

Preface

This is one of the four special issues of the Canadian Applied Mathematics Quarterly (CAMQ) dedicated to the occasion of the 70th birthday of Dr. Herbert I. Freedman, Professor Emeritus at the University of Alberta. Dr. Freedman is a founding editor of CAMQ and a founding Director of the Applied Math Institute at the University of Alberta that publishes CAMQ. He has made many significant scientific contributions to the field of differential equations and mathematical biology and provided outstanding leadership and services to Canadian Applied and Industrial Mathematics community. Papers in these four special issues were contributed from participants of the 5th G. J. Butler Memorial Conference in Differential Equations and Mathematical Biology, held during July 25–30, 2011, at the University of Alberta, a highly successful conference series founded and run under the leadership of Dr. Freedman. More papers were invited from conference invitees who could not participate and from collaborators of Dr. Freedman. All papers accepted to the special issues were peer refereed with the CAMQ editorial standard.

Herbert I. Freedman was born in Manitoba, Canada, on November 16, 1940. He obtained his B.Sc. in Mathematics from the University of Manitoba in 1962, and M.Sc. and Ph.D. from University of Minnesota in 1964 and 1967, respectively. His Ph.D. thesis, titled “Estimates on the Existence Region for Solutions of Equations Involving a Small Parameter,” was under the supervision of Professor Warren S. Loud.

Dr. Freedman then joined the faculty in the Department of Mathematics at the University of Alberta as an Assistant Professor in 1967. He was swiftly promoted to Associate Professor in 1969 and to Full Professor in 1978. Professor Freedman served as the Acting Chair of the Department of Mathematics in 1985 and 1986–1987. From 1987 to 1993, Herb was the Director of the Applied Mathematics Institute at the University of Alberta.

In 1993, Herb and Professor T. Bryant Moodie co-founded the Canadian Applied Mathematics Quarterly (CAMQ), which has become one of the top journals in applied mathematics and mathematical biology. Herb served in various capacities at professional and academic societies. In the Canadian Mathematical Society, Herb served on the Board of Directors (1983–1986), was the Treasurer (1985–1989) and Chair of the Nominating Committee (1990–1992); in the Canadian Applied and Industrial Mathematical Society, Herb was the Secretary in 1988–1998; in the

Rocky Mountain Mathematics Consortium he was the Vice-President (1988–1992) and the President (1989). He also served multiple terms on the Canadian Mathematical Olympiad Committee and the International Mathematical Olympiad Committee. The participants of the Canadian Mathematical Society Winter Meeting in Victoria 1991 still remember how Herb, as one of the meeting organizers and the conference banquet host, entertained the participants like a professional comedian with humorous comments and great jokes.

Herb has always been active in service to the greater community, serving on the Hebrew School Board of Directors, Gym Club Keyanos Board of Directors, and as a JCC Swim Club Executive. At one point he was the Treasurer of the West Edmonton Mall Casino Association.

In 1997, Herb took an early retirement offer and became a Professor Emeritus. This early “retirement” seems to have enabled him to be more actively involved in conducting research, advising graduate students, and serving the general community and the University of Alberta in particular. He supervised four more Ph.D. students after 1997 and responded to the call of duty to serve as the Associate Dean for Research in the Faculty of Science at the University of Alberta in 2001–2003. Not too excited about fund raising activities, Herb re-retired in 2003.

Herb has authored or co-authored over 140 papers, many of which are seminal and highly cited. He wrote one of the most readable research monographs in mathematical ecology and co-authored a popular textbook. He organized, with his colleagues, many timely, fully funded and well attended international conferences and workshops and co-edited six comprehensive proceedings and volumes. He delivered numerous plenary lectures, colloquia, and seminars around the world. He directed twelve Ph.D. dissertations, hosted numerous distinguished visitors and advised many postdoctoral fellows. Together with Geoffrey Butler, Lynn Erbe, Jack Macki, James Muldowney, Joseph So, and many others, Herb has helped to make Edmonton an international center in differential equations and mathematical biology with trend setting research activities, conferences and workshops, and graduate programs.

