Mathematical Biology Newsletter

Society for Mathematical Biology Volume 9, Number 2 June, 1996

Dear SMB Members,

Summer is almost here, and excitement is growing at SMB in anticipation of our annual meeting, only two months from now. This year, we are holding the meeting in conjunction with AIBS, the American Institute of Biological Sciences (Aug 4-8, 1996, Seattle, WA, at the University of Washington campus). I would like to extend a warm invitation to all our members, friends, and associates, and to anyone interested in biology, mathematics, or mathematical biology. Our session chairs have worked hard to include both experimental and theoretical lectures, in what is bound to be an exciting 3-day program and field trip (Mt. St. Helens, Aug 8). See pp 10-11.

SMB recently held elections for three board members and a president elect. As a result, Leon Glass is the incoming president, and Philip Maini, Denise Kirschner, and Mark Lewis join us as directors. The new officers will be inaugurated at this summer's SMB annual meeting; Leon Glass will take over the presidency in 1997. (See p 2 of this newsletter for more details). I would like to thank all the excellent candidates for agreeing to run in this election, and for their continuing dedication to the interests of the Society.

Sadly, this year has also seen the passing of three distinguished mathematical biologists, Ei Teramoto, Akira Okubo, and Hans Bremermann. We take the opportunity of honoring their memories in the pages of this issue.

Sincerely yours,
Leah Edelstein-Keshet
President, SMB

IN THIS ISSUE:

ABOUT THE NEXT ISSUE:

Feature Article: **The History of the Society**	(by M. Conrad)
Deadline for submissions:	Aug 1, 1996
Dissemination date:	Sept 1, 1996

Society for Mathematical Biology

President: Leah Edelstein-Keshet (Department of Mathematics, University of British Columbia, Vancouver, BC V6T 1Z2, Canada; phone 604-822-5889, FAX 604-822-6074, email: keshet@math.ubc.ca); President elect: Leon Glass (glass@ cnd.mcgill.ca); Past president: John Tyson (TYSON@VTVM1.CC.VT.EDU); Treasurer and newsletter coeditor: Torcom Chorbajian (P.O.Box 11283, Boulder, CO 80301-0003, jchorbaj@mines.edu); Secretary: Charlie Smith (cesmith@stat. ncsu.edu); Board of Directors: Ray Mejia (ray@helix.nih.gov); Jim Keener (keener@math.utah.edu); Carlos Castillo-Chavez (cc32@cornell.edu), Robert Miura (miura@.math.ubc.ca); Steve Ellner (ellner@stat.ncsu.edu); Mark Lewis (mlewis@math. utah.edu); Denise Kirschner (dek@math.tamu.edu); Philip Maini (maini@maths.ox.ac.uk)

Letter from president-elect Leon Glass

I am honored to have been elected to be the next President of the Society for Mathematical Biology.

Mathematics has helped transform biology and medicine in the second half of this century. Consider the following advances: the determination of the structure of biological molecules; the development of imaging methods; the dissection of ionic currents in cells; and the searching of databases to classify novel DNA sequences. None would have been possible without sophisticated mathematical and computer methods. But there is a paradox. Despite these advances, it is my impression that most of my biological and medical colleagues still fail to appreciate the advantage of including mathematics in the education of their students. As well, I hear of too few job opportunities with a mathematical orientation for scientists in biologically oriented departments.

Advances in two areas promise to have major impacts on our field, on science, and on society in the next two decades:

Knowledge of the structure of the genome. Unravelling the structure of genes constitutes a first step. Indeed, once we know genetic sequences, we may be able to make striking progress on understanding biological function over a wide range of levels of organization.

Increases in computer speed, memory, and graphics. The computer is changing the way we do science and the way we communicate. SMB has already begun to make use of technology to foster research and global communication in our field, but continuing work in these areas is essential.

The most compelling open questions in basic science today involve living organisms. A satisfactory resolution of these questions is impossible without a strong input from theoreticians working together with experimentalists. Yet, many young people find the current scientific and educational environment daunting. Jobs and research funds are perceived to be scarce. The situation is difficult but must be addressed. It is incumbent on all of us to continue to seek ways of communicating our field to those outside it, and to educate students as well as practitioners outside our field about what we do. No one person can have an impact alone, but if each tries to do something in his or her own way, then the collective effect may be substantial.

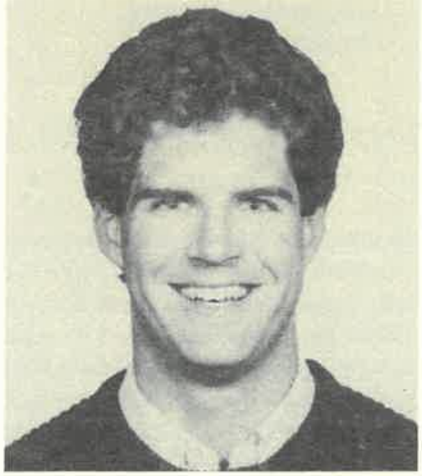
Certainly, our society would be strengthened if each of us recruits one new student or colleague member, and insists that our local library subscribes to the Bulletin of Mathematical Biology. I am impressed at the contributions of many over the years. But the current health of the Society owes a great debt in particular to Torcom Chorbajian - treasurer and co-editor of the newsletter, Ray Mejia - for running the SMB digest, Lee Segel - for editing the Bulletin of Mathematical Biology, and Leah Edelstein-Keshet - for her skill and dedication during the current Presidency. Thanks.

Leon Glass
president elect - SMB

Leon Glass
President-Elect
(From a daquerrotype
taken by Robert Shlaer
Santa Fe, New Mexico)

Denise Kirschner
Director

Philip Maini
Director



Mark Lewis
Director

A Report by Mark Lewis on the **Special Year in Mathematical Biology** held at U. Utah, Sept 95-June 96

The Dept of Mathematics at the University of Utah is currently running a Special Year in Mathematical Biology funded by NSF. So far the Year has provided an exciting mix of mathematical modeling applied to biological problems.

The fall quarter focused on mathematical approaches to problems in ecology and evolution. Steve Ellner showed us the excitement of life-history in muddy ponds, with savvy copepods, waiting for centuries before emerging into the harsh world. Bob Holt and Richard Gomulkiewicz brought a mixture of ecology and evolution into play to determine the success of species at low population levels, and incidentally proved (for those who did not already know) that existing classical theory had it all backwards. Odo Diekmann brought us up to speed on some of the subtle mathematical problems that pests must address to succeed in the North Sea.

