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or a number of years, I have wanted to write about my work on earthquakes and plate tectonics going back to my early days as a young scientist at the Lamont Geological Observatory of Columbia University and to bring it up to date with my latest work. Much progress has been made in understanding great earthquakes during the past 58 years. Timing and my preparation gave me the opportunity to be involved not only in ground-breaking discoveries in the development and testing of plate tectonics during the 1960s but also in the signing of a nuclear-test-ban treaty with the Soviet Union in 1974. Throughout the past 58 years, I have worked on verifying and obtaining a comprehensive nuclear-test-ban treaty, understanding great earthquakes, and more.

A variety of tasks pulled at me through the years: research on earth-quakes in the greater New York City region, additional work on plate tectonics, long-term earthquake prediction as new information and techniques became available, as well as my work as a consultant to New York State regarding the likelihood of earthquakes near the Indian Point nuclear-power plants, located along the Hudson River not far from New York City. During my 40 years as a professor, before my retirement in 2005, I advised approximately thirty graduate students at Columbia University, raised funds for their support, and usually taught two classes each year in a dozen different areas of the earth sciences, environmental hazards, and the nuclear-arms race.

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Now, at eighty-one years old, I have made time to reflect upon my life—professionally and personally. My undergraduate years at the Massachusetts Institute of Technology opened doors to me both scientifically and culturally. The Lamont Geological Observatory, where I landed as a graduate student in 1960 with a degree in geology and geophysics, had been formed only a dozen years earlier. I was in the right place at the right time with the birth of plate tectonics and the development of seismic methods to verify a comprehensive nuclear-test-ban treaty. My chosen field—seismology, the study of earthquakes—is the primary science and technology for detecting, locating, and identifying underground nuclear tests. Methods for examining earthquakes are very similar to those for nuclear explosions.

At Lamont, Bruce Heezen and Marie Tharp were charting the Mid-Atlantic Ridge; Maurice and John Ewing were sending research vessels to explore parts of the southern oceans to map sediment thicknesses and to chart extensions of the Mid-Oceanic Ridges in largely unmapped areas. A number of seismologists at Lamont were using surface waves to study the crust and upper mantle beneath continents and oceans. Earth scientists explored several deep-sea trenches. These studies, along with my friend Walter Pitman's "magic profile" of magnetic anomalies and my improved locations of earthquakes along the Mid-Oceanic Ridges, made possible the theories that the continents had shifted over geologic time and were moving today and that oceanic crust was young and growing.

Although these conclusions are universally accepted now, many viewed them with skepticism at the time. When I was an undergraduate at MIT, a professor told me that respectable young earth scientists should not work on vague and false concepts such as continental drift. Among the skeptics, Maurice "Doc" Ewing, the director of Lamont, strongly believed that the continents were fixed and that the oceanic crust was very old. In fact, before 1967 most earth scientists in North America were convinced continental drift was a fantasy. I, too, was a skeptic until 1966.

In mid-1966, after halting research on another project, I worked to obtain the sense of movement in earthquakes along great faults beneath the oceans and to demonstrate that new seafloor was being formed along Mid-Oceanic Ridges and that continental drift was a reality. Fortunately, the early part of my scientific career and the following decade coincided with the golden age of funding of the earth sciences in the United States.

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My decision to specialize in studying earthquakes brought with it an awareness of the importance of a full halt to the testing of nuclear weapons. A companion book, *Silencing the Bomb: One Scientist's Quest to Halt Nuclear Testing* (Sykes 2017), emphasizes nuclear testing and arms control and highlights the desirability of a full test-ban treaty and a variety of possible steps toward the control of nuclear weapons and the prevention of nuclear war. Realizing the devastating consequences of a nuclear conflict, I made a major commitment to do whatever I could to effect the signing and ratification of a comprehensive nuclear-test-ban treaty. We in the seismological community could contribute to the identification of difficult-to-identify underground nuclear explosions and perhaps bring about an end to atomic testing and the nuclear-arms race. A number of heroes and villains stand out in the search for a verifiable halt to the testing of nuclear weapons.

I have tried to make this book accessible to a wide audience of educated people, including students, scientists, and those interested in the history of science. It is not intended as a textbook or scientific review of earthquakes, plate tectonics, or earthquake forecasting. I focus instead more on the science and policy implications of the studies I participated in directly. In that sense, this book is partly autobiographical.

Chapters 1 and 3 to 6 describe my work on the development and testing of plate tectonics during the 1960s. My personal life, education, and aspects of them that influenced my work on plate tectonics and earthquakes are described in chapters 2 and 14. Chapters 7 and 8 cover my studies of seismic gaps—that is, places along plate boundaries that have not been the sites of large earthquakes for many decades. Some of these gaps are likely to be sites of major and great shocks during the next few decades. I describe efforts to refine estimates of the times of occurrence of future large earthquakes by determining repeat times of past large shocks and how far along in time certain seismic gaps are in the cycle of the buildup of pressures (stresses) toward future large shocks. Chapter 9 covers my work in the 1980s as chair of the U.S. National Earthquake Prediction Evaluation Council. Chapter 10 describes work on great earthquakes of the past fifteen years, especially the very damaging shock of 2011 in Japan and its effect on the nuclear-power reactors at Fukushima. Chapters 11 to 13 cover my work on earthquakes within the North American plate and risks to nuclear-power

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reactors, including the Indian Point reactors to the north of New York City. Chapter 14 discusses my travels abroad to earthquake sites and other locations of scientific merit. Finally, chapter 15 covers ongoing work on long-term earthquake prediction and my assessment of the future prospects of such prediction.

Herein is my story.

PLATE TECTONICS AND GREAT EARTHQUAKES