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