He was a hardworking pioneer in differential equations and mathematical biology, and did much of the heavy lifting that shaped our discipline into its present well respected form. Herb’s early research interest focused on the existence of periodic solutions of parameterized equations, almost Floquet systems, implicit function theorems, and degenerate Hopf bifurcation. In 1975, Herb visited Paul Waltman at

the University of Iowa. Through Paul's magic influence, Herb became passionate in mathematical biology and started a long and productive collaboration with Paul. Intrigued by the sustained oscillations in the Hudson Bay lynx and Arctic hare data, their early studies were on the existence of periodic solutions in systems perturbed from classical Lotka-Volterra and Kolmogorov-type predator-prey models. Herb then studied predator-prey systems with mutual interference, density-dependent death rates, periodic coefficients (with G. Butler), periodic carrying capacity, time lags, group defense (with G. Wolkowicz), and uniqueness of limit cycles (with Y. Kuang). The most noteworthy milestone is the publication of his textbook "Deterministic Mathematical Models in Population Ecology" in 1980, Marcel Dekker Inc., New York, which focuses on two-species predator-prey, competition, and cooperation models and deals with the dynamics of these models.

From the late 1970s, Herb and his collaborators (P. Waltman, J. So, G. Butler, etc.) started to analyze three species population models (three species food web, two competing predators feeding on a single prey, a single predator feeding on two competing prey populations, etc.). A motivating and most engaging issue for these models is the question of persistence, or long term coexistence of these interacting species. Mathematically, persistence means that in a given system strictly positive solutions do not tend to the boundary where at least one component assumes zero value and the species population densities stay above some positive minimum levels. Many of Herb's contemporaries (including T. C. Gard, T. G. Hallam, J. Hofbauer, V. Hutson, W. Jansen, etc.) were also considering similar properties of interacting population models and several closely related concepts were being studied. Weak and uniform persistence of a system are defined as having the property that the distance between omega limit sets of orbits with positive initial values and the boundary is greater than zero and greater than a positive number, respectively; while permanence means that the system is uniformly persistent and bounded. In the seminal paper in the Proc. Amer. Math. Soc. (1986), Butler, Freedman and Waltman proved that in a locally compact metric space, if a continuous semiflow is dissipative and the restriction of the semiflow on the boundary produces isolated and acyclic limit sets, then weak persistence implies uniform persistence. This paper (along with the subsequent paper by Butler and Waltman published in the J. Differential Equations (1986), in which the local compactness assumption was eliminated and both discrete and continuous dynamical systems are allowed) has inspired systematic and extensive studies on

persistence in dynamical systems and various types of equations. The monographs “Spatial Ecology via Reaction-Diffusion Equations” (John Wiley and Sons, 2003, by R. C. Cantrell and C. Cosner) and “Dynamical Systems and Population Persistence” (Amer. Math. Soc., 2011, by H. L. Smith and R. S. Thieme) prominently and thoroughly cover the persistence theory in dynamical systems, with much credit to Herb and his collaborators.

In the 1990s, in collaboration with J. W.-H. So, P. Waltman, K. Gopalsamy, W. Aiello, J. Wu, Y. Kuang, S. Ruan, Y. Cao, X.-Q. Zhao, and V. Sree Hari Rao, Herb studied various delay differential equation models. For example, Aiello, Freedman and Wu (SIAM J. Appl. Math. 1992) developed a single-species growth model with stage structure consisting of immature and mature stages using state-dependent delays and studied various properties of the model, such as positivity and boundedness of the solutions, existence and local stability of equilibria, and global behavior of solutions. This remains a highly cited paper and is related to the study of differential equations with state-dependent delay. In the 2000s, Herb expanded his research interest to include modeling cancer dynamics with immunotherapy, chemotherapy, and radiotherapy; he and his collaborators have published some very influential papers in this fast growing area.

Ph.D. Students of Herbert I. Freedman include: Bindhyachal Rai (1982), Joseph So (1984), Yang Kuang (1988), Ravinder Kumar (1988), Walter Aiello (1990), Feng Yang (1992), Shigui Ruan (1992), Guirong Cui (1997), Frank Nani (1998), Qui Liang Peng (1998), Wenxiang Liu (2005), Ibrahim Agyemang (2006).

Postdoctoral Fellows and Visiting Scholars hosted by Herbert I. Freedman include: Yulin Cao (USA), Miklos Farkas (Hungary), Igor Fomenko (Russia), K. Gopalsamy (Australia), Tibor Krisztin (Hungary), Peter Moson (Hungary), A. A. Martynyuk (Ukraine), S. Ya. Pilyugin (Russia), Hongshun Quan (China), J. B. Shukla (India), Yasuhiro Takeuchi (Japan), Jianhong Wu (China), Yuangtong Xu (China), Shenghai Zhang (China), Xiao-Qiang Zhao (China), Suani Pinho (Brazil).

Guest Editors

Yang Kuang, Arizona State University

Michael Li, University of Alberta

Shigui Ruan, University of Miami

Hao Wang, University of Alberta

Jianhong Wu, York University

April, 2012