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BOOK REVIEWS

Diana DALBOTTEN, Gillian ROEHRIG & Patrick HAMILTON (Eds), 2014. **Future Earth. Advancing Civic Understanding of the Anthropocene.** *American Geophysical Union, Geophysical Monograph 203. Co-publication with John Wiley & Sons, Chichester, UK*. ISBN 978-1-1188-5430-3. Hardcover, 131 p. Price £ 66,95

At first sight the present book seems a hilarious excursion from the mathematical content which is generally associated with geophysical publications. However, the American Geophysical Union has a serious reputation of publishing in its Geophysical Monograph Series contributions of global perspective and multidisciplinary approach, accessible to a wider audience. At second sight the content of this book is really transcending the boundary of conventional scientific methodology and attitudes by introducing and applying the 'PPSR' (Public Participation in Scientific Research) concept.

This book starts by presenting the Antropocene as a matter of fact. It is assumed that the natural scientists have provided compelling evidence for human-induced climate change and now have to convey this message to the public. This book focuses on a new role for scientists, to raise the public toward 'climate literacy', i.e. able to understand scientific information, gain knowledge and perspectives, encourage positive action.

The principal objective is the necessity to integrate scientific knowledge in the ways of thinking and decision making, in order to tackle the challenges of Climate Change. Bridging the gap between formal logico-mathematical reasoning adopted by scientists and the informal reasoning based on pre-existing values and beliefs of the general public is an enormous task. Science is becoming increasingly in conflict with other ways of knowing: low levels of public understanding and disinterest for science do not permit crossing 'perceptual screens' based on ideological orientations or framing of media messages: 'beliefs' are obstacles to acceptance of sound scientific information. In fact the strongly polarised nature of belief in climate change, but also in evolution or on the shale gas debate suggest that scientific evidence is not sufficient to impact on opinions or behavior. This can only be overcome by setting up society-driven or solutions oriented research and adding participatory techniques to the portfolio of scientific methods for community-driven science, e.g. by acknowledging contributions from traditional ecological knowledge and local observations (citizen participation) to enhance societal appreciation. These models slowly emerge in the geosciences but they are already successfully applied in disaster management, land use, soil and water conservation. Although positively acclaimed by the public and authorities, participatory approaches are yet detrimental for the scientific career (tenure and promotion): they are truly multidisciplinary, involving the long term, emphasising outreach and education. Without adaptation of the current peer review system not many young researchers would be willing to invest themselves in such projects.

Contributors to the present volume are teacher-scientists, students, partisans of action groups and native peoples (meaning those living with nature, and assumed to feel the effect of climate change most directly, as representatives of social groups often excluded from the decision making process). The content is grouped according to the target audiences, i.e. (potential) participants in the climate debate. Topics addressed include adaptation of the undergraduate curriculum, involve underrepresented social groups in the geosciences, enlarge public outreach by implementation of science-society collaborations, bring mutual understanding between science and journalism. Therefore the authors confront the US educational system and social system, but they present fundamental reflections on the societal role and function of science, to make this book relevant for European readers as well.

The fundamental interest of this book is presenting practical models for science – society interaction, from science-push to science-pull, from contributory to collaborative science, discussing in some detail methods of citizen participation in scientific research. Moreover, this involves questioning the motivation of scientists and adopting ethical guidelines based on sustainability of the planet instead of peer review as the decisive criterion for research programmes. This change of paradigm is already influencing research funding in Belgium and Europe; scientists have yet to accommodate to justify themselves to the authorities, action groups and the general public.

Although this work is intended primarily for an American audience – with many practical examples, from wild rice cultivation in wetlands to the potential for informal science education in museums and zoos -and should be compulsory lecture for scientists dealing with societal challenges in an American context, it contains many concepts and approaches that are globally useful. Therefore it is regrettable that the rather elevated price for a volume with simple typesetting and a few superfluous colour graphs (because they are also included in greytones) could be a limiting factor in the distribution of this book.

