Book Review

Thieves, Deceivers and Killers: Tales of Chemistry In Nature

William Agosta; Princeton University Press, 2001; 231 pp, ISBN 0-7382-0128-6; $18.95 (hardcover)

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The award-winning science writer K.C. Cole, in her 1985 book of essays entitled *Sympathetic Vibrations: Reflections on Physics as a Way of Life*, wrote of electromagnetic radiation:

> "The pupil is a tiny porthole in a sea of radiation. In a universe alight with images, we are mostly in the dark ... I know that these signals are there, in the room with me, because if I flip on the radio or tele- vision I will suddenly be able to see or hear them – in the same way that visions suddenly "appear" before me the minute I open my eyes. If I had still other kinds of detectors ... I could pick up still other kinds of signals. Yet we walk through this dense web of radiant information without being in the least aware of its existence."

With some slight modifications, such as the substitution of "receptor" for "pupil" and "chemical signals" for "radiation", Cole's passage might well serve as an introduction to *Thieves, Deceivers and Killers*, which is a popular introduction to the topic of chemical ecology, the study of the various ways in which organisms use chemical signals as means of communication, attack and defense. The past several decades have seen the intensive development of chemical ecology, something that would have been virtually impossible without the availability of analytical methods capable of detecting, separating and analyzing the minuscule amounts of compound produced by insects and microorganisms. *Thieves, Deceivers and Killers* describes a wide range of examples by which many remarkably simple compounds are used by plants and animals to influence the behavior of other organisms for purposes as diverse as seed dispersal, pollination, feeding, camouflage and hunting. Some compounds act alone, sending a single "one-word" signal, while others operate in concert, like words modifying one another to form a phrase.

For instance, the second chapter describes the stratagems by which some plants induce ants to disperse their seeds by attaching to them a small packet (called an elaiosome) containing oleic acid and linoleic acid. The oleic acid, a decomposition product of dead ants, functions as a recognition signal, inducing ants to pick up the seed and carry it, as they would carry a dead ant out of the nest. How- ever, the linoleic acid modifies this behavior, because it acts as a feeding signal, inducing the ant instead to carry the seed to the nest. Seeds are thus transported considerable distances from their plants, and placed underground, where they are protected from birds, and in an environment conducive to germination.

Chapter three ("Getting Pollinated") surveys some of the ingenious devices plants use to regulate the behavior of insects needed to pollinate them, a particularly intricate example being that of the cardboard palm, which contains both pollen cones (male) and seed cones (female). Weevils carry out transportation of pollen from pollen to seed cones. As the pollen ripens, starch and lipid are metabolized, generating heat, which volatilizes 1,3octadiene and linalool. The odors of the two compounds attract weevils, which nest in the pollen cone, mate and lay their eggs. The weevil larvae feed on the cone, mature, and migrate to nearby seed cones in search of nesting sites, carrying pollen with them. However, the adults are prevented from nesting in the seed cones by the presence of β−methylaminoalanine, a neurotoxin and repellent, lingering only long enough to deposit their pollen and move on.

Photochemistry makes an appearance in the behavior of the dragon fish, a deep-water predator that uses bioluminescence to locate its prey. Unlike nearly all other deep-water fish whose bioluminescence is blue, the dragon fish generates red light (making it invisible to its prey, whose optic nerves are sensitive to the residual blue light that predominates at great depths). Intriguingly, the red light of the dragon fish is generated by a red chlorophyll-like bacterial pigment ingested through the food chain. Excitation of the red pigment is then transferred to the dragon fish's blue pigments, and the resulting blue signal is processed normally by the fish's brain, eliminating the need for a second red-light processing pathway.

Later chapters focus on the behavior of flies, mosquitoes, and parasitic wasps, and the book culminates with a description of the intricate network of interactions linking white oaks, white-tailed deer, gypsy moths, white-footed mice and deer ticks, the balance among which controls the incidence of Lyme disease.

Overall, I found *Thieves, Deceivers and Killers* to be fascinating reading – a bit slow-moving at the outset, when Agosta has to provide some basic background material necessary for the relatively scientific uninformed general reader, but rather boring for a scientist (who might want to skim over, or possibly even skip, the first chapter), but picking up and moving at a brisk and enjoyable pace through the balance of the book.

It transported me in spirit back to the days of my youth, to my immersion in the television programs devoted to exploring the behavior of the world of living organisms. However, unlike the then-current descriptive science, which had to largely content itself with the what of behavior, Agosta can draw on the results of several decades of research in chemical ecology to elucidate the absorbing details of many of the hows – the story of the ways in which relatively simple, volatile or soluble molecules provide a network of communications between organisms, leading to the formation of symbiotic relationships, and even in some cases raising the almost philosophical question of whether two physically distinct entities are in fact different organisms. or should be considered a single organism.

Agosta has a clean and fluid writing style and I found myself reading through the book at almost the same rate I would read a novel, and with the same sense of disappointment at com- ing to the end. For the reader who does want to go further, Agosta has obligingly provided an appendix with suggestions for further reading, most at the level of *Scientific American* articles or other popular books.

I do have a couple of quibbles about *Thieves, Deceivers and Killers*, neither touching the substance of the book, but rather its appearance. First, for some reason there are no photos in the book, the only illustrations (the book's term) being artists' renderings in a kind of grayscale that is often not very illuminating, and that often left me feeling rather remote from the reality being described. I would have much preferred to see photos or photomicrographs, and find it hard to imagine that suitable ones could not have been located, or what motivated the decision to eschew them in favor of the drawings. (Color would have been a nice addition, as well.) Second (and this obviously betrays my professional prejudices), there is not one chemical formula in the entire book, which I found odd considering its subject matter and subtitle. Notwithstanding Stephen Hawking's comment in *A Brief History of Time* of having been warned that each equation in a popular book reduces its readership by 50%, I do not think it would have seriously undermined the book's appeal to have included a few simple structural formulas, if only to illustrate how remarkably simple many of the chemical signals are (acetaldehyde, carbon dioxide, dodecane, and 2-methyl-2-butanol, to cite a few examples). That said, however, I thoroughly enjoyed reading *Thieves, Deceivers and Killers*, and can recommend it as a fascinating introduction to the subject of chemical ecology for the nonspecialist. Like the person Cole referred to in *Sympathetic Vibrations*, whose sensory apparatus is unable to pick up the majority of electromagnetic signals around them, I cannot smell or see the vast majority of molecular signals that suffuse the milieu in which I move (doubtless including many that affect my own likes, dislikes, and behavior). Nonetheless, Agosta's book has at the very least increased my awareness of that lack, my appreciation for the intricacy of the chemical signals that underlie everything that we do.