Ancestral inference proved, in the masterful hands of Simon Tavare, to be just the gnarly set of tools needed to figure out our relatives. Simon Levin reminded us about living and modeling in a stochastic world. Invertebrate guts were shown to work like a carefully calibrated predictive model for Daphnia by Roger Nisbet. The value of neighborly disputes discussed at the minisymposium on territoriality (organized by Deborah Gordon) featured birds, ants, lizards, wolves and researchers, all vying for space.

The winter quarter focused on what goes on inside cells. H. Othmer gave us a glimpse of how cells see the world via signal transduction and second messengers. Biochemical and genetic factors were demonstrated by John Tyson to be responsible for forcing unsuspecting cells into inescapable cycles of growth and division. Exotic diseases of the blood were shown to adhere to exotic delay equations as Michael Mackey took on cellular replication and feedback mechanisms. Delays were apparent during John Milton's lectures as he skilfully explained his approach to coupled neurons, the brain, and the American health care system. Arthur Sherman led us through amazing bifurcations witnessed by seemingly normal cells residing in the average pancreas. Designed by Joel Keizer, a minisymposium on calcium dynamics featured discussion on the ins and outs of puffs, sparks, and waves.

Fluids, muscles and blood will dominate during the final quarter. In a quest to understand the mechanics of motor proteins, Ed Pate has shown us that early models are not always wrong (but it helps to know what you are measuring). Leon Glass reset us in the global theory of nonlinear oscillators as he entrained on a variety of clinical applications.

Currently, the story of what goes on in emergency rooms during massive shocks to the heart is electrifying us, as W. Krassowska works through the details of bidomain models. C. Peskin promises to deliver heart-felt aspects of his research, such as fluid flow, valve movement and fiber architecture. Finally, Nick Hill is scheduled to initiate us into the secret lives of swimming micro-organisms. A recent minisymposium on mapping the heart was organized by Robert Lux. A final minisymposium on Biofluids is being organized by Lisa Fauci.

Overall, the format for the special year seems to have worked well. Principal (2 weeks) lecturers have given us an in-depth look at some of the exciting current areas of mathematical biology. Short-term visitors (3 days) have interacted informally with students, post-docs, other visitors and permanent faculty. Graduates students, coming for 1 quarter of specialization, have visited from Australia, Canada, Germany, Great Britain and the Netherlands as well as the United States. The minisymposia, lasting 2 or 3 days, have involved outside visitors, and have focused on specialized topics. Inevitable constraints have limited our ability to cover all subjects or invite all visitors that we would ideally like, though the special year seemed to have been both successful and productive.

Detailed information on the special year events is available on the web from http://www.math.utah.edu/~dallon/spyear.html.

Participants at the Special Year in Mathematical Biology (Utah) pause for a group photo. Feb, 1996

MATHEMATICAL BIOLOGY IN BRITAIN

by Philip K. Maini, University of Oxford, UK

Mathematical biology is flourishing in Britain with a number of groups working in many different areas within the field. Many young people are attracted to the field at graduate and postdoctoral levels. I think that the two main reasons for this are, first, an innate fascination with biology and, second, as mathematical biology is a relatively new field, there is the potential to make contributions quickly at the forefront of the subject. The IMA set up a Forum on Mathematics in Medicine and Biology in 1991 (chaired by Tim Pedley from Cambridge) as a focus for the subject. IMA coordinates activities and disseminates information through a Newsletter.

Bath has recently set up a Centre for Mathematical Biology presently headed by Nick Britton and Nigel Franks. (See report on the first Mathematical Biology Workshop at Bath, facing page.) A number of faculty connected with the Centre, work on diverse topics, ranging from cancer modelling and angiogenesis (Mark Chaplain has built up a group in this area), to modelling fungal networks, and trail following in ants.

In Leeds, there is a Centre for Nonlinear Studies which brings together a number of people working in many varied fields, including travelling waves and patterns in chemical reactions, modelling of electrical activity in the heart, studying gait and locomotion, investigating problems in biodynamics. Tim Pedley recently left Leeds to take up a chair in Cambridge, where Bryan Grenfell is working on parasite transmission and control in animals, while Chris Gilligan is researching pest control in plants. John Brindley at Leeds is collaborating with Jacqui McGlade in Warwick, on ecosystem modelling and management.

In the game of musical chairs, Brian Sleeman has moved from Dundee to Leeds. In Dundee, Brian leaves the Centre he founded, which has many collaborative links with outside groups working on a number of deterministic and statistical problems in biology. We have recently heard that Mark Chaplain will be leaving Bath to fill the position at Dundee. Staying north of the border, epidemiology modelling, with application to AIDS, is being investigated in Strathclyde, while in Glasgow, Jagan Gomatam is working on spiral waves in BZ reactions. Spiral waves are also the focus of Dwight Barkley's work in Warwick. Jonathan Sherratt works on wound healing at Warwick. Sheffield hosts a large group in probabilistic and statistical problems in mathematical biology. There are also a number of people working on travelling waves in reaction-diffusion equations. In Cardiff, Jim Hindmarsh works on nonlinear oscillators. In Oxford, there are groups in epidemiology, cancer, cardiology, pest control, immunology, morphogenesis, respiratory diseases, and wound healing.

This is a very brief and, due to space restrictions, incomplete summary of the work going on in Britain. The geographical size of Britain enables members of one group to easily visit any of the other groups and I think that this facilitates collaborative research. Each year, there is a big applied mathematics meeting held in Britain (BAMC - British Applied Mathematics Colloquium) and mathematical biology is beginning to feature regularly in this. More and more courses in the area are being developed at the undergraduate and graduate level, to meet the increase in demand for the subject. Research is funded by a number of bodies, including the Biotechnology and Biological Sciences Research Council, Engineering and Physical Sciences Research Council, London Mathematical Society, and the Wellcome Trust. There are also a number of agencies funding collaborative work within Europe. All in all, these are exciting times for mathematical biology in Britain.

WORKSHOP REPORT: Modeling Development and Differentiation in the Immune System, December 18-21, 1995

Organizers: Ramit Mehr and Alan Perelson, Center for Nonlinear Studies, Los Alamos National Laboratory, NM.

