# INTERVENTIONS

John B. Goodenough

The course of a life depends on our responses to the interventions that intrude upon it. Eight interventions in my life are recalled.

**1. Awakening.** An unlikely scholarship brought me to an Episcopalian boarding school at age 12. It introduced me to a totally new environment. There I discovered the art of metaphor, the sacredness of dialogue, and the beauty of holiness; I developed a secret desire to serve Justice, Beauty, and Truth. At Yale University, I turned increasingly to philosophy for insight into a professional calling. While reading Alfred North Whitehead's Science and the Modern World, I concluded that I should study physics if given the opportunity after the War.

**2. World War II.** Pearl Harbor came in my second year at Yale University. When I went to enlist the next day, my mathematics professor called me to his office and persuaded me to join the Army Air Force as a meteorologist rather than the Marines. That advice allowed me another year in which to finish my undergraduate studies. I spent my war years forecasting the weather for planes crossing the Atlantic Ocean. During these years, I took leave of my struggle to find a calling.

**3. A telegram.** At war's end, I was in the Azores waiting for my turn to go home. I was naively thinking I would apply to a Law School to prepare to work for one-world government, but these thoughts were interrupted by a telegram ordering me back to Washington D.C. My mathematics professor had not forgotten me; he had placed my name in nomination for a program to study either Mathematics or Physics at the University of Chicago or Northwestern University. This offer propelled me back to my thoughts while reading Whitehead, and I enrolled in Physics at the University of Chicago. There I met my wife, I came to an understanding of Christian faith, and I was able to measure my talent against the standards of Enrico Fermi. I chose to become a solid-state scientist.

**4. Rejection.** My thesis supervisor, Clarence Zener, took a job as Director of Research at the Westinghouse Research Laboratory, and I finished writing my dissertation there. I had expected to continue at Westinghouse after receiving my Ph.D. degree, but that was not to be. I applied for a Fulbright fellowship to study Theology at Cambridge University in England, but I was told to stay in physics. I had invitations to become an Assistant Professor of Physics at the University of Pennsylvania or a research scientist at the MIT Lincoln Laboratory. I chose the latter; it offered the opportunity to work with young engineers and ceramists on the development of the ferrite-core random-access memory for the digital computer. Our successful development of that memory proved to be critical for the evolution of the computer.

**5. Encore.** Successful realization of the magnetic-core coincident-current memory meant our services were no longer needed. We were given a choice either to go with the technology to industry or to find a new problem relevant to the mission of the MIT Lincoln Laboratory. I chose to stay, proposing development of a magnetic-film memory that promised to be faster. However, the man I hired to work with me on this project wished to make it his own, so I took over what remained of the ceramics laboratory. I explored metal-metal versus metal-oxygen-metal interactions and the transition in each case from localized to itinerant electronic behavior in transition-metal compounds. It gave

me the opportunity to write two books, Magnetism and the Chemical Bond and Les oxydes des metaux de transition.

**6. Washington intervenes.** By 1970, Senator Mansfield had decided that the federal government should not be supporting fundamental research at places like the MIT Lincoln Laboratory. I was ordered to terminate my program. An increase in oil prices at that time caused me to propose a program of energy research. I developed framework structures for alkali-ion solid electrolytes and wave-length-selective films for heating with solar energy. I also proposed development of a solid oxide fuel cell and the generation of hydrogen with solar energy. However, Wahsington decided to support energy research only in Industry and the National Atomic Energy Laboratories. It was time for me to leave the MIT Lincoln Laboratory.

**7. A call from Oxford.** I had long been interested in ways to bring technology to the developing world. While considering the possibility of taking my research proposals to Iran, an offer to become Professor and Head of the Inorganic Chemistry Laboratory at the University of Oxford brought me to England. It was there that I developed the cathode materials for a lithium-ion battery for which I am being honored by the Japan Prize.

**8. A call from Texas.** In 1986, an invitation to become the Virginia H. Cockrell Centennial Professor of Engineering at the University of Texas at Austin rescued me from mandatory retirement. In Texas I have continued work on cathodes for lithium-ion batteries and have picked up my earlier proposal for a solid oxide fuel cell. Moreover, the discovery in 1986 of high-temperature superconductivity in the copper oxides brought me back to my earlier interest in the origin and exploitation of the unusual physical properties found at the transition form localized to itinerant electronic behavior in transition-metal compounds.

My life has thus been mysteriously blessed by interventions that opened or closed doors at critical moments.