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The Homo Sapiens Report ►

Chemistry and Sustainable Development ►

The Chemical Element—Chemistry's Contribution to Our Global Future

Javier Garcia-Martinez
and Elena Serrano-Torregrosa (editors)
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The recently concluded International Year of Chemistry (IYC) successfully engaged scientists, educators, students, industry, and others in a wide range of chemistry activities across the world. The IYC focused attention on the importance of policies, practices, and attitudes to chemistry and chemistry education in the context of the role of chemistry for our global future. The Year was designed to promote excitement about chemistry and its possibilities, but it was also intended to have an impact far into the future. The success of IYC, therefore, must be measured in terms of how the wider professional chemistry community in science, education and industry takes up the challenges presented during the Year.

The Chemical Element—Chemistry's Contribution to Our Global Future provides the intellectual basis for the future of chemistry in meeting these challenges. The book was launched during IYC with the patronage of UNESCO and of IUPAC and covers topics critically relevant for sustainable development. From international development issues to chemistry's role in contributing solutions to the challenges of water and climate change, editors Javier Garcia-Martinez and Elena Serrano-Torregrosa have overseen nine interesting and inspiring chapters written by contributors eminent in their respective fields.

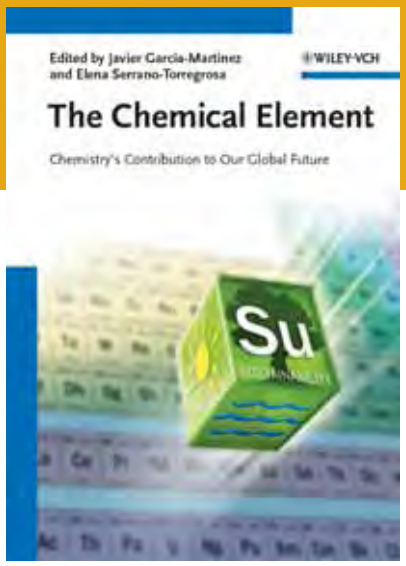
Chapter 1 on "Chemistry for Development" by Stephen Matlin and Berhanu Abegaz provides the framework for the following 8 chapters with a comprehensive review of the importance of science, technology, and innovation for national and international development. The chapter covers the UN Millennium Development Goals (MDGs) agreed by the world's governments in 2000; overviews some NGOs that contribute to these goals through capacity building; illustrates disparities in development, research output, and funding in the world; and finally introduces the main global challenges where chemistry has a critical role to play. The chapter includes over 240 useful references.

Chapters 2 and 3 address the first MDG, which is to eradicate extreme hunger and poverty. Chapter 2, on "The Role of Chemistry in Addressing Hunger and Food Security," by Jessica Fanzo, Roseline Remans and Pedro Sanchez illustrates how chemistry has been the backbone of knowledge in nutrition and food science. The chapter describes the issues and complexities of global hunger, nutrition, and food security and links these to chemistry's influence on the determinants of food security. The authors identify as a challenge the need for chemists to work in an interdisciplinary manner and ". . . highlight the importance of integrating technical interventions with broader approaches to address underlying causes of food insecurity—incorporating perspectives from agriculture, health, water, and sanitation, infrastructure, gender, and education—many rooted in the core science of chemistry."

Chapter 3 on "Poverty" by Mari-Carmen Gomez-Cabrera, Cecilia Martinez-Costa and Juan Sastre, gives a good summary of the concept and historical evolution of poverty, its asymmetry in the world, its causes, the effects on malnutrition and life expectancy, and strategies against poverty. The final section of this chapter addresses the essential role for chemistry in poverty alleviation.

"The Human Element: Chemistry Education's Contribution to our Global Future," chapter 4, by Peter Mahaffy starts with a quote from the UN Resolution declaring 2011 as the International Year of Chemistry: ". . . education in and about chemistry is critical in addressing challenges such as global climate change, in providing sustainable sources of clean water, food and energy, and in maintaining a wholesome environment for the well-being of all people . . ." The chapter focuses on the questions of whether current education in chemistry is equipping the next generation of scientists and citizens to meet the challenges, and what might be done to make this education better. The quotation from Jeffrey Sachs in the epilogue to the book speaks for the importance of this chapter which addresses an area critical for the future: "Professor Peter Mahaffy is compelling in advocating a new way to teach science, one that grips the students through the drama of the human condition. I was convinced and entranced."