ABSTRACT: In recent years, there has been considerable interest in modeling and simulating the processes of lymphocyte development and differentiation. A recent meeting was aimed at identifying and defining the relevant problems and the various mathematical and computational tools that may be appropriate for dealing with them. The report is available in three forms in the SMBnet archives at URL: ftp://ftp.ncifcrf.gov/smb/pubs in files: ImmDevWk.ascii (plain text file), ImmDevWk.tex (LaTeX), ImmDevWk.ps (postscript file). A web browser or anonymous ftp may be used to retrieve any of these files. For more information contact: Ramit Mehr, (LANL), ramit@t10.lanl.gov

Participants at a recent Workshop in Mathematical Biology, University of Bath, UK, April 1996

REPORT ON THE MATHEMATICAL BIOLOGY WORKSHOP AT THE UNIVERSITY OF BATH, April 1-4, 1996 (by LEK)

In the recent Disney animation classic, Aladdin, princess Jasmine is invited by Ali for a ride on his Persian carpet. Though "prince" Ali is really a pauper in disguise, he hopes that with royal airs, fast talk, and with many distractions of the flashy, slick ride, the "young and impressionable" princess won't notice. Fancy designs and flashy signals are, indeed, often used as strategies for impressing mates, outwitting competitors, even for signalling one's stature and worth to others, a fact that was well illustrated by M Pagel (Oxford) in his talk about "Signalling interactions among simple cells".

This was but one theme in a recent four-day workshop held in Bath, England, early this spring. Participants experienced a broad view of mathematical biology, and were given a great opportunity to interact with colleagues and young scientists from many countries. A theme on the first day of the meeting was Patterns and Rhythms. We heard lectures by Tim Pedley (Cambridge) who explained the formation of striking bio-convection patterns caused by interactions of cells and fluid motion. Interactions between organisms (ants) was further discussed by J. L. Deneubourg (Brussels). Albert Goldbeter (Brussels) gave a detailed survey of four important types of biological oscillators: glycolysis, the cell-cycle, as well as cyclic-AMP in Dictyostelium, and, last, circadian rhythm.

Tuesday, the second day of the workshop, was devoted to talks about immunology. Rob de Boer (Utrecht) discussed the analogy between the competition of T-cells in response to Major Histocompatibility Complex peptides and the principle of competitive exclusion in ecology. Angela MacLean (Pasteur Inst) talked about lymphocyte homeostasis and its disruption, and Martin Nowak (Oxford) about the immune response to persistent virus infections. Vladimir Kuznetsov (NIH) discussed Natural Killer Cells and the kinetics of their cytolytic reaction on their target cells.

Developmental Biology was the topic featured on day three, one of the more controversial days of the workshop. Our group was polarised into two camps, the Experimentalist camp and the Theorist camp. The tone was set by Lewis Wolpert (London), the "father" of chick limb-bud graft experiments and the positional information hypothesis. Picture a headmaster scolding a group of school-children for being late for school, and you will have an accurate picture of the ambiance of the morning. Though with some good humor intended, and with the license that years of experience allows, Wolpert chided the theorists among us for "failing to deliver"... Well, true, we theorists have not yet "delivered" a theory of everything.. and true, the ultimate test (of Turing morphogenesis as a biological pattern-forming mechanism) is finding those elusive Turing morphogens.. but then, as Philip Maini (Oxford) pointed out, Turing reaction-diffusion patterns were only recently realized in a chemical system,.. and Rome wasn't built in a single day, either. The cause of the theorists was shored up with a talk by A. Mogilner (Davis) about mathematical models of the cytoskeleton-based cell locomotion. The experimental camp was further represented with a survey of unresolved problems in developmental biology (including ontogeny of the elusive "snapper") by Jonathan Slack (Bath). Though we may have felt our bright plumage ruffled a little, most of us agreed that the day was interesting and thought-provoking.

The final day was devoted to Ecology and population biology. A detailed and informative lecture by Brian Grenfell was devoted to the nonlinear dynamics of Measles. Simulations vividly illustrated the impact of vaccination on disease outbreaks in the UK. Later that morning, Jacquie McGlade (Warwick) delivered an exemplary lecture about global, planetary views of ecological processes. The level of attention to detail, as well as ability to learn fundamentally important messages about the ecology of our world came out with splendour in her talk. The final event took place on Thursday afternoon. With the recent British "mad-cow" disease epidemic, Professor Sir Robert May certainly has his hands full. He nevertheless took time off a busy schedule to share a beef sandwich with the VC, and to conclude the workshop by taking us on a Persian carpet ride.

Aside from the beauty of Bath, and the charm of its architecture, the workshop had many additional pleasant and exciting aspects. Particularly novel was the treatment of the contributed poster session. In order to ensure that posters received full attention and discussion, keynote speakers were asked to identify some small set of posters that were relevant to the topic of the day. The contributors then got a chance to present a brief over-view of their projects for all of us to enjoy. Meals in the cafeteria were also superb, with many choices and plentiful portions. The organisers of the four-day workshop, Nigel Franks, Nick Britton, and Mark Chaplain, put together an excellent and thought-provoking program, and deserve our heartfelt thanks.

Workshop organisers Mark Chaplain, Nigel Franks, and Nick Britton, University of Bath, UK.

In Memoriam, Ei Teramoto (1925-1996)

Contributed by Nanako Shigesada, Nara Women's University and Yoh Iwasa, Kyushu University, Japan

Ei Teramoto passed away on February 7, 1996, losing a two year fight against liver cancer. He was the father of mathematical biology in Japan.

Ei Teramoto was born in 1925 in Matsue City, Japan. He graduated from the Department of Physics of Kyoto University in 1947, and immediately joined the faculty, beginning a research career in statistical physics of chain polymers. Teramoto was the first to evaluate the excluded volume effect of chain molecules. This work was highly appreciated by the Nobelist Flory as an outstanding breakthrough in polymer physics. Later we heard from Teramoto, himself, that he derived that effect by simulations with a pencil and tons of graph paper, without the benefit of electronic computers, non-existent at that time.

Ei Teramoto then studied helix-coil transitions of DNA, and chemical reaction kinetics in biomolecules. In parallel, he made great efforts to establish a new department for Biophysics in Kyoto University. In 1969, he moved from the Physics Department to settle in this newly founded place.

His new office was famous for its "Tatami" floor, which was probably the only one among all the Japanese universities. Seasonal changes in scenic views of the Daimonji Hill of East Kyoto seen from his office reminded Ei Teramoto of the ups and downs of animal and plant population sizes, and made him realize that mathematical ecology would be the field in which theoretical study would be most effective and that it could greatly contribute to human life in the future.

