

Book Reviews

Karl von Frisch and the Magic Well

The Dance Language and Orientation of Bees. KARL VON FRISCH. Translated from the German edition (Berlin, 1965) by Leigh E. Chadwick. Belknap Press (Harvard University Press), Cambridge, Mass., 1967. xiv + 566 pp., illus. \$15.

A Biologist Remembers. KARL VON FRISCH. Translated from the German edition (Berlin, 1957) by Lisbeth Gombrich. Pergamon, New York, 1967. x + 200 pp., illus. \$6.

Von Frisch's *Tanzsprache und Orientierung der Bienen* will surely take its place in the tiny group of genuine classics of scientific literature. It is the definitive account of the waggle dance and other forms of honeybee communication as they have been so consummately elucidated by von Frisch and his students, and it contains in addition a clear summary of the vast lore of experiments on the sensory physiology and orientation of the honeybee. The translation of the book into English together with the translation in the same year of von Frisch's autobiography is therefore an occasion to be marked, and it is perhaps appropriate for English-speaking and most particularly American biologists, removed as they are so far from the culture and academic traditions of prewar Germany, to reflect on the conditions that produced this unusual man.

Karl von Frisch was born in 1886 into a family that had been thoroughly medical and academic on both sides for two generations. One is struck by the totality of that family commitment and the security and sense of mission it imparted to young Karl throughout his childhood. His paternal grandfather was chief of the Austrian Medical Officers Corps. His father, his maternal grandfather, and all four of his maternal uncles were university professors; two of his three brothers became university professors, and the third the director of the Salzburg Studienbibliothek. In the summers the clan gathered at Brunnwinkl, the von Frisch vacation home on the shore of Austria's Wolfgangsee.

Here the atmosphere was remorselessly intellectual, yet, for the children at least, permissive and happy.

Though the young people would often keep to themselves, laughing and playing and teasing each other with innocent banter, on some nights they would be equally prepared to listen to serious talk when one of their elders told about travels to foreign lands or when recent advances about science were being discussed. . . . The great Austrian writer Marie von Ebner-Eschenbach, who spent several summers at the neighbouring resort of St. Gilgen, read quite a few of her works from manuscript to our small circle.

It would surely have taken a major convulsion to turn von Frisch away from a career in science. When he showed an early interest in animals, this was warmly encouraged by his family, and when he undertook in his teens to build a natural-history museum at Brunnwinkl, the entire family pitched in to help. It was none other than his uncle Sigmund Exner, the leading authority on insect vision at that time, who channeled Karl's earliest professional endeavors into a study of vision in honeybees, thus setting the pattern for life.

Possibly this serene history and the unquestioning, priestly reverence for science are responsible for the sparseness of personal detail given by von Frisch in his autobiography. The family religion, Roman Catholicism, is gently dismissed in one paragraph, and romance before the age of 30 is said to have been ample but is permitted only one sentence nonetheless. Images of people and events tend to be flat and stroboscopic, too often reduced to frozen little anecdotes each allotted a measure of puckish wit. Great personages become stereotypes. Von Frisch's professor at Munich, Richard von Hertwig, for example, is the kindly, absent-minded guru beloved by his large staff and group of students, yet irascible at times, just as we must have expected from foreknowledge of the stereotype.

Woe betide the young assistant who tended cultures of different stages with the same pipette and risked transferring an egg from one dish to another where it had no business to be!

One need not spend a millisecond worrying about the young assistant. We know von Hertwig only for the gentle man von Frisch wished him to be. More importantly, we know from this autobiography the gentle, shy man that von Frisch in fact is. He cannot speak ill of another man. He lives manifestly by the simple maxim passed on to him by his mother, that the meaning of existence is "to make life as enjoyable as possible for oneself and others." Vivisection and the unnecessary taking of animal life distress him. In World War I he served as an assistant to his brother in an army hospital. He was an anti-Nazi from the beginning, and in 1942, when the Reichsministry of Education discovered a taint of Jewish ancestry on his mother's side, he was harassed and came close to losing his professorship. In one supremely ironic incident, he was summoned by the Reichsministry and charged with cruelty to animals, because a student informer had reported that earthworms used in his laboratory demonstrations wriggled during dissection. Von Frisch explained at length about the primitive nervous systems of earthworms and the care used in providing them with alcohol anesthesia, momentarily putting his Nazi interrogator's tender feelings at ease.

Most of von Frisch's adult life, in fact, was as insecure as his childhood had been secure. In the course of the long cycle of academic positions that took him from Munich to Rostock, Breslau, and Graz and back to Munich, he was under constant strain from the two world wars, the Nazi regime, and the postwar economic crisis. When Germany collapsed at the end of World War II, he and his family were able to take refuge at Brunnwinkl. But his return to Munich was thwarted for a few years afterward because Allied bombing had destroyed most of the Zoological Institute. Also, there was a growing threat from the Department of Chemistry. The following sentence will be curiously reminiscent and the accidental source of bitter humor for many of his present-day zoological colleagues in the United States:

The chemists were expansionists and tried to get rid of us altogether, suggesting that we join the botanists in far-off Nymphenberg.

