brief. The mathematical derivations are well explained, but for the average student most chapters would need to be studied in close conjunction with other sources.

The content is original (for example, very few diagrams are reproduced from other sources), the presentation of the book is good, and there seem to be few errors or inaccuracies. A feature that works particularly well is the selected reading list at the end of each chapter in which key references are given and their content summarized. The level is generally more advanced than in Fowler, but is equally well explained.

In *Fundamentals of Geophysics*, William Lowrie hopes to provide a core textbook for geology and geophysics undergraduates. But aiming a book at this intermediate level is difficult: you need to ensure that material on each topic is adequately introduced and also that the treatment does not frustrate the reader with its lack of depth. Lowrie's text is certainly not advanced, but his introduction to material is frequently inadequate. The level is similar to Fowler, but less clearly explained and presented.

While it thoroughly covers solid Earth geophysics, some aspects of the book are ill-conceived. For example, the chapter on seismology starts by stating that it is necessary to have a good grasp of elasticity theory before analysing the different sorts of seismic wave. I would not agree with this. Lowrie presents the full derivation of the wave equation before more qualitative aspects, such as the seismograph, seismogram and earthquake seismology, but this does not work well. Sleep and Fujita neatly split their treatment of seismology into an earlier qualitative chapter and a later more quantitative one. Fowler's solution is to present the wave equation as an appendix, which is also a more satisfactory approach.

Another problem with Lowrie is that the level of mathematical difficulty is very inconsistent. Also, he generally introduces a topic from a historical viewpoint. While this is interesting, I think that it is more important to start with the underlying physics and then present the geophysical applications (perhaps with historical references), which is essentially the approach followed by Sleep and Fujita.

Neither of these new books has problems or exercises for the student to reinforce the contents of each chapter, which is a pity. I have found the problem sections in Fowler's text particularly useful, not only as set for students, but also for adaptation as examples in class lectures.

In summary, I wholeheartedly recommend *Principles of Geophysics* to any research geophysicist or graduate student, and as a key library text for teaching. I will continue to recommend Fowler as the course text, but will refer students to Sleep and Fujita for particular aspects (the chapter on heat flow and geothermics, for example, is outstanding). Lowrie's text needs substantial revision before I could recommend it for the support of teaching. □

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Defining moment

The Environment Dictionary
by David D. Kemp
Routledge: 1998. 464pp. $100 (hbk, not yet published); £17.99, $29.99 (pbk)

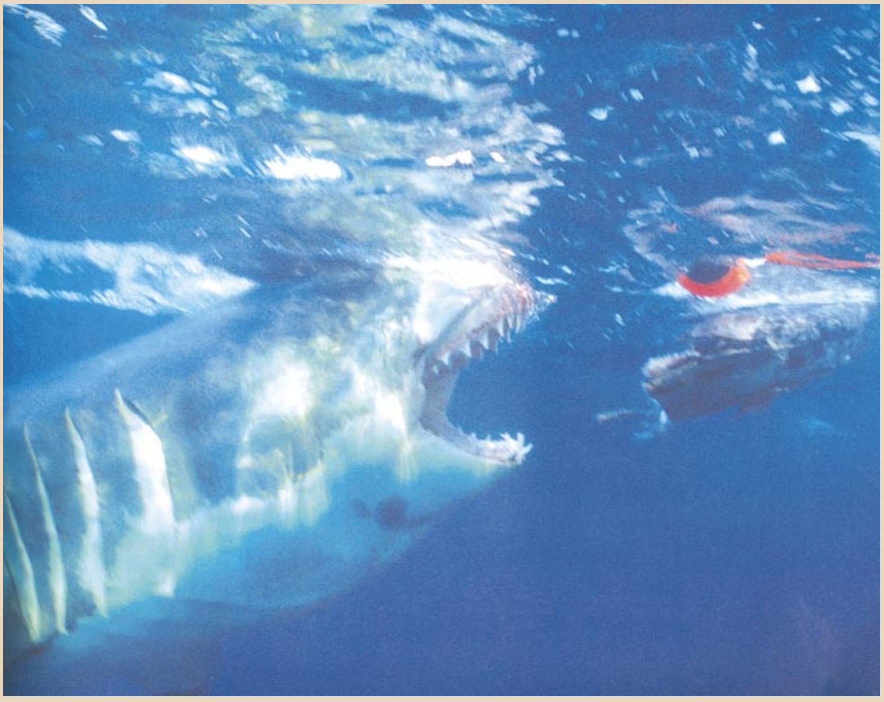
Longman Dictionary of Environmental Science
by Eleanor Lawrence, Andrew R. W. Jackson and Julie M. Jackson
Longman: 1998. 491pp. £12.99 (pbk)