In the early 1970's, Ei Teramoto and his students studied the stability and structure of model ecosystems and published a series of papers using the acronym of "Mumay Tansky", (Tansky stands for the initials of 6 co-authors: Teramoto, Ashida, Nakajima, Shigesada, Kawasaki, and Yamamura). Later, he made a number of fundamental contributions in population dynamics and ecosystem processes. Particularly notable is the study of switching predation, in which he showed that a switching effect facilitates coexistence of competing species. More recently, he gave an elegant explanation of how the pyramid structure of energy trophic levels is realized by species interactions in a food web. Ei Teramoto's laboratory included people working on all sorts of mathematical biology, ranging from protein structure, neural networks and developmental pattern formation, in addition to ecology.

He organized the International Symposium on Mathematical Biology in 1978 and 1985, held in Kyoto. In 1988, he established the Japanese Association for Mathematical Biology (JAMB), which now numbers over 200 members.

Ei Teramoto was one of the founders of The Biophysical Society of Japan, and served as the president of the society for two terms. He organized a large cooperative research program on sociobiology for 1982-1985, which contributed in establishing evolutionary ecology in Japan. He also performed a number of important administrative works, including Dean of the Faculty of Science, Kyoto University. After retirement from Kyoto University, Ei Teramoto became the Professor and Fellow of the newly established Science and Technology School of Ryukoku University in 1988.

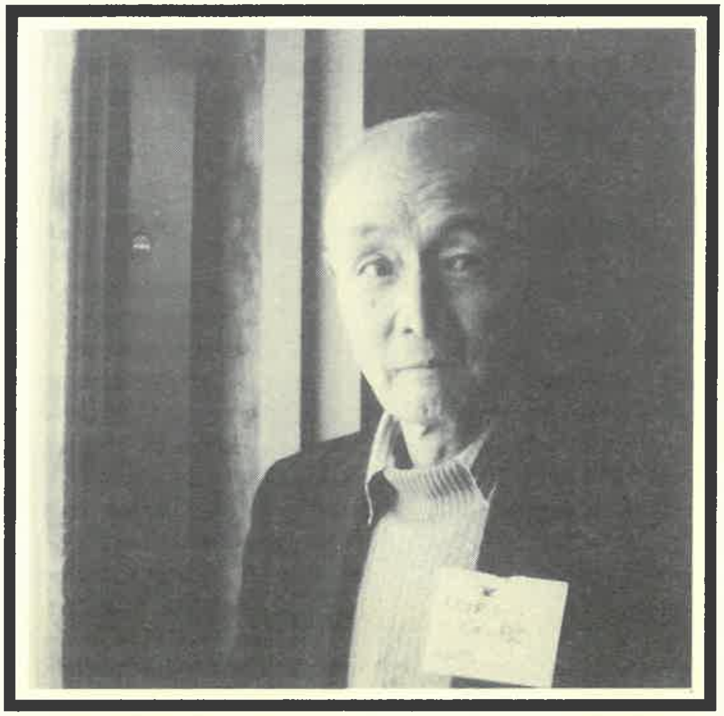
Ei Teramoto loved people and conversations over *sake*. He often spent hours of enjoyable time discussing science, philosophy and culture. He always related stories with wit and humor, which made people very relaxed.

Among about a dozen books written by Teramoto, the most recent one, entitled "Mathematics of Random Phenomena" included his analyses of species-abundance relationships and spatial structure of populations. Especially notable is that each chapter has a water color picture painted by Teramoto himself, some of which depict the scenery on the promenade to his favorite pub from Kyoto University.

Ei Teramoto loved both people and science, and inspired many active mathematical biologists of younger generations. He will be remembered for his warm character, humorous talk, and his way of achieving important jobs in an entertaining way.

In Memoriam, **Akira Okubo** (1925-1996)
Contributed by Simon Levin, Princeton

Akira Okubo passed away on February 1, 1996, at the age of 70. A great and original scientist, Akira was known both for his contributions to the theory of animal diffusion and for his exceptional humanity. He was a member of the faculty at the Marine Sciences Research Center, State University of New York at Stony Brook, for two decades; but his most lasting influence was as mentor and colleague for countless others who vied for the honor of calling him sensei, the Japanese word for a revered teacher.



Akira Okubo was born in Japan, and became a devotee of sumo, sushi, sashimi, samurai and baseball. An oceanographer, he became chief of the Chemical Oceanography Section of the Japanese Meteorological Agency in Tokyo. He came to the United States to study with Donald W. Pritchard at the Chesapeake Bay Institute of the Johns Hopkins University, where he received his Ph.D. in 1963. He stayed on at Hopkins until 1974, when he became professor of Mathematical Ecology at Stony Brook.

Akira was a consummate theoretician, inspired by natural phenomena but with the quantitative skills to derive order from what he and others observed. The author of over 150 papers, he had almost one hundred collaborators on a wide range of problems in oceanography, ethology, and wherever his curiosity took him. He won the prestigious Medal of the Oceanographic Society of Japan, and a Senior Visiting Scholarship at the University of Oxford.

Akira Okubo distinguished himself by his work on a wide variety of problems, but his greatest and most lasting contribution came from his success in dealing with the confusion of diffusion. His early dye diffusion work is a classic in the oceanographic literature, and he extended it easily to the diffusion of spores, of seeds, of fish eggs and larvae, and wherever his insights and interests led him. His work on pattern formation in the plankton was my own point of contact with him, and led to a lifelong friendship and collaboration.

Closest to his heart, however, were little animals, and his painstaking and brilliant analysis of midge swarming has inspired numerous followers. Inspired by his earlier work and a love for nature, he began extending his work broadly to animal movement, and his book on Diffusion and Ecological Problems is a classic that has had a major influence on the field. (The book is an extension of an earlier book, entirely in Japanese). One of the most powerful approaches being used today to study and model animal aggregations, that of beginning from Lagrangian descriptions of individual movements and proceeding to Eulerian descriptions, was inspired by Okubo's work and encouragement. The famous wildebeest patterns, reported by Tony Sinclair and others, were brought to the attention of theoreticians by Akira Okubo.

We have all lost a wonderful colleague and teacher; Akira's influence will live on through his work, and through the countless students and friends that he touched.

Editor's note: There will be a **session dedicated to Akira Okubo**, organized by Danny Grunbaum at the SMB annual meeting this summer. For details, please see p 10.

A Fund in Honor of Akira Okubo

Dear SMB members, Friends, and Colleagues

Those of us who knew Akira Okubo were touched by the warmth, the brilliance, and the gentleness of his personality. I, for one, will never forget the introduction of his classic book that, in modesty typical to him, lists the "good luck" that brought this great work to fruition. Equally memorable to me is his description of tracking 3D motion of flying midges - "impossible" according to grant agencies, yet still possible "because the sun was shining". (Akira ingeniously used midge shadows and trigonometry to reconstruct 3D positions).

