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## Book review

**Radioactivity Radionuclides Radiation** (including the Universal Nuclide Chart on CD-ROM) Joseph Magill and Jean Galy, Springer-Verlag Berlin, Heidelberg, New York, 2005, pages 259, Price: EUR 49.95, £38.50, \$59.95, ISBN 3-540-21116-0.

George de Hevesy, a colleague of Ernest Rutherford's in the pioneering days of nuclear research, apparently lived in a boarding house and became suspicious that the stew his landlady was serving him at dinner time was made from the previous day's leftovers. To test this hypothesis, de Hevesy one day added a small amount of radionuclide to the remains of his dinner. The following day, he examined the new serving of stew with a radiation detector. It was active, thereby confirming that at least some of it was derived from the previous day's leftovers. A nice early example of the tracer approach! — how I wish I had known this amusing illustrative tale when I was a university lecturer! In fact, it is just one of several little gems contained in this new book on “the 3 Rs of nuclear science” which emanates from the Institute for Transuranium Elements, of the European Commission's Joint Research Centre at Karlsruhe in Germany. Incidentally, de Hevesy survived the diet of old stew to win the Nobel Prize for Chemistry in 1943 for his work on the use of radionuclides as chemical tracers.

This book will be extremely useful to the many in our field whose education missed out on the fundamental science underlying radioactivity, why it occurs and what it really is. Because it is an interdisciplinary area of science, we often come across researchers on environmental radioactivity, who through no terrible fault of their own, do not know the interesting physics which explains how matter was and is created, why some nuclides are abundant and others not, why most nuclides are radioactive and a minority not, what radioactivity is, where the energy comes from and so on. Many practitioners regrettably even struggle to use correct terminology — I have several times heard “radionucleotides” used for “radionuclides” and the misuse of the word “isotope” is absolutely ubiquitous. Well, for all of them, here is the neat solution — this book, in its first four chapters, summarises in an easily assimilated and nicely condensed way everything that we need to know in order to transform such a struggler into someone who will at least sound more convincing! Let all students who read JER memorise the table of definitions of terminology on page 15 of the book! [Unfortunately, having correctly defined “isotopes” as *species of the same element*, i.e. that have the same number of protons in their nucleus but different numbers of neutrons, then the authors frequently let down we pedants and themselves as proponents of precise scientific description by variously misusing the

term, e.g. “The isotopes C-11, K-38, Cu-62, Zn-63, Ag-106, Pr-140 and Ta-180 have been produced by ( $\gamma$ ,n) reactions” and “there are now four such isotopes known in nature: Dy-163, Re 187, Ir-193 and Tl-205”.]

The book regrettably comes with no Preface, no Overview and no information about the authors. Thus there is no initial indication of the book’s objectives, no concluding summary of priorities and future needs and no basis for judging whether the authors’ experience is appropriate to guiding the readers authoritatively through the wide range of topics covered. The nine chapters of the book cover the following subjects: origins and discovery of radioactivity, nuclear energetics, radioactivity and nuclear reactions, types of radioactive decay, transmutation research, archaeology and dating, radioisotopes in medicine, scientific and industrial applications and, finally, radiation and the environment. These chapters take up 166 pages, which are followed by almost another 100 pages which some might term largely “padding” but which comprise references (actually a rather limited eight pages), recommended reading and weblinks, a glossary, appendices and an index. The feeling about “padding” is borne out by the fact that the appendices include 32 detailed printed pages of atomic masses, a database which could just as usefully have been referenced. Throughout the book, there are regular linguistic errors. The editing could have been very much better. Nowhere does this prevent understanding but, like the “isotopes” thing above, it can become irritating to an old pedant like me.

The first four chapters are excellent. They include a fascinating historical summary of ancient Greek postulates on atomic structure, theories which largely endured for more than 2000 years until a few hundred years ago. At the other extreme, there is also a valuable guide to Internet sites and systems, including Nuclear Explorer and [www.nuclides.net](http://www.nuclides.net), the latter another product of the authors’ group. Such updates and innovations are useful to we dinosaurs. I was even glad to be informed about two naturally occurring radioactive decay modes, albeit that they are rare, which have been discovered since I was a lad studying nuclear basics, namely cluster emission and bound beta decay. The subsequent chapters on various nuclear applications are not as balanced or systematic as their predecessors. They tend to cover large subjects in cursory and superficial manner, often with a strange, seemingly spurious, selection of topics. For example, the chapter on radiation and the environment has sections on: biological effects of ionizing radiation, radiotoxicity and ALI’s, radiation hormesis, high background areas, radon, radiation exposure on aircraft, Conan the Bacterium, packaging and transport of radwaste, nuclear waste disposal, nuclear tests in the South Pacific, the Chernobyl accident and the Goiânia radiation incident. I must confess that Conan the Bacterium, like the Hevesy Stew, was new to me but I felt the better of knowing about him. And indeed there is a connection between Conan and the Stew. Because seemingly Conan was first isolated from a can of beef, one that had been radiation sterilized. This bacterium, *Deinococcus radiodurans*, is resistant to massive doses of radiation. Although doses in excess of 10,000 Sv damage Conan’s DNA by breaking it into more than a hundred pieces, it has a unique repair system that efficiently repairs the damage within a few hours. According to the authors, the bacterium is believed to be “as old as the Earth” and “could have been one of the earliest forms of life on the

planet. Due to its radiation repair abilities it could even have come from space". Told you this was good stuff! But who's connin' who?!

So the latter chapters are perhaps reminiscent of a short course on nuclear applications at senior high school or first year non-specialist undergraduate level. For example, if you want, when reading about the applications in archaeology, to assimilate the principles of radiocarbon dating via a 6-line text which does not mention past C-14 fluctuations or the issue of timescale calibration, then this is the book for you! But these latter chapters do cover a lot of ground and are actually a useful read for anyone wanting to learn or be reminded of the wider picture, namely of the great range of important applications through which nuclear science and radiation underpin key aspects of our everyday lives. But, Conan apart, this is largely science without the biology and with virtually no chemistry, earth science or ecology.

The book is accompanied in a front cover pocket by a hard copy of the Karlsruhe Chart of the Nuclides, always an attractively coloured covering for the office wall and indeed an invaluable information source. Unfortunately a large section of my particular copy was misprinted, with drunken blurred double-images of all lettering and numbering. Not typical of a Karlsruhe product. The back cover pocket contains a CD-ROM of the Universal Nuclide Chart, developed using Java applet software technology and running under various operating systems. This is a great asset to the book. The CD is easy to use, contains all the nuclear data you could want, and some others. You can even change the colour schemes to those of the charts of different organizations that produce them (i.e. switching between the Karlsruhe, Strasbourg, General Electric, JAERI and ITU versions). Most useful.

In conclusion, this is a book with pluses and minuses. For me, the pluses dominate. It is not expensive as books go. You get a wallchart and a CD-ROM, both extremely functional. And, in the book itself, you get a kind of updated review of what radioactivity and radiation are and some aspects of how they are applied in science and society. All good enough for even a Scotsman to cough up £38.50 – or more exactly in this case for a Scotsman to think the book good enough to take the trouble to review it in order to keep his free review copy!

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