editorial

Introduction to thematic series on sphingolipids in honor of Professor Herbert E. Carter (1910–2007)

This Thematic Review Series on Sphingolipids represents a collection of papers by leading investigators in the field to commemorate the achievements of Herbert E. Carter following the Memorial Symposium in his honor that took place in October at the University of Arizona, Tucson, Arizona. Since the structural identification of sphingosine by Carter over 60 years ago, the field has witnessed a remarkable evolution and expansion, particularly on the functional aspects of sphingolipids in normal and disease states.

Carter was a towering figure in science, education, and humanity. He received a PhD degree in 1934 in organic chemistry (Carl S. Marvel) from the University of Illinois. He remained at Illinois as a member of the faculty and served as head of the Department of Chemistry and Chemical Engineering (1954–1967) and later as Vice Chancellor for Academic Affairs (1968–1971). Following his retirement from Illinois in 1971, he moved to the University of Arizona and established the very successful Office of Interdisciplinary Programs, and created and headed the University Department of Biochemistry (1977–1980). He remained active there until the age of 94.

Carter was the father of the fields of sphingolipids and glycolipids. His early interest in the famous Thudichum (1829–1901) enigma, sphingosine (sphingein) (1) was aroused by his solution to the structure of the amino acid threonine (2), newly discovered by his colleague, William C. Rose (3) as an essential amino acid. Sphingosine, like threonine, is a hydroxyamino compound with two asymmetric centers. An early interest in fatty acids, combined with his studies on α-amino-β-hydroxyacids, led Carter to the structure and synthesis of sphingosine (4). These studies resulted in the Eli Lilly Award for Carter in 1943.

Further research led to the structures of dihydrosphingosine and cerebrosides (5, 6). When Carter turned his attention to lipids of plants, he discovered the new base phytosphingosine and investigated the structure of its parent compound, phytoglycolipid (7). Subsequently, the structures of phytosphingosine and dehydrophytosphingosine were established (8), followed by the discovery of branched-chain sphinglipid bases (9, 10). He also discovered a new class of plant glycolipids, the galactosylglycerides (11). Carter made important contributions to the structure of bacterial lipid A (12), and to the structure and function of polyene antibiotics (13). He discovered a new class of ethylene glycol-containing phospholipids in lung tissue (14).

Studies on the antibiotic/toxin patulin (15) led to an interest in antibiotics during the war in the 1940s, when Carter was involved with a consortium of midwest chemists in work on penicillin and other antibiotics. In collaboration with David Gottlieb, he isolated and determined the structures of streptomycin (16), streptothricin (17), chloramphenicol (18), neomycins (19), and levomycin (20).

Carter's early interest in establishing the configuration of chiral centers led to a life-long fascination with stereochemistry. It is rarely recognized that he first drew attention to the concept of prochirality. In a landmark paper (21), he established the fact that the reaction at a prochiral center (to which he gave the name "meso-carbon") with an asymmetric reactant gave an unequal ratio of diastereoisomers. He was strongly criticized at the time (22), but his conclusions were widely verified by others.

Carter was not only a leader of scientific thought, but also a servant to the scientific community. He played important roles as President of the American Society of Biological Chemists (1956–1957) and as member (1954) and chair of many important committees of the National Academy of Sciences, the National Research Council, the Gordon Research Conferences, the National Institutes of Health, and the National Science Foundation. He served as a member, and then as chairman, of the National Science Board. In recognition of his contributions at the National Science Board, a mountain ridge in Antarctica, Carter Ridge, was named after him. He was the founder of the series *Biochemical Preparations*, and served as a member of the editorial boards of many scientific journals, including the *Journal of Biological Chemistry* and the *Journal of Lipid Research*.

Carter was an inspiring teacher and provided intellectual guidance to 66 PhD students and many postdoctoral associates. Many of his pupils later became prominent in their own fields, including his first graduate student, Phillip Handler, who chaired the Department of Biochemistry at Duke University and was President of the National Academy of Sciences, and Martin Rodbell, who won a Nobel Prize in physiology in 1994.

For those who knew him, Herbert Carter was a kind, compassionate, wise, humorous, and loyal friend. His motto,

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"If research isn't fun, it shouldn't be done," sums up much of the personality of this great scientific pioneer.

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