Better survival through chemistry

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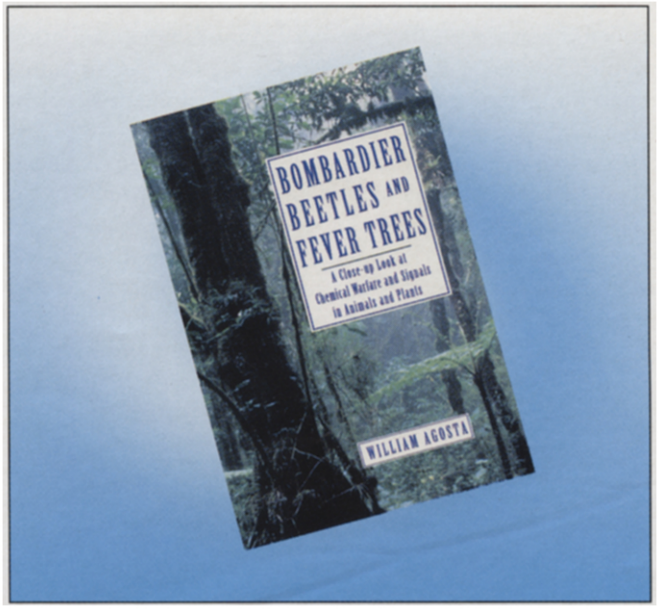
Bombardier Beetles and Fever Trees: A Close-up Look at Chemical Warfare and Signals in Animals and Plants by William Agosta, Addison-Wesley Publishing Company, Reading, MA, 1995. 224 pp. $25.00 (hardcover) ISBN 0-201-62658-6



'Better living through chemistry' was the motto of the Dupont Chemical Company for several years. In the recent past, however, this motto was changed to avoid any mention of chemistry. This was probably due to the flurry of bad press on chemistry and science, including stories on dioxin, cholesterol, Chernobyl, chemical wastes and a host of others.

William Agosta thinks differently about chemistry from the nay sayers. In his book, Agosta points out some of the sublime, beautiful and impressively exquisite examples of how 'chemistry' is involved in life. He describes cases of how chemicals not only influence life's simplest processes, but also regulate such complex phenomena as organismal defense, behavior, offense, disguise and survival. He uses specific cases of well studied biological processes and documents them with excellent prose, accurate descriptions, and proper acknowledgments of the people and events involved in the discoveries. Furthermore, he adds an interesting measure of how these observations, mostly on insect behavior and plant biology, may have an eventual impact on mankind's health and well being.

One of the classic examples in his book is the description of the bombardier beetle's 'munitions factory'. In one of the truly remarkable feats of nature, the nearly 30 known species of bombardier beetle (*Brachirus spp.*) have a unique system of counterattacking when assaulted. These common ground beetles (8–12 mm long) spend the daylight hours under rocks and logs. They commonly feed on the larvae of other insects. None of this is unusual! But when attacked, the beetle exudes a glob of hot liquid, whose release is accompanied by an audible pop. The liquid contains a mixture of irritant quinones, and both the popping sound and the chemical irritant distract the aggressor. Agosta carefully describes the clever experiments by Eisner's group at Cornell and Schildknecht in Germany to examine the accuracy of the beetle's spray and the chemical reactions involved in this unique system of chemical defense. Apparently, the beetle has two glands at the rear of its abdomen, one holding hydrogen peroxide plus a mixture of phenols, the other a mixture of common enzymes such as catalases and peroxidases. A channel connects the two glands. When disturbed, the beetle opens the valve between the two chambers. The peroxide, phenols and enzymes instantly mix, yielding oxygen from the peroxide, and the phenols are converted to toxic quinones. The generation of heat and gas from these reactions is great enough to generate an explosive force, accounting for the popping sound. This, according to Agosta, is "impressive chemical warfare for a little beetle".

Agosta chooses many other wonderful cases to illustrate his points. The text is written clearly and in a manner that all can understand. His strongest cases, with the best vignettes, describe insect behavior. The glowworm and firefly stories are as fascinating as that of the bombardier beetle, as are tales of pheromones, concealment, slave-making ants, chemical bribery, imitation and toxins. Excellent case stories are also taken from the annals of plant biology, parasitology and ethnobotany.

The book is a collage of well written stories of nature's chemical influences on the processes of life. Although each concept and example is nicely presented, the text only holds together loosely. For instance, information about mind-bending drugs and clandestine drug labs in South America does not fit well into an otherwise interesting text on chemistry and life. The space devoted to this would, in my opinion, have been better used to

strengthen his rather weak presentation on plant–microbe interactions. The tabtoxin story, which Agosta chooses as his main example of a chemical involved in plant defense against an invading bacterium, is over 30 years old and hundreds of other novel phytotoxins have since been discovered, each with its own story. This is not to mention toxin receptors, plant resistance genes, compounds controlling gene expression, microbes making taxol, plant signaling compounds such as methyl jasmonate, host-specific toxins and more. Another small quibble is that it seems to me that the text would be more interesting if the author had personalized it with his own experiences and contributions. Photographs and more illustrations would also help the presentation of this material.

I like this book and feel that it is not only enjoyable and educational, but inspiring as well. It is written so that a motivated high school graduate could understand it. Maybe the second edition will be better organized, have the extraneous information removed, and present a better update on plants and microbes.