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Gus GUNN (Ed.), 2014. **Critical Metals Handbook.** WILEY, 439 p., ISBN 978-0-4706-7171-9.

The Critical Metal Handbook provides a unique overview of information on different aspects including geology, deposits, processing, applications, recycling, environmental issues and markets of 13 metals, which are vital to new digital and low-carbon technologies as computers, flatscreens, aeronautics, green energy and electric cars. The first three chapters are quite general: the first one concerns the fundamentals and concepts, the second one sketches the world of the mining industry and

the third one introduces the reader to the important field of recycling. In the remaining chapters every of the chosen critical metal or metal group has been treated in a multidisciplinary way by using a common scheme that covers all interesting aspects of the ore-metal-commodity cycle. These chapters give thus: - an introduction covering the key facts of the material and its historical and actual situation, - an overview of the physical and chemical properties that make the metal so valuable or specific, - a geochemical situation sketch covering the distribution and abundance in the Earth, - an overview of the mineralogy with indication of the useful phases, - a thorough description of the different deposit types with well-chosen examples, sometimes briefly documented, - information about the common extraction methods and the most important beneficiation, ore processing and metallurgical methods, - specifications and uses describing the different types of products that are fabricated from this commodity and their uses and applications in all kinds of essential materials and consumables in our society, - the state of Recycling for the specific metal, the possibility and percentage re-use, - the possible substitution materials for specific uses with their pro's and contra's, - the environmental aspects of the different production phases: mining, processing (waste dumps and hydrological pollution), metallurgy with energetic aspects (air pollution and CO2 aspects) and problems to health aspects for workers, neighbours and the general public, - an overview of the World resources and information about production data for the important producing countries and sometimes even the major companies, - world trade data, eventually with geopolitical aspects, - an estimation of the future supplies, - the evolution of the prices of the different products, - an outlook of the actual and potential users of the metal and the possible provision problems.

The metals considered in this book as critical are Antimony, Beryllium, Cobalt, Gallium, Germanium, Indium, Lithium, Magnesium, PGM the Platinum-group metals (Ru, Rh, Pd, Os, Ir, Pt), the Rare earth elements (REE) ([Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu), Rhenium, Niobium & Tantalum and Tungsten. As specified in the first chapter this is a choice: some other metals could have been chosen and some of the mentioned not considered, depending on the variability of the concept criticality. Most of the discussed critical metals are key-elements in the production of high-tech applications or transport and energy related materials as batteries. The rate of use of these materials is increasing strongly in the growing global economy what makes them important and susceptible to future scarcity. However the various reasons why a metal is considered as critical are as interesting as the actual element itself: - an element is unique or only substituted at considerable costs and loss in performance in the production of certain materials considered as vital in our society (Ga, Li, REE, Re, Ta, W), - its presence on the market depends completely on the production of a more common metal, what makes its availability completely dependable from that commodity and thus unreliable. Examples are Cobalt as by-product of some copper and nickel deposits; Gallium and Germanium as by-product of some Zinc ore, Indium as a by-product of some Copper-ore, Rhenium as by-product of Molybdenum, - the restricted geological distribution of valuable ore (Sb) eventually accompanied by the geopolitical or policy instability of the few producing countries (Mg, Co, PGM, REE, Nb, W), or the rapidly changing demand compared to the slowly evolving production rates of the commodity due to the time needed to start a new mining and processing project (Be, Li, REE).

The first three chapters, independent of the critical aspects of the metals considered in the rest of the book, are very instructive for everyone considered by minerals, metals, and mining in all their facets. The basic concepts are explained, the important factors affecting mining and production of metals, trade of minerals and metals are considered, the financing of exploration and exploitation etc are discussed. All these aspects are generally applicable in the world of mining and mineral exploitation and this makes the book so instructive and valuable. The chapter on recycling explains the inherent problems of the sector and why recycling can never completely replace mining. The commodity-specific chapters of the handbook are written by international experts. They treat a specific metal or metal-group in all its facets. They are not so technically detailed that a professional will consult the book for more information about its speciality but it will provide him with the essential background as well as key information from the other disciplines or other commodities.

