Since death is so final and, when it comes, so quintessentially abrupt, we may note the irony that such gradualism has acted as a persistent bias to encompass all scales of extinction as extrapolation from ecological moments (with mass extinction as an even greater test of competitive mettle than natural selection in ordinary times). Raup continues:

> Conventional dogma is being questioned and in some cases discarded. We are seeing a change from dominantly gradualist interpretations of natural phenomena to those that emphasize strongly chaotic events.

Obviously, if the Alvarez impact theory holds (and it now seems virtually established as a major factor in the Cretaceous debacle, with intriguing hints for its general validity as a primary trigger of disaster), then mass extinction is not competition by natural selection extended (by Darwin's metaphor of the wedge), but a separate process with rules for differential termination that cannot reduce to simple extensions or intensifications of ordinary adaptive struggles. Organisms cannot track or prepare for periods of cosmic disturbances (including major impacts) that occur once every 26 million years or so.

In his contribution, Paul Martin shows that extrapolation fails between coordinated deaths on small oceanic islands (inspired by human arrival) and extinctions of large mammals on several continents (where climate makes a stronger, perhaps dominant, contribution). Why, then, should we gather the vastly more different scales of this book together and regard death as fit for a common theory.

I offer no counsel of despair, but plead instead for hard thinking about proper taxonomies as guides to more adequate general theories. If we break up superficial categories such as death, or increasing diversity, in favour of events with common causes that respect the true differences across tiers of time and levels of hierarchy, then what shall we group together? Steno's great *Prodromus* superseded Kircher. The *Prodromus* is a treatise on taxonomy, though not usually so regarded. It makes a radical proposal — that the important objects of geology are solid objects within solids (from fossils and crystals in rocks to sediments in basins of deposition), and that the comprehensive category of solids within solids can be broken into subcategories reflecting common causes (fossils that solidified before entombing rock vs crystals precipitated into spaces of a matrix already solid, for example). Such a taxonomy must have startled people used to ordering objects by Kircher's criteria of form and place — but it provoked the revolution that began modern geology. What is a proper taxonomy for the stuff of evolution and life's history? □

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Magnify the soil

J.A. McKeague

Micromorphology of Soils.
By E.A. FitzPatrick.
Chapman & Hall/Methuen: 1984.
Pp. 433. £32.50, $59.95.

THE subject of soil micromorphology, involving the use of microscopes in the study of soil, developed gradually after the publication in 1938 of W.L. Kubiena's pioneering book, *Micropedology*. Nowadays hundreds of soil scientists throughout the world examine soil thin sections by microscope to complement information obtained by other means, but only a dozen or two of them are specialists in micromorphology.

Dr FitzPatrick is one of those few experts and his individualism and enthusiasm are evident in this book, an attempt at a comprehensive treatment of the study of soil thin sections. Detailed instructions are given on the preparation of thin sections; apparently they work, as the numerous photomicrographs of soil features are of good quality. It is doubtful, however, that the details of equipment will be generally useful as equipment differs so much from one laboratory to another. Explanation of the use of the polarizing microscope for studying soil thin sections is excellent for readers without formal training in microscopy, while the chapters on properties of minerals and soil features in thin section are clear and will be helpful to the intended users (students and soil surveyors). By contrast, the material on ancillary techniques, photography and teaching micromorphology seems too brief to be effective. Potential applications of soil micromorphology to fields such as agriculture and engineering are presented with some zest.

Difficulties over terminology, ever-present through the brief history of micromorphology, will harass readers of this book. Although Dr FitzPatrick declares in the preface his intention to use simple nomenclature and standard terms, he assails the readers with a bewildering chapter in which he recycles his own unique terminology for soil horizons and proposes some new, poorly-defined terms — resolution of nomenclature should be left to an international committee. Fortunately, Dr FitzPatrick complies with his intention of using standard terms in the "detailed description of thin sections", one of several appendices; although not meeting the "detailed" aspect, the descriptions are a model of the effective use of common words.

This first attempt at an all-embracing treatment of thin section studies of soil will be a useful reference book, especially for students. It is, however, an individualistic treatment rather than a state-of-the-art account of the subject. □

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The nuts and bolts of bosons

J.H. Mulvey

The Particle Connection: The Discovery of the Missing Links of Nuclear Physics.
By Christine Sutton.
Hutchinson/Simon & Schuster: 1984.
Pp. 175. £8.95, $16.95.

NOTHING quite like it has happened in experimental physics since 1888, when Hertz detected the electromagnetic radiation predicted by Maxwell — an observation which set the seal on the unification of electricity and magnetism. Nearly a hundred years later, in 1983 at CERN, it was the turn of the W and Z bosons, the radiation of the "weak force" responsible for nuclear radioactivity and for the first step in the chain of events by which the Sun derives its energy. The parallel is close, for just as Maxwell joined electricity and magnetism the observation of the W and Z at CERN was a crucial confirmation of a theory which links electromagnetism with the weak nuclear force.

In the Deutsches Museum, Munich, the apparatus used by Hertz sits on a shelf. Christine Sutton describes how the search for the W and Z required the use of CERN's particle accelerator, built by John Adams in a tunnel 7km in circumference, and a 2,000 ton particle detector housed in a huge cave 50m underground. Her book tells the tale of this great enterprise, an experimental *tour de force* which earned the two principal characters, Carlo Rubbia and Simon van der Meer, the 1984 Nobel Prize for physics. It is a sober, nuts and bolts account of the project and of the steps that led up to it. The preparation of the ground is thorough, perhaps to a fault, and we do not arrive at the W and Z experiment until Chapter 8, about two-thirds of the way through.

As a popular book on a major discovery the presentation would have benefitted from more explanation, more illustrations and less detail. But readers already hooked on the rapidly developing story of progress in understanding nature's forces will be well rewarded, especially by the very complete description of the pains taken by the physicists to be sure they had found real, not bogus, bosons. □

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