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Book Review

Review of *Research between Science, Society and Politics: The History and Scientific Development of Green Chemistry*. Johan Alfredo Linthorst, eds. Eburon Academic Publishers, Utrecht, The Netherlands, 2023

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This book is the publication of the Author’s PhD thesis in History, discussed on February 2023 at the Faculty of Arts and Social Sciences of Maastricht University. Johan Alfredo Linthorst got a Master’s degree in Chemistry at the University of Groningen in 2004 and a second Master’s degree for teacher training in chemical education at Fontys University of Applied Sciences in 2005. He is involved in chemistry education at pre-university level since 2003. Parallel to his interest in teaching chemistry, including designing and publishing new experiments for students, he developed a personal interest in the history and philosophy of sciences and chemistry in particular. In this connection, in 2015 he started his research at Maastricht University as an external PhD candidate which culminated with his dissertation, which constitutes the present publication.

The subject of this book is well summarized by its sub-title: “The History and Scientific Development of Green Chemistry”. Green Chemistry has been and continues to be a subject of intense debate among chemists themselves, starting from the term “green chemistry” itself, to continue with its scope, aims, significance, and character as a new discipline or not.

Green Chemistry, also referred to under many other designations, such as “safe chemistry”, “benign by design chemistry”, “sustainable chemistry” among the most frequent albeit not necessarily used with the same meaning, has emerged in the beginning of the 1990s as a new way of approaching a chemical synthesis considering all aspects under the point of view of safety and sustainability.

Chapter 1 of this text is devoted to the birth and emergence of Green Chemistry. Here, the reasons and the events that pushed to look at (synthetic) chemistry under a different and more environmentally oriented man-

ner are summarized and analyzed. The emergence of this perception as a consequence of the negative image of chemistry raised by accidents in the chemical industries and by widespread pollution caused by production and use of chemicals are discussed. The key role played by environmental chemists, especially working at the Environmental Protection Agency (EPA) of the USA, in pursuing these ideas are introduced, as well as linkages among society, politics, and scientists. These connections, including the role of the respective chemical societies (ACS, American Chemical Society; RSC, Royal Society of Chemistry; KNCV, Royal Netherlands Chemical Society) in promoting this new way of thinking, are presented and discussed in great detail in the following three chapters, devoted to the rising and shaping of Green Chemistry in the USA (Chapter 2), UK (Chapter 3) and the Netherlands (Chapter 4). In Chapter 5, a picture of the subject under a more scientific point of view is given, again illustrating the development in chronological order. Thus, examples of reactions are reported which are evaluated about their greenness, also utilizing some of the proposed and mostly applied quantitative descriptors (eg, the atom economy percentage and the E-factor, among some tenths proposed up to date). The “Twelve Principles of Green Chemistry” listed by Anastas and Warner in 1998 in their booklet “Green Chemistry: Theory and Practice”, which represent the first attempt to rationalize and define the concepts and scope of Green Chemistry seen as a new way of doing chemistry rather than a scientific discipline, are also showcased. Finally, Chapter 6 reports the Author’s conclusions on the subject.

No doubts that the roots of Green Chemistry are to be searched in the USA, with the debate among scientists in the EPA following societal impulse and that USA politics (eg, with the Presidential Green Chemistry Challenge Awards program launched in 1995, *inter alia*) has largely contributed to its quick diffusion and acceptance among the general public. It is also true that UK and the Netherlands are among the nations that largely contributed to the diffusion of ideas of Green Chemistry in its infancy, albeit with notable differences that are exhaustively presented and discussed by the Author in Chapters 2 to 4. However, circumscribing the treatment to these three countries, although representative, is the major limit of this endeavour. Expanding the analysis at least to EU countries and EuChemS societies would have been appropriate. For example, in Italy the Green Chemistry issues have been recognized since the early 1990s already by the government, which approved the institution of the Interuniversity Consortium INCA-“La Chimica per l’Ambiente” (“Chemistry for the Environment”)

in 1993, which played a major role in the following years in promoting and diffusing the ideas and culture of a more environmentally friendly chemistry at national and international level. Nevertheless, this limit does not diminish the value of this work, which is the most comprehensive treatise on the history of Green Chemistry published up to date. Other studies on green chemistry and its emergence and history have appeared previously, which are recognized by Linthorst and summarized in Chapter 1, but are much more limited in scope and lack the wide breadth of intent and perspectives of this work. The Author made a huge effort, collecting an impressive amount of diverse bibliographic sources, in order to give solid foundation to his representation of the Green Chemistry movement and its connection with society, politics, funding agencies and scientific societies. This text is an invaluable source of information for both practitioners and novices and deserves to be read by all scientists interested to the subject.

From Introduction and Conclusions it appears that the phenomenon allows many interpretations concerning either the causes of its emergence and the motivations for its reception by the scientists. The different opinions opened a great debate, which still leaves open questions as apparent from the Conclusions. Despite its use as an umbrella term or for greenwashing operations, certainly abused, it is important as (synthetic) chemists to recognize that Green Chemistry has contributed substantially to multiply our efforts in pursuing procedures more respectable of the humanity well-being and of the environment. As a matter of fact, Green Chemistry guidelines have already pervaded our lives. As researchers, we are aware that the Green Chemistry principles are strictly connected to many of the 17 Sustainable Development Goals (SDGs) of the 2030 UNO Agenda for Sustainable Development. Moreover, every time we sign the DNSH (Do Not Significant Harm) declaration, eg, when applying for funding from the EU or National programs, we state to comply with those principles.