The book is a must for everyone, professional or academic, concerned with exploration geology, mining, finance, mineral processing, metallurgy, recycling and manufacturing but also for policy makers in different fields as resource management, land-use and environmental matters.

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Jelle REUMER, 2013. **De vis die aan land kroop. De evolutie van gewervelde dieren in vogelvlucht.** Historische Uitgeverij, Groningen, 212 p., 83 fig. ISBN 978-90-6554-039-3 (paperback). Price € 25,00

It is a good read, this 21-chapter-thick book (14 x 21 cm), with many witty asides and references to the preparation and consumption of animal food – your anatomical knowledge will benefit hugely from this! This publication is based on lecture material for students at Utrecht University (the Netherlands) where Reumer is part-time professor of palaeontology. Chapters are arranged in a logical order, and the underlying message is clear from the beginning – not human beings, but birds constitute the crown of creation, and chance is the central notion in evolution. That descriptive palaeontology is a genuine science which is able to formulate well-founded and testable assumptions, is nicely illustrated on the basis of *Tiktaalik*. In addition, cladistic analyses of fossils, in particular of vertebrates, are explained well. Most of the illustrations are fine, except for a few out-of-focus photographs and a single line drawing with an erroneous scale bar.

Points of criticism on the text are the following. Some errors of style should have been noted during the last

correction round, a few names are spelt wrongly (e.g., Osteichtyes, *Maastrichtidelphis*), of the account of the discovery of Neanderthal man there are two versions in the book (pp. 23, 159), and is it true that all sharks have five gill slits? Chapters VIII-XI brim over with facts and jargon, to such an extent that some readers may feel lost. Two plurals of the word dinosaur are used in conjunction ('Dinosaurussen' en 'Dinosauriërs'); this should have been avoided. And: there is definitely a species of lungfish in South America and gibbons do not have tails!

More serious are other issues. For instance: what is written on *Pikaia* (p. 30) is outdated – not lancet fish, but sea squirts are most closely related to vertebrates. In the evolutionary lineage towards the latter, for sea squirts to become sessile thus is a 'secondarily' acquired feature. Pertinently erroneous (p. 66) is that an embryo poops into its allantois; the old German word for allantois, 'Harnsack', is closer to the truth, at least in reptiles and birds. In mammals the allantois, in various guises, forms part of the umbilical cord/placenta, and the allantois veins play a role in gas exchange, supply of nutrients and expelling of waste products between mother and embryo. Also documented is that in most mammals (pp. 112, 118) the 'ectotympanicum' cannot be recognised as a distinct bone; in humans it becomes fused with the 'temporale' just prior to birth and thus is part of the temporal bone. The description of the placenta (p. 135) might have been a bit more detailed; it does hold true for Carnivora and odd-toed ungulates, but does not for primates, pigs and rodents.

A final point of criticism involves the link between vertebrate palaeontology and molecular biology (p. 177), which in actual fact differs from the account given here. Of course, Thewissen did unearth primitive whales (which point to a terrestrial origin of this group), but it was molecular biology that has demonstrated that whales are related to artiodactyls (in particular hippos). Molecular biology has forced palaeontologists to look differently at primitive whales. After all, initially, the morphological features that point at this relationship had not been noted at all.

In spite of these criticisms the book is recommended to a wider readership. It succeeds in supplying a good overview of vertebrate palaeontology, with examples from the Dutch subsoil, and is a nice starting point for a career in this line of business.

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J.F. GEYS, 2014. **De Geschiedenis van het Leven. 8d. Jura - Arthropoda (behalve Insecta).** *VLAGAST vzw, Hallebaan 132, B-2390 Malle* <www.vlagast.be> 208 p., 177 figs. ISBN 978-90-809140-8-7. Price 16,50 € + postage BE 2,50 €, NL 8,00 €.