Peter Brimblecombe

The maturity of a subject can often be gauged by the development of its specialist reference works: dictionaries, encyclopedias and handbooks. Many traditional disciplines offer fine examples of these, but the growing importance of the environmental sciences is only beginning to be reflected in the quality of its reference works. The environment is of such widespread interest that it has created the need for both popular and specialist reference books. These range from handbooks for active researchers through to volumes that help ordinary people confronted by the barrage of environmental terminology now in everyday use.

Although both David Kemp's *The Environment Dictionary* and the *Longman Dictionary of Environmental Science* aim at fairly general readers, they are very different. The former provides 1,700 general entries in the style of an encyclopedia. These are often some pages in length and well supplied with advice on further reading. The latter offers nearly 13,000 short definitions.

What is environmental science? This has always been a difficult question, so it provides an appropriate first test for these two books. Under "environment" Kemp tells us that "environmental science includes not only the traditional sciences such as chemistry, physics and biology, but also engineering, economics, sociology, politics and law. The study of the environment is thus very much interdisciplinary in nature". The Longman dictionary defines it as "the study of how humans and other species interact with their non-living and living environments". One can hardly disagree, yet they don't seem to go far enough. Seemingly such passive building blocks, one is left wondering if environmental science is more than the sum of its parts, and to what extent it promotes action.



Shark truths and some great white lies

Only seven people this century have been killed by the great white shark, the man-eater of the movies – fewer than the number killed by bee stings. In *Sharks! Predators of the Sea* (Running Press, $19.98), Piero Angela and Alberto Angela, aided by 160 full-colour photographs by Alberto Luca Recchi, explore the truths and myths about these ancient predators and reveal why it is more a case of the biter bit, as man's culinary cravings threaten these creatures' survival.

Moving on to another broad and problematic word, pollution, the Longman dictionary describes it as "any harmful or undesirable change in the physical, chemical or biological quality of air, water or soil", embracing both anthropogenic and natural pollutants. Kemp gives a much longer definition, full of examples. Interestingly, neither introduces aesthetic pollution issues, restricting the idea of unwanted effects to the more physical. As a final awkward concept I looked up Gaia. I was impressed with Kemp's reasonably unbiased account and his final comment that "the partial or complete removal of mankind might be Gaia's natural answer to the Earth's current problems". The Longman dictionary gives a tight definition, but no sense of the controversy that surrounds the Gaia hypothesis.

Specialist terms often present problems for the lexicographer, whose expertise can hardly cover every topic. From atmospheric chemistry I took the word immission, which I cannot understand or pronounce, but it was in neither book. Henry's law is found only in the Longman work, and is given in the dimensioned form with non-SI units ($mol\,l^{-1}\,atm^{-1}$) that is often used by atmospheric chemists, although others formulate it differently.

The nitrogen oxides are difficult to refer to. In both speech and textbooks they are often introduced carelessly, perhaps because the word 'nox' is so ugly. Longman defines "nitrogen oxides", "oxides of nitrogen" and "NO_x" (the latter correctly as $NO + NO_2$). Kemp has no entry for NO_x, which is a pity as a reader might well use this index term. The "oxides of nitrogen", N_2O, NO and NO_2, have an entry, but are incorrectly equated to NO_x. Oddly, neither dictionary spells sulfur in the way approved by IUPAC.

