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Snow, Ice and Other Wonders of Water. A Tribute to the Hydrogen Bond. By Ivar Olovsson. World Scientific, 2016. Softcover, Pp. 124. Price GBP 13.00 ISBN 9789814749367

Enrique Espinosa*

Université de Lorraine, CRM2, UMR 7036, Vandoeuvre-les-Nancy, F-54506, France, and CNRS, CRM2, UMR 7036, Vandoeuvre-les-Nancy, F-54506, France. *Correspondence e-mail: enrique.espinosa@univ-lorraine.fr

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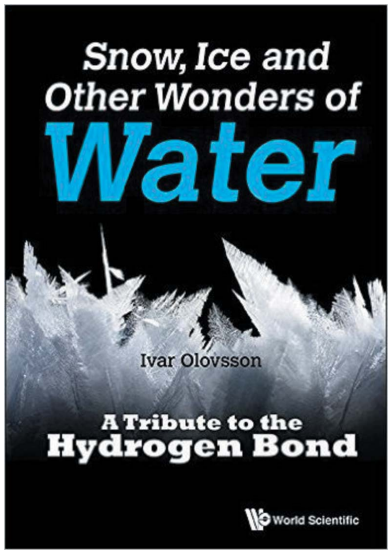

Among the huge quantity of information that one can find on water and its solid phases, this book focuses on some selected topics, mainly dealing with snow and ice phenomena and their relationships with the water environment in which they are growing. Observations of forms and properties of snow and ice are followed by short scientific explanations clearly exposed to a broad reader with some scientific background on physics and chemistry. In many cases, they are mixed with historical references and nicely illustrated with early drawings and scientific descriptions coming from past centuries, and with photographs once optical equipment was available to scientists and artists. In general, the book is pleasant to read and should be appreciated by readers wondering about many aspects of snow and ice phenomena. That said, the short treatment of the selected topics and the significant quantity of historical references, artworks and secondary aspects with low or irrelevant scientific interest addresses the book to readers looking for scientific disclosure rather than to those expecting deep scientific insight. In that way, three reprints coming from the scientific literature and ending the book seem somehow incoherent with the flavour of the precedent chapters.

This small book runs over 116 pages and is divided in nine chapters. Chapter 1 is very short and aims at defining the main terms used throughout the book, such as 'snow crystal', 'snow flake' and 'ice crystal'. Chapter 2 is a historical pathway through snow crystal observations, from earlier descriptions, draws and scientific contributions since the XVI century up to first photographs. Chapter 3 is devoted to artificial snow crystals. In the first part, earlier crystal growth of snow crystals in research laboratories permits to introduce the dependence of crystal shape on temperature and humidity. In the second part, the chapter describes briefly the mathematical concept of fractal applied to dendritic snow crystals and several observations involving snow crystals, such as ice patterns on windows, twins, snowflakes, hail, as well as the aging of snow process, the formation of rain as a consequence of previous ice formation, the formation of artificial snow from snow guns in ski slopes and the natural process of heavy snowfall from the so-called lake effect. Chapter 4 is a beautiful compilation of frozen water photographs, showing snow and ice crystals in Nature. Here, a description of light interference in thin film ice crystals as resulting from small air pockets in their central part is given and illustrated with photographs. Chapter 5 shows a few photographs of snow sculptures during the winter. Chapter 6 deals with the formation of ice spikes on ice surfaces between water and air. Physics involved in this growth process are explained in a short and clear way. The chapter also includes some short paragraphs on ice surfaces, icebergs, effect of ice melting on the sea level and ice on an aircraft carrier. Chapter 7 describes the separation of partial charges in O and H atoms and the electron density distribution in the water molecule, leading to its permanent dipole moment and to the dual hydrogen-bond acceptor/donor character of the molecule. As a natural consequence of the disposition of the H atoms and the oxygen lone-pairs, the crystal structure of ordinary ice Ih is introduced, and the key-point of the disordered H-atom positions compatible with the crystal structure explained. The chapter ends with the phase diagram of ice, introducing other forms which include amorphous ice, ice Ic and the structures of ice II–XI, as a function of temperature and pressure. Chapter 8 describes the particular physical properties of water and ice. In the first part, the reasons associated with the high melting

and boiling points, as well as the influence of the molecular arrangement and the temperature in the density of both phases, and their consequences in nature, are explained. The second part of this chapter is mainly devoted to liquid water. Here, experimental techniques based on X-ray and neutron diffraction that are able to characterize and analyse the structure of liquid water, and theoretical models aiming to explain its anomalous properties, are briefly introduced. Finally, the very short Chapter 9 aims at shifting from the spirit of the previous chapters towards a scientific treatment of hydrogen bonding and hydrogen bonds. Hence, it introduces three reprints from the scientific literature, just following the chapter. Two of them are from the author of the book and deal with the role of the lone-pairs in hydrogen bonding and with proton transfer paths in hydrogen bonds, while the third article is an excellent review of the hydrogen bond in the solid state. It is a pity that this short scientific treatment cannot fill in the too important distance separating the quantity and quality of the huge scientific literature found in the domain. To this end, the book needs to be expanded in an updated review of the field, involving both more recent research and a broader perspective in line with the selected topics treated in the previous chapters. However, this exercise seems to fall out of the scope of the book.

In summary, disclosure and short scientific explanations are interpenetrated in this book which walks at the interphase between snow, ice and water, and focuses on their observations, aiming to be a broad scientific overview of water and its solid phases.