Preface

John Chadwick wrote in *The Decipherment of Linear B* (1958):

> The urge to discover secrets is deeply ingrained in human nature; even the least curious mind is roused by the promise of sharing knowledge withheld from others. Some are fortunate enough to find a job which consists in the solution of mysteries . . . But most of us are driven to sublimate this urge by the solving of artificial puzzles devised for our entertainment. Detective stories or crossword puzzles cater for the majority; the solution of secret codes may be the hobby of a few.

I count myself among the fortunate mentioned in the opening words of Chadwick's absorbing account. With Michael Ventris he "broke the code" of an ancient script that was the writing system of an unknown language—something even some of the wisest scholars considered a logical impossibility.

The present book results from a personal amalgam of Chadwick's two categories: fortunate to have employment solving mysteries and a sublimated recreation of "breaking" codes. A vocation of zoological research on animal behavior has, among other topics, led to analyzing animal communication, which in some ways is not unlike deciphering ancient scripts. The avocational parallel was trying to figure out how certain codes work, such as the Universal Product Code and the information hidden in the serial number of a driver's license in some American states. A sort of epiphany occurred upon the realization that simple, man-made signaling devices encoded information in much the same way as animal-evolved signals.

This coding framework called to mind the mathematical theory of communication, or, as it is more commonly called, information theory. When this theory—invented more or less independently by mathematician Norbert Wiener and telecommunications engineer Claude Shannon—became

general knowledge, many zoologists and psychologists envisioned optimistic applications to human and animal communication. The reason such promise has failed almost completely can be attributed to at least three factors. First, information theory told us how to measure the efficiency of a communication code but not how to create or even recognize one. Second, the theory was concerned mainly with the information transferred between sender and receiver, but details of that transference proved elusive in all but the most restricted and intensively studied systems of communication. And third, the setting of incessant transmission via telecommunications was simply not how most signaling works.

Things are different now. Coding theory has developed in its own right, giving us more specific ideas of what we might look for in communication. Furthermore, we can apply certain notions of information theory (e.g., entropy, channel capacity, and redundancy) to signaling without having to characterize the information transferred during communication. Finally, the framework of information theory can be broadened from telecommunications to the kinds of signaling situations we find in human-devised and animal-evolved systems. Applying aspects of information theory to such signaling inevitably entails some loss of precision, conceptually as well as numerically, and (some experts might assert) damaging oversimplification as well. Thus this book could try the patience of information theory aficionados. No apology is offered for that because the gain in understanding communication more than offsets the corruption of rigorous information theory.

Comparing animal signaling codes with human-devised codes is not a wholly new idea. One of the founding fathers of ethology, Konrad Lorenz, likened the color patches (specula) in the wings of puddle ducks to national flags. Another of the founding fathers, Niko Tinbergen, included an illustration comparing these ducks and flags in his classic book, *The Study of Instinct*. As the reader will find out later, the comparison is a little faulty. The idea of showing the parallels between human-devised and animal-evolved codes is, however, salutary.

At least three good reasons exist for introducing each principle of coding with human-devised codes before explaining examples of animal signaling. First, we *know* that the man-made system was devised for signaling. Animal examples must sometimes be assumed to have evolved for communication until studies can adequately confirm the communicative function. Second, our day-to-day familiarity with most of the human-devised signals often makes the coding principle easier to grasp than are

the often unfamiliar and sometimes esoteric animal examples. Last, the human systems may be easier to remember than the animal examples, and thus more readily remind us of the underlying coding principle.

Several colleagues who kindly criticized the initial outline and semi-draft of this book suggested expansions of the coverage beyond signaling between members of the same species. These suggestions included predator–prey communication, signaling between ecologically competing species, communication in cleaning symbiosis (in fish) and other mutualisms between species, signaling of plants to their pollinators, and even molecular messages among cells of the body. These colleagues are correct in asserting that many of the encoding principles used within animal species are also used in other fascinating communication systems. Nonetheless, an author must draw a line somewhere, and in this book it is intraspecific communication.

I am beholden to those who read the early "augmented outline" and offered comments and suggested specific examples that might be used in the book. These people included my longtime friend and colleague Arthur Myrberg, who unfortunately passed away before this book was finished. The others to whom I am equally grateful are Jane Brockmann, Mark Deyrup, Jon Greenlaw, Sylvia Halkin, Robert Jaeger, Robert Jeanne, Peter Klopfer, and Charles Snowdon. Numerous others with whom I have discussed animal communication over the years remain unnamed but certainly have my appreciative thanks. Cheryl Hughes—as illustrator for the Zoology Department at the University of Wisconsin—prepared many wonderful figures for my teaching and research over the decades. I have used a few of her drawings and copied others, as figure captions make explicit. Finally, I need to mention my wife Liz, who, after I completed *Optical Signals* in 1977, announced she would divorce me if I ever wrote another book. Well, I did and she didn't. In fact, Liz has coauthored two books with me in the interim, and as we approach our golden wedding anniversary, I realize that no words can be sufficient to thank her for such unselfish support over so long a time.