Nature's treasure chest

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Thieves, Deceivers and Killers: Tales of Chemistry in Nature

by William Agosta

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As befits the book's chilling title, William Agosta, Professor Emeritus at Rockefeller University, regales us with tales of the natural world beyond the imagination of even most fiction writers. Chemical communication amongst and between organisms of various shapes and sizes is vividly described, from the 'blitzkrieg' employed by the bacterium *Shigella* when it invades the human body to the various methods used by plants to attract insects for pollination. And the more we understand these surreptitious methods of communication, the more we may be able to exploit them for our own purposes, for instance, for pharmaceuticals or agriculture. Thus, this book is not only a collection of fascinating stories from nature, it also conveys an essential message: the rich complexity of the Earth's ecosystems contain a wealth of chemicals potentially useful for mankind. In order to preserve and benefit from this treasure chest, we must ensure we protect the diversity of life and make it a high priority in our research efforts.

Agosta starts by describing the evolution of natural chemicals in the first chapter, throughout which he carefully explains the relevant technical terms. He

goes on to analyse the benefits of those compounds already exploited by humans and briefly reviews the great potential that the new field of chemical ecology harbours. These themes recur in the following 11 chapters where they are examined in greater detail. I wish I could give you a taste of all the chemically governed interactions described, but space limitations clearly restrict me to the following selection.

In total, around 300 000 insect species are pollinators of flowering plants, and a strange relationship often exists between these two life forms. We are all aware that bees are attracted by the scents of flowers for the purpose of pollination, but this is a rather simple example compared with an Australian fly that, following a scent, finds a blossom blooming underground. The important role of chemicals is also illustrated by orchids that attract male bees with an aphrodisiac that stimulates the bee to 'mate' with the flower and, in the process, transfer pollen from orchid to orchid. But the clear stars of the book are the social insects, particularly ants. This emphasis is not surprising when we learn about the enormous range of chemicals they employ for their own means. Their creation of willing slaves, the construction of ant gardens and the production of antibiotics to keep fungal growth under control are just some of their activities where chemical communication is vital.

The importance of understanding the underlying chemistry of insect-man communication is exemplified in the chapter 'Flies and the misery they bring'. Here, we learn that the fly-transmitted yellow fever virus killed tens of thousands of Frenchmen sent by Napoleon to the Caribbean, finally leading to the collapse of the French imperial aspirations in that region. Malaria, for which mosquitoes are the essential vector, kills millions of people every year. It is now clear that one way to effectively combat these vector-transmitted diseases is to determine and disrupt the chemical signals critical to the life of these dipterans. But apart from these important messages, the book is also packed with vivid, interesting details, such as the description by Roman historian Pliny the Elder of flies being sacrificed in the temple of Hercules.

Another chapter deals with the chemical complexity of bacteria and again, these compounds are placed into their relevant biological contexts. Deep-sea fish produce red light that they should not be able to detect, according to their typical photopigments. However, chlorophyll-like red-sensitive pigments have been shown to be present in these species. Where do they come from? Agosta informs us that they are produced by bacteria at the bottom of the food chain of these fish. True co-operation between bacteria and nematodes—an image of which is featured on the cover of the book—is also described. This teamwork, based again on chemical communication, has great potential for the development of biopesticides, since it allows the nematodes to actively seek out specific host insects that they ultimately destroy.

The five final chapters describe the significance of natural compounds in human life. Beginning with the first biotechnological industry of the ancient world—when Phoenicians produced royal purple from marine snails—they stretch to today's situation where material scientists join forces with biologists and chemists to investigate materials from nature. The expectations are high that future discoveries will be made through the study of the chemical ecology of marine organisms. The research strategy will be 'biorational deduction', in which connections are made between the lifestyle of a creature and our desired biotechnological goal. One example of the success of this strategy is the search for extremophile enzymes, whose optimum activities are attained under extremely high or low temperatures. More effective detergents and the cheap and easy PCR method used widely in laboratories today are the far-reaching results of this kind of approach.

As we have no idea what further treasures still await us in this natural pharmacopoeia, it is surely wise that we do our utmost to preserve our fascinating, living world.

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