Yet adversity had its uses. One senses that the extraordinary thoroughness of the work embodied in *The Dance Language and Orientation of Bees* was accomplished not in spite of the difficulties but because of them. For long periods of time von Frisch was tied to his bee colonies and the simplest of equipment, and he was forced to exploit this one subject to the fullest.

Every successful scientist has a small number of personal tools with which he levers discoveries out of nature. Von Frisch had two in which he attained great mastery. The first was the repeated exploitation of the passage of honeybees from nest to flowers and back again, a complex sequence of behavioral events that is nonetheless easy to manipulate and to monitor. The second was the method of Pavlovian training, by which von Frisch associated the stimuli to be studied with a subsequent reward of food. Animals trained in this fashion will respond sharply to odd stimuli that they otherwise ignore, thus revealing ultimately their utmost sensory capacities. Using the training method, von Frisch at an early age confounded von Hess in their famous debate on color vision in insects, demonstrated the ability of fish to hear and of insects to perceive polarized light, and—over the years—sketched out in great detail the sensory *Umwelt* of the worker honeybee.

The Dance Language and Orientation of Bees is a well-written encyclopedia of the subject. It details von Frisch's methods of behavior analysis, foraging behavior and communication in bees and other social insects, and the evolution of the bee dances. Attention is paid to other groups of animals where comparisons illuminate the biology of the honeybee. There are several ways in which this massive work can be studied with profit. One can read the chapter summaries in sequence and obtain a lucid introduction to the subject, although Martin Lindauer's *Communication in the Social Bees* (Harvard University Press, 1961) remains superior in that special regard. One can browse among the excellent illustrations and tables, pick experiments almost at random, and pleasantly absorb thereby the von Frisch style and spirit. The specialist, of course, will read with care the definitive treatment of every topic. Although von Frisch attempts to cover all of the literature, his emphasis is naturally on his own work and that of the large and distinguished group of students and research asso-

ciates who began studies on the honeybee under his direction, from Beutler, Jacobs, and Röscher in the early years at Rostock and Breslau to Bizetsky, Boch, Esch, Heran, Lindauer, and Renner in the later Munich periods, and many others. Martin Lindauer has been most active in advancing the subject in recent years and his own students—Nedel, Kiechle, Markl, Rathmayer, Martin, Maschwitz, Neese, Sticker—have fanned out in many new directions to give German universities a leading role in the study of insect sensory physiology and behavior.

"The life of bees is like a magic well," von Frisch said in an earlier work. "The more you draw from it, the more there is to draw."

Young biologists should contemplate the broader truth behind this simile. It is the current fashion to measure the importance of a discovery solely by its generality; the most important discoveries, it follows, are the ones that apply to all organisms—at the molecular level, of course. But who can deny the intrinsic importance of von Frisch's work, much of which applies to only one species of *Apis*? The race to make dis-

coveries of the greatest generality, to solve the major problems in the "mainstream of biology," does not strike me as the best research strategy to teach to students. It results in an implosive convergence of effort on a few subjects, in a sharp decline in the number of discoveries per man per unit time, and in frustration on the part of young scientists who realize too late that their own professors have already picked up the best pebbles on the beach. Von Frisch's approach represents an alternative strategy. The elegant analyses of complex systems conducted by his school are science of a high order, despite the fact that most of the individual phenomena could not possibly be of wide occurrence. The opportunities provided to beginning researchers do not decline with time, and as the subject grows, new perspectives are gained that lead, with any good fortune at all, to discoveries of a more general nature. The exemplification of this truth provides, in my opinion, the deeper contribution from von Frisch's life and work.

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A Documentary of Our Recent Past

The Cosmos of Arthur Holly Compton. MARJORIE JOHNSTON, Ed. Knopf, New York, 1967. xxii + 480 pp. \$10.

Rarely do all the important issues of an era come to a focus in a single life. This unusual concentration of significance did occur in the experiences of Arthur Holly Compton, whose writings, speeches, and actions reflect and in large measure engendered the atomic age. This book, which is a collection of essays from Compton's pen, is therefore more than a memorial to a distinguished scientist and man of letters: it is an authentic documentary of the events, the discoveries, the human involvement, and the deep anguish of a sensitive soul in our recent past.

Responsible for the selection of text material were the editorial advisers John J. Compton, the author's son, Edward U. Condon, Thomas S. Hall, Marjorie Johnston, and Howard Lowry, president of the College of Wooster, where Arthur Compton received his early training and where his father was a professor. I quote these scholars' characterization of the book:

... It opens with brief personal reminiscences, followed by a section on the general relevance of science to human affairs. After an examination of several aspects of the philosophical background of science, there follow examples of the intellectual adventure of scientific pursuits, as seen in the author's work and in that of other scientists. The last half of the book is devoted to specific social and political issues in which science plays a role.

Some portions of this book have already appeared in published form, and the major previous publications have been credited in the acknowledgments. Such publications did not always have the benefit of Mr. Compton's final scrutiny, and many of them differ somewhat from his preferred or revised texts, which have been used here.

The first article is a 50-page informal autobiography, priceless for the personal touches it contains. Then follow articles on the historical and social significance of science. The vein of informality returns in a charming piece reflecting Compton's youthful interest in aeronautics, a letter written to his father at the age of 17. There are articles, notably two dealing with the problem of freedom, that have great philosophic depth. Compton's interest