



EDITORIAL

Natural Products and Climate Change

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Perhaps the greatest challenge facing humankind in the generations to come are the issues related to climate change. Some projections suggest that over the next century the world could see a loss of 50 % of our species diversity. If these projections are indeed accurate the repercussions of a mass extinction event of this magnitude will alter life on the planet for millions of years to come. Among the many aspects of life impacted would be our ability to address the need for new chemical entities for the control of emerging and resistant infectious diseases and cancer. Some estimate suggest that the Earth has become home to an estimated 9 million species, each with an ecosystem of its own harboring dozens of culturable - and hundreds of currently unculturable - microorganisms. Other estimates that consider carefully the microbial communities put the planets species diversity closer to 1 trillion; in any scenario this represents a wealth of opportunities to discover and develop therapeutics for the diseases most threatening to humankind. The numbers of natural products from these unique ecosystems and their diversity of species is essentially limited only by a handful of physical constraints associated with the availability of elements which typically include just C,H,N,O and a handful of minerals as well as the number of bonds available to each element. Other subtle constraints which remain poorly defined in natural ecosystems include PK, bioavailability and stability. As a result, the structural complexity and diversity of natural products are unmatched from any other resource in regard to potential drug and drug-like molecules. The utility of natural products is further enhanced through the incorporation of synthesis and semi-synthesis methodologies that allow for incorporation of reactions and elements not achievable in nature to complex natural product ring systems. These resources and approaches have spawned all of our drugs outside of the direct application of proteins. Our ability to respond with new therapeutics to emerging infectious diseases, drug resistant cancer and neurological disorders will be dramatically altered and become severely limited. Creating further challenges is that the majority of endangered plant species are also part of the family groups that are drug producing. Species diversity in isolated mountain regions and marine ecosystems are certain to suffer greater losses than those in regions where species diversity is lower. As a result, the long-term protection of our species diversity is absolutely critical to the continued discovery and development of novel therapeutics. Indeed, the recent award of Nobel prizes for the discovery of artemisinin for the control of malaria, and ivermectin for roundworm parasites, highlights the tremendous impact that natural products can have on the health of humankind.

Further challenges in mitigating the damage to future natural products discoveries involve the need to control forest fires. It is estimate that the number of forest fires in the US alone has doubled in the last 50 years with climate change playing a prominent role in this increase. Of all the professions that need to strongly advocate controls of climate change, natural products investigators are among the groups that need to stand strong in regard to promoting the use of renewable energies and mitigating the damage that climate change has already inflicted, thus threatening our species diversity. Our future controls for human health depend intimately upon species diversity and the associated chemodiversity of the planet. In addition, no other group of scientists should understand better the profound potential for carbon dioxide to absorb energy across a broad region of the electromagnetic spectrum, as natural products investigators use spectroscopy in their daily activities of discovery and characterization of new molecules.

The good news is that advances in renewable energies are well within our grasp and the application of renewable energies will have a profound impact on the long-term health of the planet and those that inhabit it. An interesting product of the use of renewable energies will be a significant change of wealth distribution across the planet. The availability of consistent, clean and renewable energy will effectively distribute wealth generated from energy relatively evenly. Currently available technologies are becoming increasing cost-effective and improvements in efficiency in the years to come are certain to continue to drive down the value of petroleum based energy sources. Even at current efficiency levels, solar energy which is essentially available across the planet, can power homes and cars with the energy from the surface of a home. With the recent increases in solar efficiency to the levels of 40 - 50 %, the installation of solar devices across the globe is certain to occur quickly. In addition, the growing application of wind, geothermal, biofuels and hydroelectric technologies allows access to renewables at every corner of the globe. Biofuels and natural products will begin to play a uniquely prominent role for the generation of renewable sources for not only therapeutics but also food additives, cosmetics, materials science and polymer chemistry.

As a result of technological developments, what would seem to be a daunting challenge and dilemma for natural products research and human health on the planet has the potential to generate a wealth of new opportunities through the replacement of organics from petroleum streams with renewable resources from natural products. In addition, a more even distribution of wealth associated with energy across the planet will significantly improve the availability of pharmaceuticals to all members

of society. Natural products investigators are afforded a great opportunity to provide leadership in placing the planet on a track of sustainability unlike that ever experienced before by humankind.

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