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# ADVANCES IN CHRONOBIOLOGY

## Part A

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## Dedication

These two volumes of *Advances in Chronobiology* are dedicated to Professor Franz Halberg in recognition of his 40 years of service to biology and medicine and the leadership he has provided our discipline.

Franz Halberg was born in Bistritz, Romania, on July 5, 1919. After receiving his elementary and secondary schooling in Bistritz, he enrolled in the University of Cluj in Koloszvar where he received his medical degree in 1943. He became a citizen of Austria and served in the Department of Anatomy at the University of Innsbruck from 1946 to 1948, first as a *Wissenschaftlicher Assistant* and later a *Universitäts-Assistent*. Even during those early years, groups of enthusiastic students collected around him, and in informal seminars he introduced them to critical scientific thinking and biomedical research.

Contact with a group of leading U.S. scientists who were teaching in postwar Europe led to an invitation to come to the United States where he could find a broader scope of research opportunities. He immigrated in 1948 and became a Research Fellow at Harvard Medical School and an Assistant in Medicine at the Peter Bent Brigham Hospital in Boston. It was at that time he encountered time-dependent, recurring, and thus predictable rhythmic changes in biological variables; many of these were of greater magnitude than the effects of the experimental intervention being studied. These observations became a turning point in his life, which he then dedicated to the study of the time factor in biology and medicine.

In 1949 he joined the staff at the University of Minnesota Medical School where he has served for more than thirty-seven years. Starting as a Fellow he advanced through the ranks to Instructor (1950), Research Associate and Assistant Professor in Physiology (1951-1954), Assistant Professor and then Associate Professor in the Division of Cancer Biology (1954-1958), and the Elsa A. Pardee Professor of Cancer Biology and Experimental Pathology (1958-1962). Since 1962, Franz Halberg has held a Career Award Professorship in Laboratory Medicine and Pathology, and he also is a Professor of Physiology and Biology in the Graduate School. He is the Director of the Chronobiology Laboratories at the University of Minnesota which are officially affiliated with the University of L'Aquila, in L'Aquila, Italy; the René



Professor Franz Halberg

Descartes University in Paris, France; and the Faculty of Computer Science at the Autonomous University in Madrid, Spain.

In his long and distinguished career, Professor Halberg has received many honors including medals from the University of Montpellier in France, the University of Krakow in Poland, the University of Ferrara in Italy, and the University of Szeged in Hungary, as well as an Honorary Doctorate from the University of Montpellier in 1980. He is a regular member of numerous scientific societies, an honorary member of others, and a Fellow of both the New York Academy of Science and the American Association for the Advancement of Science. At the present he is Vice-President of the International Society for Research on Civilization Diseases and the Environment, the Director of the Editorial Board of *Chronobiologia*, a member of the editorial boards of *Fortschritte der Medizin* and *New Trends in Experimental and Clinical Psychiatry*, and a member of the Editorial Advisory Council of *Chronobiology International*.

In the past Dr. Halberg has served on or has been the chairman of numerous national and international programs, committees, and panels. He has been a consultant to the National Heart, Lung and Blood Institute as well as the Sloan-Kettering Institute for Cancer Research and Memorial Hospital. He has served on the editorial boards of *Rassegna di Neurologia Vegetativa, Sleeping and Waking, Reader, the International Review of Rheumatology,* and the *International Journal of Chronobiology*.

To many workers Franz Halberg is the father of modern chronobiology and its undisputed leader, particularly as it relates to biomedical research and therapy. For almost four decades he has worked day and night with students and faculty from all levels of the academic ladder and from all parts of the world. He has studied the basic problems of biological rhythmicity including synchronization and desynchronization, the free running of rhythms from their environmental synchronizer, and the importance of rhythms for adaptation to the environment and the resistance or susceptibility to various stimuli. The latter contributed to the development of the field of Chronopharmacology which is in the process of revolutionizing many forms of treatment in clinical medicine. He has studied time structure by the physiological and statistical evaluation of rhythms with periods ranging from fractions of a second to years during growth, development, and aging and at all levels of organization: cellular, endocrine, neural, and societal. For many years he has been interested in improving methods of data collection and has worked with biophysicists in the development of miniaturized solid-state data collectors which he and his family have tested on themselves. He is a splendid mathematician and statistician and is chiefly responsible for developing and refining the cosinor method for analyzing time-series data. He combines modern, miniaturized, solid-state data collectors with such classical tools as thermometers and sphygmomanometers for self-measurements that can be

analyzed by computer techniques. Using such techniques he has pioneered the area of autorhythmometry that has provided so much information about ranges of values that can be correlated with living routines, time of day, and season. The information obtained from this work has produced novel temporal characteristics that have been employed by physicians to gauge health and by biologists to determine normalcy. The information also has provided new reference standards and end points that can be used to screen for elevated risks of developing diseases, for diagnosis and prognosis, and for timed treatment.

Franz Halberg certainly is one of the most productive scientists in the world. He published his first article in 1946, and since that time he has authored or co-authored more than 1300 papers, abstracts, chapters, and books. Almost all his papers are multiauthored, but those who know him will attest to the fact that he has been the principal author of many, even those in which his name appears last. Fine scientists have trained in his laboratory over the years. These include many senior investigators who have spent sabbaticals in Minnesota. There they have discovered what it is like being around a human dynamo, who works from early morning to late at night seven days a week. But Franz Halberg does not confine his activities to the Chronobiology Laboratories at the University of Minnesota. The world is his laboratory, and he is involved in cooperative research projects all over the United States, in many countries, and on all continents. Hardly a month goes by when he isn't visiting other laboratories, giving guest lectures, and attending conferences or scientific meetings. Everyone around him gets caught up in his work. He welcomes collaborative efforts and always can be counted on to do more than his share. He particularly likes to help young investigators get started in the field and often takes with him to scientific meetings an entourage of students, some of whom may still be in high school.

Professor Halberg has a long standing interest in terminology, has served as the Chairman of the International Commission on Nomenclature in the field of Physiologic Periodicity, and is a member of the Glossary Committee of the International Union of Physiological Sciences. He personally has coined much of the terminology used in modern chronobiology including the term "circadian rhythms".

Although Franz Halberg probably spends as much time at work as any living scientist, he still finds time to be a devoted husband and father and a wonderful friend. Chronobiology is always with him, and those who know him well can recall discussing experimental procedures on the tennis court or novel statistical analyses on the ski slopes.

Professor Franz Halberg served for more than ten years as President of the International Society for the Study of Biological Rhythms and, after the name was changed, as President of the International Society for Chronobiol-

ogy for another fifteen years. During this time he worked untiringly to develop a “field of interest” into a recognized integrative discipline of modern biology. The exploration of many of the basic phenomena in chronobiology and many of the methods for their quantitative study are inseparably tied to the name and the work of Franz Halberg. These volumes are dedicated to him in recognition of his outstanding contributions to science, his pioneering efforts in the field of chronobiology, and the help and encouragement he has provided colleagues all over the world.

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