Overall, however, each of these books will find its readers, and will serve them well, providing either comprehensible short accounts or tight definitions. □

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In retrospect chosen by Gordon L. Herries Davies

Principles of Physical Geology

by Arthur Holmes

(1944)

In Britain in the early 1940s things looked pretty black. From Norway and Dunkirk to Crete and Singapore, the war had been a chain of disasters. The public craved the relief of escapism. There was no prospect of victory in sight, but that did nothing to inhibit dreams of a glorious post-war world. The building of castles in the air was easier than the holding of redoubts in Greece or Malaya. The Beveridge Report (1942) offered a vision of British society reborn. The Scott Report (1942) looked forward to the day when there would be national parks for national enjoyment. Butler's Education Act (1944) held the promise of a new scholastic Elysium.

Up in Durham, Arthur Holmes (1890–1965) was a man of that age. He was the university's professor of geology and he found himself with time on his hands. By day his teaching duties were diminished because the call to arms had removed most of his students. By night the nocturnal hours dragged on as he performed his air-raid patrols. In the dark skies above, menacing Heinkels opened their bomb doors; in the shadow of St Cuthbert's shrine below, Holmes could do little more than reflect on the future well-being of his science.

During those troubled years Holmes was by no means unique in his concern for geology's destiny. The science was widely seen as ailing. For decades it had been plodding through a sludge of stratigraphy within a miasmic fog of fossils. The British geological theatre had lacked real drama ever since 1888 when the curtain fell on that long-running and thrilling production, 'The Highland Controversy'.

More recent offerings, such as Arthur Vaughan's epic of 1904 set amid the Carboniferous strata of the Bristol district, might possess great scientific merit, but they were unlikely to bring the audience to its feet. In Victorian times, geology had been a favourite among the sciences, but by the 1930s it was a lame 'also ran'. Its devotees grumbled about a press which no longer reported on their activities. Even the fellowship of the famous Geological Society of London was in decline. Its numbers had fallen from 1,279 in 1922 to 1,067 in 1942, and the society's president had felt it appropriate to devote half of his 1941 anniversary address to a diagnosis of geology's malaise. Ten years later I must surely have wondered about the health of the discipline myself, because when I became an undergraduate in 1950 I discovered that three pillars of my first-year reading-list — Rutley's *Elements of Mineralogy*, Watts's *Geology for Beginners*, and Woods's *Palaeontology* — were all written the previous century.

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Holmes: revitalized interest in geology.

Holmes's reflections upon the condition of geology brought him to a decision. Through the authorship of a new textbook he would seek to play his part in shaping the subject's future. That work, *Principles of Physical Geology*, was published during September 1944, its preface bearing the twin dates of July 1942 and May 1944. (By that second date Holmes had moved from Durham to the Regius Chair in Edinburgh.) In retrospect these seem to be singularly apt dates. Individually they mark the eve of those two climacterics of the Second World War, Stalingrad and Normandy. On a very different plane, the appearance of the book stands at an equivalent turning-point in the story of modern geology. Widely acclaimed, it was soon an international best-seller. Known simply as 'Holmes', it was destined to become the vade-mecum of an entire generation of young geologists.

I was given my own first copy by my father sometime during 1945, when I was 13. Displayed in the window of a Manchester bookshop, the volume had excited his interest. That particular copy — a volume from the first of 18 post-1944 reprintings — now lies before me as I write. The claret of the spine has lost its sparkle. The frayed corners, the loose hinges, and the thumb-marked fore-edge all betoken the age and heavy usage of a book which has been my companion through life. It today well merits its honourable retirement from active service, shelved in its Valhalla alongside my Coles, Geikies, Lyells and Ramsays.

Having selected physical geology as his canvas, Holmes created some exciting images. He treated the shaping of the Earth's topography from arêtes to yardangs. Earthquakes, orogenesis, volcanism, and the cause of ice ages all received attention. Ever since 1911 Holmes had been writing about radioactive minerals and the age of the Earth, so that topic too featured strongly. And the final chapter was decidedly risqué, exploring the notion that our continents might be mobile, an idea which most geologists of the 1940s would surely have dismissed as risible.

Within just a few years of the appearance of that first edition of Holmes, geology began to enjoy a new prosperity, as startling discoveries once again placed the science squarely in the public gaze. The study of an early Holmes must have been a seminal experience for many who subsequently became active participants in the subject's mid-twentieth-century renaissance. Now, 50 years later, those same geologists are passing from the intellectual scene, and it is fitting that we should remember the text that was for so many their earliest inspiration in the Earth sciences. □

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