ABSTRACT

This is the story of a group of scientists who, in the local context of the Institut des hautes études scientifiques (IHÉS), France, contributed to the elaboration of catastrophe theory and deterministic chaos theory. Starting with a study of the role of Bourbaki's mathematics on the French intellectual scene (and especially with respect to strcuturalism), this dissertation examines the resources from topology, embryology, and linguistics used by René Thom to construct catastrophe theory. It describes the foundation of the IHÉS by Léon Motchane in 1958 and the ideology of fundamental research that shaped it. It reviews the history of structural stability for differential equations, focusing on the work of Alekandr Andronov and Solomon Lefschetz, among others, and the synthesis achieved in the 1960s by Stephen Smale at the University of California, Berkeley. These mathematical developments were used by Thom to develop new modeling practices. The IHÉS, which welcomed topologists such as E. Christopher Zeeman and Ralph Abraham, played a role in developing modeling practices based on recent advances in topology. A physics professor at the IHÉS, David Ruelle, together with Dutch mathematician Floris Takens, adapted the modeling practices of these 'applied topologists' and proposed a mechanism for the onset of turbulence, thereby introducing the concept of strange attractors. Looking at the history of fluid mechanics, I argue that Ruelle's work displaced earlier emphases on fundamental laws, like the Navier-Stokes equations, and focused on the modes of representation rather than representations themselves. A certain Bourbakization of physics and the advent of the computer shaped

this evolution. Finally, focusing on convection, and taking the Rayleigh-Bénard system as a boundary system, various communities' responses to the Ruelle-Takens model are examined, in particular hydrodynamic stability theorists, phase transition physicists and Pierre-Gilles de Gennes's group, and chemical physicists orbiting Ilya Prigogine. Prior interest in developing interdisciplinary approaches for the study of turbulence helped the adaptation of a dynamical systems approach for the study of natural phenomena, greatly inspired by the work of Smale, Thom, and Ruelle.