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# Foreword

The importance of natural products and their impact on human development and society cannot be overstated. Natural products can be interpreted as pure chemicals or their mixtures from nature or even the crude materials afforded by Mother Nature herself, for example, timber, resins and crude herbal drugs. The sources of these chemicals are manifold with key examples from insects, plants, microbes and terrestrial and marine animals. To give an indication of the value of these materials, almost 25% of all of our prescription drugs owe their origins to a natural source, and in the area of antibiotics and anticancer agents this figure is nearer to 40%. It is hard to imagine a world where natural products do not play a pivotal role in all areas of human endeavors.

Our anticancer drugs are a classic case of this impact, with drugs such as Paclitaxel from the Pacific Yew tree (*Taxus brevifolia*) for ovarian and breast cancer, and Trabectedin from a marine tunicate (*Ecteinascidia turbinata*) for soft-tissue cancers. Both of these drugs are superb examples from our global chemical diversity. Their complex shapes, beautiful functionality and exquisite biological activity exemplify the value of chemicals from natural sources. Even our cholesterol-lowering drugs owe much to natural chemicals; with lovastatin from the filamentous fungus *Aspergillus terreus* being a template for our modern statin drugs, widely used globally to lower the risk of heart disease.

Natural products not only have importance for the science of single chemical entity drugs, but for their impact on crude drugs and complex mixtures. An understanding of the chemical complexity of crude drugs in systems of medicine (e.g., traditional Chinese medicine) is vital to ensure quality, stability and efficacy in formulations and preparations. This can be extended to studying the ethnobotanical uses of medicines, to understand how traditional healers use these substances, which can lead to new drugs and equitable benefit sharing amongst communities. The goal of this process should be the preservation of traditional knowledge for future generations.

Our understanding of natural products has also contributed to our appreciation of our environment; nature can be "nasty," and many of the most potent toxins are naturally produced and, where obvious, are historically avoided, for example, Hemlock of Socrates fame. These substances are of varying degrees of severity ranging from contact poisons (*Heracleum* sp.), to inedible toxic berries (*Atropa belladonna*) through to deadly mushrooms (*Amanita phalloides*). An awareness of their taxonomy, phytochemistry and biological activity has resulted in a greater understanding of their impact.

As an extension of this, our ability to understand the effects of drugs on human consciousness is also related to natural product science. The human desire for intoxication through alcohol and drugs of abuse such as heroin has enabled us to appreciate their damaging effects on society, their cultural usage and even their augmentation to medicinal properties. Examples of both sides of this can be seen with Cannabis (*Cannabis sativa*), a drug now legal in several states of the United States, and having

a European product licence for ameliorating the pain and spasm of patients with multiple sclerosis. Unfortunately, such drugs are often accompanied with a darker side, for example, tetrahydrocannabinol, the active compound within cannabis, has led to the development of many synthetic cannabinoids, the so-called “legal highs” or novel psychoactive substances. These materials have exceptionally high potency at the CB<sub>1</sub> receptor, and may well have long-term harms leading to psychosis and schizophrenia.

Natural products also have a profound impact on plant reproduction: Many insects are able to detect colored compounds, ultraviolet-active compounds and volatile attractants and, therefore, pollinate many of our crop plants as they are attracted to the plant flowers. This has vital importance for the development of ecosystems and for mammalian life. We are often oblivious to the fact that natural products have made enormous contributions to human healthcare, improved our understanding of our interactions with nature and made huge impact on the development of human society and other species on our planet.

*Botanical Miracles: Chemistry of Plants That Changed the World* is, therefore, aptly named as it beautifully makes the case for how natural products have impacted on our lives, culture and our development. Dr. Raymond Cooper and Dr. Jeffrey Deakin have written a text aimed at encouraging young people at the “A”-level/high school to early undergraduate studies of the value and utility of plant natural products. This text builds on Dr. Cooper’s earlier text *Natural Products Chemistry: Sources, Separations and Structures* published in 2014, which highlights the basic science behind natural product science. *Botanical Miracles: Chemistry of Plants That Changed the World* takes the reader through the medicinal impact and classes of the main phytochemicals, how our food and drink has transformed our society, the usage of psychoactive materials and how plant natural products are used as *cosmeceutical* preparations. Finally, the chemistry of color is covered, ranging from the chlorophylls and photoaccessory pigments through to the pigments that shaped commercial colorants in the industrial revolution, through to the natural colors of berries in our foodstuffs that profoundly impact on our health.

This book has great utility and has been written with a sense of enthusiasm that will be infectious to the reader. It will find an avid audience amongst those who wish to understand the enormous contributions that plants have made to our world, and the further opportunities that exist from this and other natural sources. Drs. Cooper and Deakin have put together a fine and highly readable text, and it is with great confidence that this lovely book can be recommended to those who wish to further appreciate the magnificent contributions of plants and natural products to our world, our health, security and comfort.

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