SMB is now setting up a fund to preserve the memory of this dear and cherished colleague. The fund will be invested, and income used in perpetuity to honor Akira, eg. by awarding a biennial prize for an excellent scientific contribution, with the recipient invited to present at an SMB meeting. Si Levin has agreed to coordinate with Yoh Iwassa, secretary general of the Japanese Association for Mathematical Biology in an effort to make this fund-raising a joint effort. Details will follow in the SMB digest and newsletter.

Please send your tax-deductible contributions (by check payable to the Society for Mathematical Biology) to L. E. Keshet, Math Dept, UBC, Vancouver, BC, V6T 1Z2, (keshet @math.ubc.ca) 604-822-5889. Include full address and a receipt will be forwarded to you. With thanks, Leah E- Keshet

In Memoriam, Hans J. Bremermann (1926-1996)

Contributed by Russell W. Anderson, Biomedical Engineering, University of Northern California

Hans Joachim Bremermann, professor emeritus of mathematics and biophysics, University of California at Berkeley, died of cancer on February 21, 1996. Born in Bremen, Germany, on September 14, 1926, he earned his Ph.D. in mathematics from the University of Münster. After teaching mathematics for a year at Münster, he held teaching and research positions Stanford University, Harvard University, again at Münster, and University of Washington. In between, he was twice invited to conduct research at the Institute for Advanced Study in Princeton, first as a mathematician (in 1955), and again as a physicist (in 1958). In 1959, he moved to the University of California, Berkeley, where he remained until his retirement in 1991.

At Berkeley, he held professorships in mathematics and in biophysics. He also was a member of the graduate group in bioengineering at the University of California, San Francisco. He was a founding editor of the Journal of Mathematical Biology, a Fellow of the American Association for the Advancement of Science, a member of the AMS and other societies in mathematics, artificial intelligence, and biophysics.

An accomplished mathematician in complex variables and distribution theory, Bremermann also pioneered several branches of computer science and mathematical biology including complexity theory, genetic algorithms, neural networks, fuzzy logic, optimization theory, artificial intelligence, pattern recognition, host-parasite dynamics, and evolution.

His interest in computation and practical algorithms developed early from seminars on Turing machines in Münster and his own frustrating experiences programming von Neumann's computer, MANIAC [1]. His studies of the physical limits of computation led to the development of the "Bremermann limit," a seminal contribution to the emerging field of complexity theory. He continued to explore approaches to the understanding of complex (especially biological) processes and systems for the rest of his life. His intellectual journey was marked by brilliant insight and foresight.

He was among the first to develop and analyze evolutionary/genetic search procedures, which employed all of the elements of modern genetic algorithms--- binary and continuous genetic coding, random mutation, selection, and sexual recombination. As early as 1968, he suggested applying such algorithms to training multilayer perceptrons, which he finally implemented in 1988. In 1995, he was awarded a lifetime achievement award by the Evolutionary Programming Society, and the proceedings of this year's annual meeting are dedicated to his memory.

With Lotfi Zadeh, he supervised several theses on fuzzy logic. With his student, Richard Hodges, he attacked the problem of pattern recognition using deformable prototypes. He developed a global optimization algorithm inspired by his analysis of bacterial chemotaxis. The "Bremermann optimizer" has been applied to determining nucleic acid sequences, analysis of spectra, parameter estimation for the Calvin photosynthesis cycle, and optimal neuromuscular control.

His experience with genetic algorithms, led him to study evolutionary significance of sexual recombination at the molecular level. He analyzed pathogenic strategies, host/parasite interactions, virally-induced cancers, and catastrophies in cultivated crops.

Bremermann continued researches into his retirement and illness. Last July, he gave an invited lecture at the Dalai Lama's 60th birthday in India. In recent papers on HIV he used mathematical and immunological arguments to expose fundamental paradoxes in the conventional, direct viral killing model and advocated the view that AIDS is a disease of HIV-induced immune activation [Ascher et al. 1995].

Hans is remembered not only for his genius, but also for his warmth, generosity, courage, integrity, humility, and love. He is survived by his loving wife of 42 years, Maribel, a native of Spain and professor emeritus of Romance Literature at San Francisco State University. Contributions in his name can be made to the American Cancer Society.

1. A recent account of his career can be found in a festschrift published on the occasion of his retirement: R.W. Anderson and M. Conrad, "Hans J. Bremermann: A pioneer in mathematical biology" Biosystems, 34(1-3):1-10 (1995). An interview with Bremermann, conducted by Michael Conrad appeared in the Society for Mathematical Biology (SMB) Newsletter (April 1992).

2. M.S. Ascher, H.W. Sheppard, R.W. Anderson, J.F. Krowka, and H.J. Bremermann. HIV results in the frame -- Paradox Remains. Nature 375:196 (1995).

A note from Ramit Mehr-Grossman

I would like to express my deepest thanks to all SMB members, friends and colleagues who contributed to the Mehr-Grossman Fund. This gift will be used for the future of my children - more precisely, towards ensuring their higher education, as Tal would have undoubtedly wished. I am very grateful for this - and, moreover, for the warm sympathy, encouragement, help and advice that all of you have constantly bestowed on me and the children since Tal's tragic death. You are my real ``support group". I would like also to extend my special thanks to Denise Kirschner for organizing the fund, and for always being there for us.

Wishing the best to you all,
Ramit Mehr-Grossman.

News Release from UCLA School of Medicine

LANDAW NAMED CHAIR OF UCLA BIOMATHEMATICS

Elliot M. Landaw, M.D., Ph.D., has been named chair of the UCLA Department of Biomathematics in the School of Medicine, effective July 1, 1996. Landaw, who replaces former chair Dr. Kenneth Lange, was previously vice-chair of the department.

Landaw received his M.D. degree from the University of Chicago in 1972, and his Ph.D. from UCLA in biomathematics in 1980. He completed post-graduate medical training in pediatrics at the UCLA School of Medicine, and is board-certified in pediatrics. He is a noted authority on optimal experimental design and modeling, but also conducts applied research in the areas of cancer chemotherapy, pharmacology, and physiology.

"My goals for the department include continuing the expansion of our interactions and collaborative ties with the basic science and clinical programs," said Landaw. "Sophisticated mathematical and computer modeling have become important tools in modern biomedical research, and with the growing efforts at UCLA in a number of fields, including human genetics, the neurosciences, and cancer research, biomathematics will play an ever more pivotal interdisciplinary role. I also aim to further strengthen our graduate and undergraduate teaching programs, and to continue to give medical students the tools they need to be critical-thinking physicians, including the statistical and logical basis for effectively interpreting the medical literature."