The following five chapters cover specific areas of chemistry and their role in sustainable development. Health is addressed by René Roy in a chapter entitled "The Impacts of Synthetic Chemistry on Human Health," which starts with a short historical approach to medicinal chemistry and a summary of the status of present day drug discovery, manufacturing, and usage. The next sections focus on general concepts of drug



design, patent protection issues, drug metabolism, and drug resistance. By way of specific examples, the final sections of the chapter cover antibacterial agents, antiviral agents, Viagra, and vaccines for humans. The reader is left with no doubt of the importance of chemistry for disease prevention and treatment.

Pietro Tundo, Fabio Aricò, and Con Robert McElroy present "The Greening of Chemistry," starting with the history of Green Chemistry, its place in the economy, with China as the example, and a section on awards that support Green research. The chapter continues with an exposition on the different applications of Green Chemistry, such as alternative feedstocks, innocuous reagents, natural processes, alternative solvents, safer chemicals, alternative reaction conditions, energy conservation. This chapter should inspire many a young chemist to greener pastures!

The important topic of water is covered by Maya Trotz, James Mihelcic, Omatoyo Dalrymple, Arlin Briley, Ken Thomas and Joniqua Howard in a chapter on "Water: Foundation for a Sustainable Future." Their introduction provides some basic concepts about global water (e.g, the location of the totality of fresh water on Earth, the range of concentrations of chemicals found in natural waters, and water footprints around the world). The topics of water pollution and water quality, and water treatment technologies comprise the major part of the rest of this interesting review.

Next comes "Facing the Energy Challenges through Chemistry in a Changing World" by Gabriele Centi and Siglinda Perathoner. In the introduction, the authors develop the theme of chemistry as the core science "making possible . . . sustainable use of energy, although this role is often hidden." Illustrating the complexities of providing sustainable energy, further sections in this chapter address chemistry and the role for development of society, chemistry and sustainable energy, sustainable energy scenarios and climate changes, nanomaterials for sustainable energy, biofuels, and solar fuels. The authors tellingly end their review with the words: "This will also require improving educational effort in training chemists for the interdisciplinary approach needed to provide creative and scalable solutions to the energy issues."

The last chapter on "Ozone Depletion and Climate Change" by Glenn Carver gives an overview of the fascinating discovery of the Antarctic Ozone Hole, the chemistry and role of ozone in the atmosphere, its depletion by man-made chlorofluorocarbons, and how governments responded through the Montreal Protocol to the scientific data in the 80s. Ozone, a radiatively important gas exerting a control on the behavior of the stratosphere, is also a greenhouse gas itself and so the final section of this chapter provides a summary of current ideas about the complex processes controlling ozone changes and global warming and how they can link together. While "The way in which the ozone hole problem was tackled might be considered as a model for solving the issues of man-made climate change . . . sadly the same is not true for climate change; the science is more complex, the impacts take longer to appear, the solution will involve significant lifestyle changes, and public perception is nowhere near as clear."

Professor Jeffrey Sachs, director of the Earth Institute at Columbia University and director of the UN Millennium Project group (2002–2006) as special advisor to United Nations Secretary-General Kofi Annan on the Millennium Development Goals, has written a two-page epilogue which is a most important contribution to this book. He comments "As a policy strategist, I was riveted page by page, as the technological possibilities for the future were authoritatively conveyed. Each chapter offers remarkable clarity, breadth, technical precision, and a deep sense of humanity. If there is a theme that runs in common, it is that the highest flights of science are bound up intimately with the highest human aspirations." He end with "I personally would like to express my profound appreciation to the editors and authors of this book for this important contribution."

In summary, the book makes for fascinating reading and is highly recommended not only to the chemistry community but to a wide readership including individuals concerned with sustainable development, politicians, young people, teachers, and global strategists. It is a must for every chemistry educator who can use it as a tool in teaching students or in informing non-scientists about the possibilities of this fundamental science. This book is an excellent antidote to criticism of the relevance and usefulness of chemistry for sustainable development. It is also a concrete legacy of IYC 2011.

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