tists and students involved in that effort, and worked with my associates to prepare the material for three reports on our research.

Our first book, *The Limits to Growth*,* presents the basic premises underlying our research program. It describes the dynamic characteristics of exponential growth, the physical limits to growth imposed by a finite planet, the relation of technological advance to physical constraints, and the various levels of population and material consumption that might be accommodated upon this earth. *The Limits to Growth* also summarizes the assumptions comprising our revised global model, World3, and illustrates the conclusions derived from it through the use of twelve computer simulation runs generated by the model.

Our second report, *Toward Global Equilibrium: Collected Papers*,† is an anthology of thirteen research papers prepared by Professor Forrester and the project staff. Seven of the papers provide technical descriptions of the submodels we constructed to study in detail specific sectors of the global models. The submodels illustrate the level of detail and the time horizon appropriate for future efforts to disaggregate the world models. In addition, they test the utility of important, simplifying assumptions in World2 and World3 and extend the perspectives derived from the global models to shorter-term issues more relevant to current decision makers.

The Dynamics of Growth in a Finite World, the third book in the series, presents a detailed description of World3, the computer model that was constructed to facilitate our understanding of growth in global population and material output. Although the model will certainly be improved through further work, it currently provides an easily understood, dynamic theory of the long-term, complex changes arising from physical growth in a finite environment. This text will serve analysts who wish to extend our analysis or to construct their own large-scale simulation models. It also provides a technical basis for multidisciplinary courses on population, the environment, and economic development. We assume throughout this text that the reader is throughly familiar with the material presented in *The Limits to Growth*.

The version of World3 presented here differs in several minor respects from the model employed in *The Limits to Growth*. After publication of the first book, several variable names were changed to clarify the meaning of an element or to make our terms more consistent with the nomenclature of the relevant fields. A few numerical parameters were also altered, and some dynamic phenomena were modeled in more detail to incorporate new data obtained since the completion of the first report. The changes in World3 affect neither the general behavior of the model nor the conclusions derived from it. In Chapter 7 of this book we present computer runs from the final version of World3 that are identical in all important respects to those presented in *The Limits to Growth*. To maintain consistency within the three reports, future printings of *The Limits to Growth* will employ a set of twelve computer runs generated by the

*D. H. Meadows et al., *The Limits to Growth* (New York: Universe Books, 1972).

†D. L. Meadows and D. H. Meadows, eds., *Toward Global Equilibrium: Collected Papers* (Cambridge, Mass.: Wright-Allen Press, 1973).

version of World3 described here. Appendix G to this report presents the rerun equations required to obtain those twelve runs.

Our team disbanded after completing The Club of Rome project, but all the former members are continuing their research on various aspects of the limits to population and material growth. Our current research at Dartmouth has now shifted to constructing simulation models that offer the time horizon and the detailed empirical validation necessary for managing the transition to material and demographic equilibrium at both the national and the regional level.

Acknowledging the contribution of everyone who has assisted our work is impossible, because modeling social systems is chiefly an exercise in synthesis. Not only our data but even most of our theories were drawn from the work of others. The task of assigning credit is further complicated by the fact that many of the concepts in World3 were employed in a context unfamiliar to and perhaps even unacceptable to their originators. Under the circumstances, I have chosen to let the references cited throughout this book testify to our indebtedness for the content of World3. Here I shall express our appreciation only to those who made a direct contribution to the conduct of the research project.

The Volkswagen Foundation and The Club of Rome accepted the risk of sponsoring a highly unorthodox project and provided continuing support throughout its evolution. Three members of the Club's executive committee played a special role: Aurelio Peccei constantly encouraged us to maintain a global and long-term perspective; Eduard Pestel provided assistance by securing the initial funding and by providing profuse and pertinent remarks on an early draft of this third report; and Carroll Wilson was a continuous source of wisdom, helping us to locate obscure but important information and recommending approaches to the administration of the project.

At M.I.T., Jay W. Forrester built the prototype model, World2, offered the use of his simulation laboratory facilities, and provided through his own research a set of intellectual standards that inspired each member of the team. Three long-suffering secretaries struggled through numerous drafts of this report. We are grateful to Judy Machen, Constance Fitzsimmon, and Donna Brown for their ready willingness to incorporate endless changes into the text of the manuscript. Jack Pugh, Thomas Todd, and Phil Koch provided the programming assistance required to initiate the work at M.I.T. and then transfer the model to Dartmouth College. Bill Shaffer spent long hours at the console creating the printouts for all model listings, runs, and documentation. Steve Flanders lent his special style to the artwork in the report, and Jean Clark patiently labored to convert our scribbled marginal insertions into a legible manuscript. We would also like to thank the publishers of this book, especially Holly Foster and Naren Patni, who managed to remain polite and helpful as deadline after deadline slipped by while we struggled to make explicit verbally the many concepts implicit in the equations of World3.

Finally, I want to express my appreciation to the entire team listed in *The Limits to Growth* for making the project a great pleasure, socially and intellectually. One member of the group merits special mention. Roger Naill took ultimate responsibility for converting the disparate chapters on the model sectors into a self-consistent