PREFACE TO SPECIAL ISSUE IN HONOR OF CARLOS CASTILLO-CHAVEZ

A little more than a quarter-century ago, I received an inquiry from a young Assistant Professor of Applied Mathematics at the University of Tulsa, the honoree of this volume, Carlos Castillo-Chavez. Though he was well situated in a faculty job, he was not satisfied: He was interested in mathematical biology, having written an excellent thesis in population biology with Fred Brauer at Wisconsin entitled Linear and Nonlinear Deterministic Character-Dependent Models with Time Delay in Population Dynamics. But that success had only whetted his appetite to become more deeply embedded in biology, and he was prepared to give up his faculty job to start a postdoctoral fellowship in ecology. It is always difficult to read in such letters what potential exists in the author; but there was something about what Carlos wrote, the obvious sacrifice he was prepared to make, and my regard for Fred Brauer that convinced me that I must meet this fellow. We did meet, for lunch in an LA restaurant, and the qualities that have led to his remarkable career were immediately obvious. I resolved on the spot to make sure he joined our group. Carlos arrived at Cornell shortly thereafter, and did not leave for nearly twenty years.

Carlos wanted to be a theoretical population biologist, and made clear that he really wasn't terribly interested in doing anything with infectious diseases. So we worked on a variety of other problems in ecology and evolution (Castillo-Chavez, Levin, & Gould, 1988; Castillo-Chavez, Levin, & Shoemaker, 1989), while I subconsciously maneuvered him closer and closer to the subject where I thought he could make his greatest contribution because of his desire to tackle problems of importance to people, especially in developing nations. Long and productive visits to Cornell by Ken Cooke and Herb Hethcote sealed the deal; Carlos became deeply involved with the complexities of influenza A and of HIV dynamics, serving as lead author on a range of papers that explored the interplay among different strains, different diseases, and demography, and skillfully mastering the biology as well as difficult mathematical techniques. (Brauer & Castillo-Chavez, 2001; Castillo-Chavez, Cooke, Huang, & Levin, 1989a, 1989b, 1989c, 1989d, 1989e; Castillo-Chavez, Cooke, & Levin, 1989; Castillo-Chavez, Grünbaum, & Levin, 1987; Castillo-Chavez, Hethcote, Andreasen, Levin, & Liu, 1988, 1989). For influenza, the puzzle was to explain the factors underlying oscillations. The interactions between two strains were not sufficient (Castillo-Chavez, Hethcote, et al., 1988, 1989) although later work has shown that sustained oscillations are possible if more strains are involved (Lin, Andreasen, & Levin, 1999). Similarly, age-structure alone, which induced oscillations due to the implicit delay (Schenzle, 1985), was not sufficient to sustain oscillations. Together, however, these two factors, age structure and cross-immunity, were mutually reinforcing, and could produce sustained oscillations.(Castillo-Chavez, Hethcote, et al., 1989)

HIV-AIDS presented different challenges, including the interaction with other diseases like gonorrhea or tuberculosis, and especially the importance of mixing

structures within a population due to sexual behavior, drug use or other factors. There were similarities to influenza, where heterogeneous mixing was due largely to age structure; but Carlos attacked the problem in novel ways, both theoretical and empirical(Busenberg & Castillo-Chavez, 1991). Carlos even designed questionnaires to study the social and sexual behavior of Cornell students, in the hope of improving understanding of the factors affecting spread. Needless to say, he evolved rapidly from a recalcitrant disease modeler to one of the leaders of an exciting and important field (Brauer & Castillo-Chavez, 2001).

For most academics, the success in research that Carlos achieved would have been sufficient to allow resting on laurels. But Carlos was far from satisfied: He wanted to transmit his enthusiasm for the subject to as many others as possible, and to make the pathway easier for others wanting to make the transformation that he had made. Furthermore, having known the special difficulties minorities face through his own experiences, Carlos created a variety of wildly successful programs for minority students, for which he has quite deservedly received much recognition. More important to him than that recognition, surely, is the loyalty and devotion those he has helped feel towards him.

This volume is remarkable testimony to the breadth of Carlos's influence, across a wide spectrum of mathematical biology. It includes contributions from mentors to colleagues to students, across a broad swath, and covering a wide range of problems. Surely Carlos never imagined such a tribute when we met those many years ago in the LA restaurant; I can't claim to have predicted just how great his impact would be. But certainly the tribute is appropriate, and simply a milepost in a career that is still expanding.

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