

Geochemistry: up and down and all around the oceans

Henry Elderfield

Tracers in the Sea.

By Wallace Smith Broecker
and Tsung-Hung Peng.

*Lamont-Doherty Geological
Observatory, Columbia University:
1983. Pp. 690. \$35.*

THE past decade will be judged as crucial in the development of chemical oceanography. We now know that hydrothermal circulation of sea water through ocean ridges has a profound effect on the geochemistry of elements in the oceans, rivaling continental weathering processes in its contribution to the dynamics of element transport across ocean boundaries. Technical advances in studying trace metal and isotope distributions in ocean waters, in measuring chemical fluxes in particulate materials and in studying the chemistry of pore waters have led to a greater awareness of the flow of elements within the marine environment.

Further, work using natural and anthropogenic radioactive tracers has added much to our understanding of the movement of ocean waters; in particular, the chemical tracers offer the most important tool we have for studying the oceanic thermocline. Advances have also been made in documenting the chemical history of sea water — especially glacial to interglacial changes over the past 10^5 years and long-term changes related to plate movements and crustal weathering — although serious problems still exist in deciphering the sedimentary record. Man is also taking a hand in changing the oceans' chemistry, and urgent efforts are being made to evaluate the impact of fossil-fuel carbon dioxide on the oceans' chemical cycles.

It is also a decade since the publication of W.S. Broecker's *Chemical Oceanography* (Harcourt Brace Jovanovich, 1974), a lively, stimulating, arm-waving book and the predecessor of *Tracers in the Sea*. In the new book, co-written with T.-H. Peng, Broecker blends an account of these aforementioned advances with some material from the old to produce a major text. Like its predecessor, the book stimulates by generalization and speculation, and by addressing the explanation rather than the documentation of how the oceans operate chemically.

A principal theme is the Earth's carbon cycle and a major data set used is that produced by the American GEOSECS (Geochemical Ocean Sections) programme, the success of which was due in large part to Arnold Bainbridge (to whose memory the book is dedicated). The book

explores the links between carbon in the atmosphere, sea water and oceanic sediments, showing how this focal element in large part controls the chemistry of sea water and the distribution of sediment types, and how perturbations to carbon sources can be linked to past and future changes in oceanic chemistry. It provides, too, a topical summary of how chemical tracers give key information on water movements. Carbon isotopes play a central role in such studies: carbon-14, together with the nutrients silicate and phosphate, and tritium, radon-222, radium-228, helium-3 etc., to trace the movements of water through the deep sea and the oceanic thermocline; carbon-13 to trace differences in phosphate between water masses, thus permitting reconstructions of ocean chemistry in glacial times; and carbon-13 and carbon-14 to constrain and refine models of the oceans' uptake of carbon dioxide produced by the burning of fossil fuels.

Wrapped around this account of the marine carbon cycle are data and ideas emphasizing the chemical dynamics of the

oceans and the means for investigating them: the uranium and thorium decay chains for determining mixing and accumulation rates; lead and neodymium isotopes as source and reactivity tracers; excess helium as a hydrothermal tracer; and so on.

Overall, this leads to a very stimulating, reasonably integrated but necessarily focused view of what controls distributions of chemicals in the sea. To guide the reader through the various concepts are twelve anagrammatic apostles who, sharing the authors' well-known propensity for box models, lurk at the conclusion of each chapter and ask for advice on the interpretation of results from their aquaria experiments. Anyone who reads this successful book, parochialisms and all, will learn a lot about the chemical driving force in the oceans and will appreciate much of the interplay of ocean physics and biology with chemical cycles that makes marine geochemistry so fascinating and challenging. □

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Why study H-Y?

Peter Goodfellow

H-Y Antigen and the Biology of Sex Determination.

By Stephen S. Wachtel.

*Academic/Grune and Stratton: 1983.
Pp. 302. \$44, £29.20.*

THE mammalian Y chromosome is required for male sexual determination. As it is almost totally lacking in defined genetic loci, any gene found on the Y chromosome has been regarded as potentially related to sexual determination.

Male-specific antigens have been defined by tissue transplantation, *in vitro* T-cell killing and by serological assays. The antigen or antigens recognized by these disparate assays are all referred to as "H-Y antigens" or "H-Y". Transplantation, T-cell killing and, initially, serological assays showed a correlation between the presence of the H-Y antigen and the Y chromosome, and for this reason H-Y antigen has been extensively studied as a candidate for the elusive male determining substance. Subsequent work with the serologically defined antigen, particularly on H-Y antigen positive XO individuals, has relegated the Y-linked gene from a structural to a controlling locus. The importance of the H-Y antigen in sex determination now rests on a series of *in vitro* functional blocking tests based on the morphological evaluation of aggregation of germ cells.

Stephen Wachtel is well qualified to write the history of the H-Y antigen and sex determination as he has been responsible for much of the work in this area. Two of

the difficulties in writing scientific tomes is to make the work interesting to non-specialists and to translate the precise scientific words (jargon) into a more generally understood English. Dr Wachtel has solved the first problem by spicing his book with quotations from antiquity and from the more prescient of contemporary scientists. The second problem has only been partly solved: the immunology is explained clearly but the medical descriptions of the unfortunate individuals with indeterminate sexual phenotypes requires close study of *Gray's Anatomy* and a medical dictionary before understanding dawns.

However, the final test of a scientific book must be the scientific content. The review of the H-Y antigen literature is exhaustive and gentle; differences in opinion or results are nearly always reconciled by generous interpretation. In my view a more critical approach would have been ultimately more constructive as it is difficult for outsiders to form conclusions from the baroque serological experiments needed to define the H-Y antigen status of an individual. For example, it is not clear to me if normal females express a basal level of serologically defined H-Y antigen.

It was a monumental task to sort through all the papers on H-Y antigen and Dr Wachtel's book is worth buying as a compendium of that information. But the book will not be the basis of a consensus on the nature of the H-Y antigen and its relationship to sex determination. The last word remains to be written. □

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