The series 'History of Life – an overview of Historical Palaeontology' was started by Prof. em. Joris Geys (UAntwerpen) in 1985 with the publication of a single volume on the Precambrian and Cambrian. From the Carboniferous onwards (published in 1993-94) a single volume was no longer feasible in view of the much larger literature on Carboniferous biodiversity compared to older stratigraphic units; moreover with passing of time, the explosion of global scientific research leaves its marks. The Triassic was treated in 6 volumes (published 2002-2007), and the ongoing treatise of the Jurassic is going to beat that number. The present volume is the 20th of this series, achieved 30 years after the start of the series, with still many to go. We wish Prof. Geys good health to achieve his magnum opus.

Some characteristics make this treatise on palaeontology unique. First of all a very uniform presentation for all books in this series, with redrawing of all illustrations. This allows to focus on morphology of the fossils but rarely provides clues on the containing lithologies and misses the advantages of modern imaging techniques, such as the scanning electron microscope. The second characteristic is the focus on taxonomy, which heavily relies on information from Fossil-Lagerstätten (a concept refined by Prof. Geys), fortunately a domain on which many new publications have appeared recently. The purpose is not to guide the reader towards identification of fossils but to make him understand the complex and interrelated life-forms that have evolved through time. The third characteristic is that this work takes a truly global and encyclopedic perspective on fossil finds and their evolution but is solely available in Dutch language, probably without equivalent in any other language. Moreover, the level of anatomical and taxonomical detail is such that a good biological and stratigraphical background is required among the readership.

The present volume is devoted to arthropods except insects: crustaceans (including ostracodes, daphnia, barnacles, copepods, sow bugs, and malacostracans such as lobsters, crabs and shrimps, which forms the dominating group, but also 'living fossils' such as Triops), Chelicerata (horseshoe crabs, spiders, ticks and mites, scorpions) and myriapods (millipedes). Such a volume doubtlessly will appear less spectacular than a treatise on dinosaurs or ammonites, but is justified by the sheer number of arthropod species and the place occupied in ecosystems and food chain. Because of their variable conservation potential, their generally humble appearance and limited attractiveness for constituting collections, these fossil groups have limited visibility and information is heavily relying on few but well studied sampling localities, mainly located in western Europe (Germany, France, UK) and central Asia (Russia, China). One rather unknown Konzervat-Lagerstätte, La Voulte-sur-Rhône in the Ardèche department, is presented in this volume. Nevertheless, the spectrum of data remains world-wide, including as a curious outlier data from the colonial period on the Central Congo basin (Grekoff, 1957; Leriche, 1913). Regrettably there are no discoveries from the Gaume to find their way to the present volume! Nevertheless, fossil descriptions by some Belgian (Van Straelen) and Dutch paleontologists (Jagt, Fraaije, Van Bakel) have deserved proper attention. A minor setback is that the references are not properly organized and seem to be incomplete with respect to the illustrations. An inconvenience of the present volume is that the fossil groups treated are not particularly associated with the Jurassic era, contrary to the better known dinosaurs or ammonites. The author must have been aware of this, as he

frequently switches from Paleozoic to Recent in interpreting the phylogenetic relationships. This results in a rather complete evolutionary overview of the treated groups.

In conclusion, it is the whole series that matters, single volumes may appear dull and pass unnoticed to the inadvertent reader if he has no particular interest in the fossil groups and stratigraphical interval concerned. Single volumes remain chapters of the whole series (the present volume consists of chapters 22 to 25 of the Jurassic) and have no dedicated introduction (except a preface, setting the scene) nor conclusion, practically obliging the reader to acquire the whole series. Prof. Geys is assured of a faithful readership, mainly composed of amateur-paleontologists from Belgium and The Netherlands, but he has clients worldwide.

This treatise consists of a compilation of current knowledge (references are quite up to date), interpreted by the author. This series is far from popular science for the general public; on the contrary it is a scientific publication, which is also of interest to geoscientists in quest of insight in the evolution of biodiversity on Earth.

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