Industrial Mathematics Modelling Workshop For Graduate Students, August 5 - 13, 1996, Center for Research in Scientific Computation, NCSU, Raleigh, North Carolina. Organizers : F. Reitich , J. S. Scroggs, H.T. Tran

FOREWORD: The Industrial Mathematics Modeling Workshop for Graduate Students, which is the fourth in the series, will take place at the Center for Research in Scientific Computation at North Carolina State University in Raleigh, North Carolina, 5-13 August 1996. This workshop is being held annually; the previous highly successful meetings was held at the Claremont College in 1993 and 1994, and at NCSU last year. The goals of the workshop are to expose 30 graduate students in mathematics and statistics to challenging problems from industry and government and to introduce students to the team approach to problem solving. Funding is provided by the National Security Agency. Additional support is anticipated from CRSC and the Dept of Mathematics at NCSU.

FORMAT: Students will be divided into teams to work on "industrial mathematics" problems presented by experienced applied mathematicians. These problems require fresh, new insight for their formulation and solution.

APPLICATION PROCEDURE: Graduate students in mathematics, applied mathematics, statistics or operations research can be nominated for this program by a faculty member by sending a letter of recommendation. In addition, the student is required to send in a copy of a recent transcript. THE DEADLINE FOR APPLICATION IS JUNE, 30. Students will be expected to finance their travel. The workshop will cover all local living expenses for U.S. citizens and permanent residents.

CONTACT: Hien T. Tran, Dept. of Mathematics, Box 8205, North Carolina State University ,Raleigh, NC 27695-8205, Phone: (919) 515-8782, Fax: (919) 515-3798, e-mail: tran@control.math.ncsu.edu

---

THE INTERNATIONAL CONFERENCE ON MATHEMATICAL BIOLOGY

May 26 - 29, 1997, Hangzhou, China

First Announcement and Call For Papers

The International Conference on Mathematical Biology (ICMB) will be held on May 26 - 29, 1997, in Hangzhou which is one of the most beautiful cities of China. ICMB'97 is jointly sponsored by the Chinese Mathematical Society, Chinese Society of Biophysics, Chinese Society of Biomathematics, and Zhejiang Agriculture University. English is the official language. The registration fee (US $300 US) covers abstract book, local tours, and reception.

The scientific program of ICMB'97 has five sessions (1)Mathematical Ecology, (2)Environmental Resource and Sustainable Agriculture, (3) Genetics and Evolution, (4) Neural Computing, and (5) Biomedical Information Processing. Contributed papers are accepted based on the abstracts. Deadline Oct 1, 1996). Please send your abstract with a file in LATEX, WordPerfect or Word, and indicate topic. Send to: Prof Jun Zhu, Research Center of Biomathematics, Zhejiang Agriculture University, Hangzhou 310029, People's Republic of China, Phone: (571) 604-1733 ext. 2871, Fax: (571) 604-9815, email: juzhu@zjau.edu.cn

PROGRAM OF THE SMB ANNUAL MEETING

in conjunction with AIBS , Aug 4-8, 1996, UW, Seattle

MONDAY MORNING, 5 AUGUST
SESS 1 **Pattern Formation and Developmental Biology.** Organized by Sharon Lubkin, Department of Applied Mathematics, UW (lubkin@amath.washington.edu)

Talks by: P Dale (Oxford) Mathematical modelling of scar tissue formation; P. Burgess (UW) Modelling the formation of stretch marks in the skin; P Monk (Oxford) A mathematical model of delta-notch-mediated lateral inhibition; R. Vernon (UW) TBA; J Cook (UCLA) Tissue Dynamics; M Reimers (Memorial U.,Newfoundland) A polyclone model for animal coat pattern formation; Mei Zhu (Lafayette) Simulations of color pattern variation in lizards; L. Harrison (UBC) Hearts and somites: Problems of pattern formation in vertebrate embryology; D Holloway (UBC) Modelling concurrent chemical patterning and cell surface growth in algae; M.Lyons (USC) Comparing faces: a shape similarity measure which mimics human perception.

MONDAY AFTERNOON, 5 AUGUST
SESS 2 : **Neurophysiology and Physiological Modelling.** Chair: Robert Miura, Department of Mathematics, University of British Columbia (miura@math.ubc.ca)

Talks by: J Neu (UC Berkeley) Criterion for initiation of propagation in an excitable fiber; J. Enns-Ruttan (UBC) Triggered activity in excitable cells; L. Glass (McGill) Entrainment and termination of reentrant wave propagation in a periodically stimulated ring of excitable medium; M. Pernarowski (Montana) A continuum model for bursting electrical activity in the pancreatic islet; J. Holly (R.S. Dow Neurological Sciences Institute) Linear and angular head acceleration combined by the vestibular nuclei; P. Macgill, (WSU) Boundary conditions for single-ion diffusion; L Dai (UBC) Lattice Boltzmann models for ion movements within the brain-cell microenvironment and their applications; R. Mejia, (NIH) Role of BSC-1 regulation on the renal concentration mechanism.

TUESDAY MORNING, 6 AUGUST
SESS 3 **Foraging Theory and Ecological Modelling.** Chair: Shay Gueron, Technion, Israel. (shay@math. technion.ac.il)

Talks by: J Parrish (UW) Coherence, competition, and consequences: foraging of schooling fish; T. Lauck (UBC) Marine reserves, bane of industry or necessary management strategy. S. Gueron Foraging in a group: advantages, disadvantages and optimal group size; M Mesterton-Gibbons (Florida State) Wars of attrition without assessment; S. Sinha (Hyderabad, India) Unusual behaviour and suppression of chaos in discrete population growth models under migration; A. Sun (UW) . On the occupation of space: when does mass mortality matter? M Burke (Kennesaw State College, GA.) Mathematical models of potential malaria vaccines; A. Foster (Memorial U., Newfoundland) Causal bifurcation sequences in models with periodically forced oscillations.

