English. The Max-Planck-Institute for Dynamics and Self-Organization is located close to the center of the medieval town of Göttingen. More information about the group is available on the web at: http://www.fas.harvard.edu/~ohallats/). The student will be enrolled in the Göttingen Graduate School for Neurosciences and Molecular Biosciences (GGNB, http://www.ggnb.uni-goettingen.de/). Applicants should have a master's degree or equivalent in biology, math, physics, or related fields. If you hold an excellent BSc (1st class honors) please contact us about possible accession. German is not required but international students will be offered opportunities to take German courses. Interested candidates should send a cover letter summarizing their research background and interest in the position, CV, and contact information of two potential referees as a single PDF file to: oskar.hallatschek.applications@gmail.com Applications will be reviewed beginning December 1, 2008 and continue until the position is filled. Interviews will be held in January. Starting date is February 1 2009 or later. If you have any specific questions (e.g., details of the project), feel free to email Oskar Hallatschek oskar.hallatschek.applications@googlemail.com.

Postdoc in Infectious Disease Modeling, Univ of Toronto

A position for a postdoctoral fellow/infectious disease modeler is available at THETA, the Toronto Health Economics and Technology Assessment Collaborative - University of Toronto and the University of Guelph. The postdoctoral fellow/infectious disease modeler will collaborate with project investigators to address questions in the cost-effectiveness of preventive and therapeutic pandemic influenza mitigation strategies, including vaccination, targeted antiviral prophylaxis, treatment and social distancing measures. The postdoctoral fellow/infectious disease modeler will primarily develop, parameterize, and simulate an agent-based model of influenza transmission that projects clinical effectiveness and cost-effectiveness of mitigation strategies. The postdoctoral fellow/infectious disease modeler will also coauthor manuscripts and interface with graduate students working on the project. The position may be structured as a one-year full-time or two-year part-time position, with job duties to be specified accordingly. To express interest or apply for this position, please send a cover letter, CV, and the names and contact information for two referees to Beate Sander (beate.sander@theta.utoronto.ca). Review of applications will begin 5 January 2009 and continue until the position is filled.

Postdoc in Oscillator Coupling, St Hughes College, Oxford

The Centre for Mathematical Biology (CMB) is looking to recruit a postdoctoral research assistant to work in the area of mathematical and computational modelling of coupled oscillators in biological systems. The position will be held in association with a Career Development Fellowship at St Hugh's College. More specifically, the PDRA will work alongside Dr Ruth Baker and Professor Philip Maini (CMB) and Professor Kevin Burrage (University of Oxford Computing Laboratory) to develop multi-scale models to describe the dynamics two paradigms of coupled biological oscillators: the molecular clock involved in segmentation of the vertebrate body axis and the hair follicle cycle. In either case, models consisting of systems of non-linear differential equations will be developed on the level of the individual oscillator, in tandem with phenomenological models to describe events on the tissue level. Different types of oscillator coupling, the role of noise and the integration of individual-level models into population-level models will be addressed, and there may also be the opportunity to visit experimental collaborators. Further particulars may be obtained from vacancies@maths.ox.ac.uk and at http://www.maths.ox.ac.uk/notices/vacancies/. If you have any questions or would like to discuss this position contact Ruth Baker (ruth.baker@maths.ox.ac.uk).

Postdoc in Math Epidemilogy, Odum School of Ecology, Univ of Georgia

Applications are invited for a postdoctoral research fellowship in Mathematical Epidemiology. The position will involve developing new mathematical models and the analysis of data with a view to understanding the persistence, transmission dynamics and evolution of whooping cough in the US and UK. For further information about these projects, contact Pej Rohani, e-mail: rohani@uga.edu. Applicants should send a detailed CV, together with a brief statement of research interests and three references to Pej Rohani, Odum School of Ecology, University of Georgia, Athens GA 30602. Electronic applications are encouraged. Review of applications will start on Jan 15 and will continue until the post has been filled.

PhD/Postdoc position in Computational Biomechanics, U. Stuttgart, Germany

The PhD student/Post-Doc is supposed to work on a project focusing on developing novel computational techniques to model skeletal muscles mechanics. The goal is to overcome the computational challenge of realistically modeling lumbar spine muscle mechanics while taking into account the influence of a large number of muscles involved in complex upper body movements. The skeletal muscles are modeled using the Finite Element method in three dimensions and principles of nonlinear continuum mechanics. For this purpose, a good background in computational continuum mechanics, the Finite Element Method, and some programming skills are desirable. Applications with the usual documents (CV, degree certificates, references, publication list, letter of motivation) should be sent directly to Jun.-Prof. Oliver Roehrle (roehrle (_AT) simtech.uni-stuttgart.de), Applications will be accepted until the position is filled. http://www.mechbau.uni-stuttgart.de/ls2/institut/personen/r%F6hrle/PhDposition.pdf

MARK YOUR CALENDARS!
2009 SMB Annual Meeting
July 27-30, 2009
University of British Columbia, Vancouver

Deadlines:

Minisymposium proposal	Jan. 31, 2009
Contributed-talk proposal	May 10, 2009
Poster proposal	June 27, 2009
Early Registration	June 27, 2009

2009 SMB Membership Join / Renew Online

If you have not already done so, you are invited to join/renew membership in the Society of Mathematical Biology membership for 2009 using our on-line membership process. We are continuing to work with the Botanical Society of America on this so the page is listed through their site. As a reminder, here is how it works. Please go to: https://payments.botany.org/joinsmb/index.php. To renew: If you used the on-line system in 2008, choose "Renew your membership with the Society" and then simply fill in your username and password that you created last year. There is the "Forgot your login details" if you can't remember your password. If you did not use the on-line system in 2008, you may still be in the system if you provided us with your email address. Try this first, simply fill in your email in the "Forgot your login details" section and push "Send reset details". If we have your email in the database, this will send you an automatically generated email with a link to login. You will be prompted to change your password and led through the renewal process. If your email is not in the database, please follow the join for the first time option. To join for the very first time: Select this button, continue, and you will be led through the process. You can pay on-line using a credit card, or you can opt to send a check by mail. We encourage you to use the on-line process either way as it will allow you to fill in your address accurately, specify interests and other options, and will expedite the membership process.

Editor's Notes:

We invite submissions including summaries of previous mathematical biology meetings, invitations to upcoming conferences, commentaries, book reviews or suggestions for other future columns. The deadline is the 15th of the month prior to publication.

The SMB Newsletter is published in January, May and September by the Society of Mathematical Biology for its members. The Society for Mathematical Biology is an international society which exists to promote and foster interactions between the mathematical and biological sciences communities through membership, journal publications, travel support and conferences. Please visit our website: http://www.smb.org for more information.

Holly Gaff, Editor, editor@smb.org