

## Figures of speech

Chris Philippidis

**More Than One Mystery: Explorations in Quantum Interference.** By Mark P. Silverman. Springer: 1995. Pp. 212. DM48, £19.95 (pbk).

THIS is a beautiful and clear exposition of how quantum interference, non-locality and long-range correlations interweave to produce characteristically quantum effects that have no classical counterparts. From the foundational point of view, however, one has to raise an eyebrow at Silverman's declared intention to proliferate the mysteries of the quantum world. This is an unnecessary blemish.

The term 'quantum wholeness', although ubiquitous in the literature on the foundations of quantum mechanics, is never used in the text. Nevertheless, Silverman develops this theme in a symphonic fashion. Interference, coherence, non-locality and correlations are leitmotifs that get worked and re-worked in a variety of situations and imaginative experiments (some real and some *gedanken*). The unflinching outcome is that the classical intuitions always fail spectacularly.

Through concise but succinct calculations, the author treats several cases involving two-slit interference in conjunction with Aharonov-Bohm solenoids and Einstein-Podolsky-Rosen set-ups. Magnetic fluxes arranged in different topological configurations in various interferometers form the basis of many of his case studies in the earlier part of the book. He then goes on to deal with quantum interference in contexts such as beats in radiative decay of excited atoms, oscillating field spectroscopy and the parallel between optical rotation and a two-level system.

Silverman creatively unmask the features of the quantum domain to reveal the subtle workings of entangled states, second-order correlations, photon bunching and interference in time and so on. He often alludes to foundational issues. During his treatment of interactions of ions with vector potential fields, for example, he raises the question of the inconsistency between the Schrodinger and the Pauli and Dirac formulations.

Yet the book poses an unintended paradox. On the one hand, it successfully develops quantum intuitions and ways of seeing and contrasts them well with their naive or classical counterparts. On the other hand, its language resides within the discourse of the 'mysterious', which undermines the very project of establishing quantum wholeness as a natural mode of expression and communication.

This might have been understandable if the author's communication skills were found wanting. But throughout the book,

Silverman shows considerable awareness of and sensitivity to discursive techniques. The text is well-structured and punctuated by effective rhetorical questions. He also places issues in context by briefly reporting the debates that surround them.

Silverman's mysteries are sustained by a classical and observer-centred narrative, as in:

Can it truly be the case that the AB [Aharonov-Bohm] effect occurs if one looks for two electrons at *one* location, and does not occur if one looks for electrons at *two* locations? If so, the present example leads to an extraordinarily puzzling consequence which I illustrate concretely by resorting to a monochromatic plane-wave description of the electrons.

Having consistently shown the irrelevance of classical imagery, why resort to it when formulating such questions? Why talk of 'looking' at one place or another when the effect discussed result from concrete experimental arrangements? The wiring of detectors to register independently or in coincidence is an integral part of a consistent quantum language.

It would be interesting to know Silverman's views on the de Broglie-Bohm approach. This approach would not only bring out even more forcibly the particular features of quantum mechanics he has so ably demonstrated but would also impose a mystery-free way of expressing them. Perhaps not so good for sales but it would work wonders for quantum physics. □

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## Paths of discovery

Douglas Palmer

**Dinosaur Tracks and Other Fossil Footprints of the Western United States.** By Martin Lockley and Adrian P. Hunt. Columbia University Press: 1995. Pp. 338. \$29.50.

FROM their publication record, Martin Lockley and Adrian Hunt would seem to have invented a subspecies of 'dino-trekking'. They have certainly done a very good job in promoting the scientific investigation of fossil dinosaur tracks. They build though on a respectable tradition that, in the United States, goes back to Edward Hitchcock's mid-nineteenth-century pioneering studies of the Jurassic period of the Connecticut Valley. Hitchcock regarded the three-toed imprints he found there as the footprints of giant birds. He was spectacularly wrong of course, but the ornithischian characters of some dinosaurs had not been recognized

at that time. This historical digression does, however, illustrate the sort of pitfalls lying in the stratigraphic record awaiting the unwary ichnologist.

Lockley and Hunt do not balk from these and the many other problems that beset their area of study, such as the taxonomy of trace fossils. Rarely can tracks be linked to body fossils, so there has to be an independent nomenclature. The difficulties of matching prints with their biological maker are not confined to species or genera but can still cause problems for the experts even at the class level. For instance, the authors' discussions of Upper Palaeozoic tracks highlight the difficulty of distinguishing between amphibian and reptile prints.

This non-dinosaur aspects of the book are particularly interesting, partly because the dinosaurs are so well served in other books (such as D. D. Gillette and M. G. Lockley's *Dinosaur Tracks and Traces*, Cambridge University Press, 1990) and the non-dinosaur literature is so scattered. But these trace fossils also promise significant progress in our understanding of early tetrapods and the environments in which they lived. If it is necessary for this area of study to 'piggyback' on the more popular appeal of dinosaurs, so be it.

The Cenozoic tracks of birds and mammals also get a look in but have far fewer recorded sites in the western states than the reptiles do in the older rocks. Clearly this is not a lack of suitable terrestrial sedimentary rocks, which are abundant on the wide flanks of the Rockies. They just haven't been found yet. Every other page of the book refers to old collections that need reworking or new collections that are awaiting study.

From the subtitle, the book might seem a bit 'parochial'. But the region covered is a large parish and probably contains as many sequences of terrestrial sediments, through as much of the Phanerozoic, as anywhere on Earth. There are enough tracks and trails here to fill many a PhD thesis into the next millennium. □

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**Making Science: Between Nature and Society** by Stephen Cole. Harvard University Press, £10.50. Reviewed by S. Blume in *Nature* **364**, 725 (1993).