TUESDAY MORNING, 6 AUGUST
SESS 4 **Genetic, Metabolic and Physiological Networks.** Organized by Denis Thieffry, Centro de Investigacion sobre la Fijacion de Nitrogeno, Universidad Nacional Autonoma de Mexico (denis@cifn.unam.mx)

Talks by: M Savageau (U Michigan) Design principles for gene circuitry; J. Reinitz (Mount Sinai Hospital, NY) Adventures in the forbidden zones: The stripe-forming architecture of the gap gene system. J. Van Helden (U. Libre de Bruxelles) Pattern formation and feedback loops; J. Mittenthal (U. Illinois) Designing metabolism: alternative connectivities for the pentose phosphate pathway; P. Roberts (R.S. Dow Neurological) Rhythms in dynamic biological networks; D.Thieffry (U.Nacional Autonoma de Mexico) Neuro-hormonal regulation of the immune response: A 5-variable model and its feedback loop analysis; J. Shapiro (U Chicago) Bacterial self-organizing systems - *Proteus* swarm colonies; R. Redfield (UBC) Uptake signal sequences in natural transformation: modelling evolution and function.

TUESDAY AFTERNOON, 6 AUGUST
SESS 5 **Theoretical Ecology: Evolution of Social Spacing: Aggregation and Territoriality.** This session is dedicated to the memory of **AKIRA OKUBO**. Organized by D. Grunbaum,Dept of Math, U. Utah (grunbaum@math.utah.edu)

Talks by: D. Grunbaum, Introduction and retrospective: Okubo and his contributions to theoretical ecology; F. Adler (Utah) Evolution of facilitation in communities structured by local competition; P. Kareiva (UW) Theory and reality in ravaged habitat: Mount Saint Helen's; J. Watmough (UBC) The formation of trails in two dimensions by individuals using osmotropotactic orientation; K. Eppler (Utah) Deer neighbors: prey-mediated wolf pack interactions in Northeastern Minnesota; P. Auger (U. Claude Bernard, France) Aggregation methods in predator-prey dynamics - predator decisions and information constraints; P. Moorcroft (Princeton) Dynamics of territoriality in coyotes; E. Silverman (UW) The dynamics of mixed species waterfowl flocks; A. Wikan (Harstad College, Norway) Nonstationary and chaotic behaviour in Leslie matrix models with density dependent survival terms; M Lewis (Utah) A tale of two tails: the mathematical link between dispersal, patchiness and variability in a biological invasion.

TUESDAY AFTERNOON, 6 AUGUST
SESS 6 **Cancer Modelling: Dynamics and Control.** Organized by J C Panetta, Department of Mathematics, Penn State University Erie, The Behrend College, Erie, PA (panetta@wagner.bd.psu.edu).

Talks by: S. Michelson (Roche Bioscience) Feedback control systems in tumor growth: characterization of the host response; L Greller (Smith Kline Beecham Pharmaceuticals) Modeling the effects of genetic alterations on progression dynamics and disease outcome; G Webb (Vanderbilt) Resonance phenomena in periodic chemotherapy of tumors; D. Cameron (Edinburgh) Mathematical modelling of the response of breast cancer to therapy associations with tumour biology and patient outcome; J C Panetta, Mathematical models of chemotherapy: its effects on bone marrow; V Kuznetsov (NIH) Mathematical modeling for quantum kinetics of binding and internalization of the interleukins by their receptors; D Kirschner (Texas A & M) Initial Transient in Immune dynamics of *H. pylori*; J Adam (Old Dominion) Mathematical models and metaphors in cancer biology;

TUESDAY EVENING, 6 AUGUST
SESS 7 **SMB POSTER SESSION**, joint with **SMB MIXER**, followed by **SMB BUSINESS MEETING**

Posters by: L B Pachepsky et al: 2DLEAD, a two-dimensional model of leaf gas exchange; C Regalado, et al, Satellites and the spitzenkorper: An example of aggregation and collapse during motion of vesicles in the fungal tips; G Mccollum: Hierarchical and serial organization in motor control; A. Boulton, et al: Evolution of genetic recombination: the hotspot conversion paradox; Charlie Smith, et al: Cycle-time and residence-time density approximations in a stochastic model for circulatory transport; MV Jose, et al: Elisa-based affinity distribution measurements of synthetic peptides of HIV; Y Takeda: A method of reconstruction of developmental process and its application to Drosophila dorso-ventral axis formation; A Spiros, et al: Models for the clustering of actin mediated by alpha-actinin and other actin binding proteins; J Mahaffy: Age structured modeling of erythropoiesis; S. Veronese, et al: Irregular patterns in 2 and 3 dimensional models of cardiac tissue; M. Xie, et al: Resonance in excitable systems under step-function forcing. (Other posters will be shown in the same session).

We are still accepting contributed posters. Send your abstract in today!

To contribute a poster: contact cesmith@stat.ncsu.edu for abstract form. Closing date for contributions: July 4, 96.

6:45 MIXER: SOCIETY FOR MATHEMATICAL BIOLOGY.
7:45 SOCIETY BUSINESS MEETING: all members welcome.

WEDNESDAY, 7 AUGUST
SESS 8 **Models of Motility: Molecular Motors to Moving Animals**. Organized by T. Daniel, Department of Zoology, U. Washington, Seattle, (danielt@zoololgy.washington.edu).

Talks by: E Pate (WSU) Analysis of the myosin step size using data from muscle fiber mechanics and actomyosin solution biochemistry; W Hancock (WSU) Motility of single headed kinesin; J Sherman (UW) Models of cross-bridge dynamics with filament compliance; E Burmeister (UC San Francisco) Calcium regulation in skeletal muscle: synthesis of Troponin-C, Parvalbumin and sarcoplasmic reticulum ATPase models; A Mogilner (Davis) Mathematical models for cell locomotion; P. Spiro (Utah) A model of excitation and adaptation in bacterial chemotaxis; G Odell (UW) Do microtubule motors position contractile rings? Does microtubule polymerization push? M Dickinson (UC Berkeley) The organization of the flight control pathway in flies; C Jordan(U Colorado) Coupling internal and external mechanics to predict swimming behavior: a general approach? A Trimble (UW) A computational model of flight in Manduca sexta: integrating physiology, mechanics, and neural control; W Megill UBC) Modelling the integration of structural biomechanics and hydrodynamics of jet propulsion in jellyfish; B Hannaford (UW) Real-time simulation of segmental reflexes in the human spinal cord.

SMB MIXER:will be held on Tuesday, August 6, 1996 at 6:45 pm in conjunction with our poster session. Light refreshments will be provided. (Alcoholic) Drink tickets must be purchased in advance, at the registration desk. Come join us for an informal evening, and stay for the member's meeting immediately following the mixer, at 7:45 pm.

BUSINESS MEETINGS: Officers of the Society will meet over dinner on Monday night, August 5, 1996. The general member's meeting will be held on Tuesday evening at 7:45, directly following the mixer.

FIELD TRIP UPDATE: The Society for Mathematical Biology is sponsoring a field trip to Mt. St. Helen's (organized by Bill Fagan, UW) on Thursday, Aug 8.

According to Bill (UW), past winter's storms have destroyed the only road into the east side of the monument itself, precluding our access to many of the best sights that we were hoping to visit . The US Forest Service is hoping to have the main trunk road open by August, but this is still to be confirmed. At this point, we are hoping to hold the field trip by approaching from the west side of the monument. Although it is less spectacular, there are some stopping points and short trail trips possible. Updates on the status of this field trips can be obtained by contacting Bill Fagan: faganb@zoology.washington.edu (Tel: 206-685-6893)

MORE INFORMATION AND DETAILS: See the smb home page at http://www.iam.ubc.ca/spider/spiros/smb/index.html for complete program details and abstracts as they evolve.

REGISTRATION MATERIAL: contact Marilynn Maury at AIBS (mmaury@aibs.org) Tel:202-628-1500 ext 254; Fax 202-628-1509; 1444 Eye St, NW, Washington DC 20005

Landahl Travel Support for Students

The Landahl Travel Fund Grants provide financial support for graduate student members of SMB attending the SMB meeting. Deadline for application: June 28, 96. Faculty advisor must send letter of recommendation, indicating funding needs and other available support).Preference given to students contributing paper. Contact: J Rinzel at: Mathematical Research Branch, NIDDK, NIH, 9091, Wisconsin Ave, Suite 350, Bethesda MD 20814. FAX: 301-420-0535, phone: 301-496-4325, rinzel@helix.nih.gov

ANNOUNCEMENT AND CALL FOR PAPERS

Pacific Symposium on Biocomputing 1997

We are pleased to invite you to submit full papers, abstracts or computer demonstrations in the context of the following:

EXTRACTING BIOLOGICAL KNOWLEDGE FROM DNA SEQUENCES

A growing number of ambitious sequencing projects are in progress, and there is an increasing need for integration and analysis of these huge amounts of sequence data. The central question that remains is: how to leap from pure sequence information to useful biological knowledge?
There are many theoretical, mathematical and computational approaches useful in this enterprise. Examples of these are statistics, artificial intelligence, linguistics and information theory. A common goal is to identify functional units in the sequences, looking for characteristic patterns and regularities found in a set of examples. Some of the identified units also maintain complex relationships among themselves, allowing to explain regulatory phenomena. As some complete genomic sequences become available, there are new opportunities for comparative analyses involving global questions dealing with complete genomes. A new type of sequence analysis focusing on higher order sequence patterns is emerging.

Purpose: This session will address the different theoretical and computational approaches aimed to extract biological information from DNA sequences. This includes but is not limited to Statistical analysis of DNA sequences, Analysis of codon usage and compositional patterns, Gene identification and localization, Definition and recognition of regulatory signals, Characterization of complex functional patterns, Knowledge extraction from sequence databases, Comparative genome analysis, New tools for automated analysis, Cross validation of existing tools.

Communications: The submission of contributions for oral presentations, poster communications and live computer demonstrations are encouraged. PSB '97 will publish peer-reviewed full papers in an archival proceedings. Only the authors of peer-reviewed full papers are eligible for giving oral presentations at the meeting. Each accepted paper will be allocated 12 pages in the proceedings volume. Authors who do not wish to submit a full paper are welcome to submit a two-page abstract, which will be distributed at the meeting separately from the archival proceedings. Authors are also welcome to display posters and give live computer demonstrations. Five copies of full papers must be submitted to the central PSB address: PSB-97,c/o Section on Medical Informatics, Stanford University Medical School, MSOB X215, Stanford, CA 94305-5479 USA
Please contact the track co-chairs regarding the format requirements for full-papers and abstracts in advance, at the e- mail address: psb97@gene.cinvestav.mx

Deadlines: Full-Paper submission due: July 1, 1996, Notification of full paper acceptance: September 9, 1996, Abstract submission deadline: September 9, 1996, Final paper due: September 30, 1996

Track Chairs J. Collado-Vides, Centro de Investigacion sobre la Fijacion de Nitrogeno, UNAM Cuernavaca, A.P. 565-A, Morelos, Mexico; F. M. De La Vega, Depto. de Genetica y Biologia Molecular, CINVESTAV-IPN, A.P. 14-740, Mexico D.F. 07000, Mexico; D. Thieffry, Centro de Investigacion sobre la Fijacion de Nitrogeno,UNAM Cuernavaca, A.P. 565-A, Morelos, Mexico
For more information, visit the PSB WWW Home Page at: http://www.cgl.ucsf.edu/psb/

Literary Events

* "Advances in Mathematical Modeling of Biological Processes", Denise Kirschner, Editor, in International Journal of Applied Science & Computation, Volume 3 (1), 1996 (This is a Memorial Issue dedicated to Betty Tang)

* An Introduction to the Mathematics of Biology, E.K. Yeargers, R.W. Shonkwiler and J.V. Herod. Birkhauser, July 1996 / Approx. 433 pp. $64.50 (tent.)

* Biological Membranes: A Molecular Perspective from Computation and Experiment, K.M. Merz, Jr. and B. Roux. Birkhauser, 1996 / 608 pp. $85.00 (tent.)

* Wavelets in Medicine and Biology, Akram Aldroubi and Michael Unser. CRC Press, 1996 / 608 pp. $74.95

* Dynamics of Small Neural Populations, John Milton. American Mathematical Society, June 1996 / 125 pp. $35.00

* Monotone Dynamical Systems, Hal L. Smith. American Mathematical Society, 1995 / 174 pp. $49.00

* Thermodynamic Theory of Site-Specific Binding Processes in Biological Macromolecules, Enrico Di Cera. Cambridge University Press 1996 / 320 pp. $69.95

* The Theory of the Chemostat: Dynamics of Microbial Competition, Hal L. Smith and Paul Waltman. Cambridge University Press, 1995 / 329 pp. $59.95

* Neural Networks and Qualitative Physics: A Viability Approach, Jean-Pierre Aubin. Cambridge University Press, 1996 / 325 pp. $49.95

* Models for Infectious Human Diseases, V. Isham and G. Medley, Editors. Cambridge University Press, 1996 / 450 pp. $59.95

* Adaptive Individuals in Evolving Populations: Models and Algorithms, Richard K. Belew and Melanie Mitchell, Editors. Addison-Wesley, 1996 / 533 pp.

KEEP YOUR SMB MEMBERSHIP CURRENT !