ing that the primary source of the manuscripts is a European based symposium. Generally, *Biotechnology for the Environment: Soil Remediation* will provide a good supplemental resource for those looking for specific examples of applicability of remediation.

Robert L. Tate III
Rutgers, the State University of New Jersey

Managing Soil Quality: Challenges in Modern Agriculture
S. Elmholt and B. T. Christensen, eds.

2004. Kluwer Academic Publishers. vi + 140 pp. CAB International, 368 pp., $140.00 (U.S.), $75.00 (UK)

The editors of this book, P. Schjønning, S. Elmholt, and B.T. Christensen, have succeeded in compiling perhaps the most focused technically based book on soil quality published to date. The chapters they have brought together are predominately the work of European, Australian, and Canadian authors who, to a greater degree than in previous texts, have taken a data-based analytical approach to concept demonstration and testing. This is refreshing for a topic that has been largely dominated in the American literature by philosophical semantics and institutional proselytizing, more often than not in the absence of specific data collected or applied to the proposed conceptual framework. Even the nonempirical opening and closing chapters by Schjønning et al., which are intentionally philosophical, consider some new conceptual refinements and are at least somewhat open to the possibility that critiques of the soil quality concept offered to date have merit worth pondering. Nevertheless, as one of us communicated to Per Schjønning during the preparation of the book, we feel an opportunity was missed by failing to include more objective assessments of the concept directly from concept-skeptics. Although a few chapters cite the existence of concept criticisms superficially, none deal substantively with any of the twenty or more specific technical reservations about the soil quality concept that have been specifically and repeatedly articulated in several high-profile critiques in the literature. Fewer than ten sentences in Schjønning et al.'s book deal with these specific reservations, and none substantively.

The value and the strength of Schjønning et al.'s book parallel what are likely the four greatest strengths and contributions of the soil quality movement: (i) the soil quality concept seeks new ways to draw attention to holistic soil attribute management; (ii) it seeks newer, simpler ways and terms to present integrated soil status analysis to farmers and other land managers; (iii) it seeks interpretations of those analyses that provide a tracking mechanism for long-term management regimes, especially on public lands, for publicly financed programs on private lands or for publicly regulated tracks of private lands such as commercial forests; and (iv) it fittingly draws a more appropriate amount of attention to soil biological attributes, which, before the 1990s, were often neglected. The greatest single contribution of the Schjønning et al. book is the extent to which it addresses the third of these features. As editors, Schjønning et al. have steered authors toward identifying quantitative indicator-attribute threshold values, or at least discussing how one might attempt to arrive at them.

Most of the book's technical chapters focus on developing interpretations of an individual soil property (specifically: pH, N, P, K, organic matter, microbial diversity, bulk density, structure, erosion, and contaminants). Despite the importance placed on the philosophical and systems chapters on holistic interpretation, there was little or no consideration in these individual soil attribute chapters of the alterations in individual property indexing that are necessitated by the effects of the status of the other properties for a given soil function or use (i.e., interactions among properties as well as multiple and conflicting function-dependent soil property optima, the consideration of which would seem to be the essence of the concept of holism). The near absence of consideration of how to construct and interpret indices for properties to cope with simultaneous multiple conflicting soil functions was striking since this deficiency has been noted repeatedly by both concept critics and proponents alike (Letey et al., 2003; Singer and Ewing, 2000; Singer and Sojka, 2002; Sojka et al., 2003; Stenberg, 1999).

We were especially struck by this oversight in a chapter that we expected to be focused specifically on this difficulty, Chapter 16, Soil Quality Knowledge and Land Use Planning by J. Bauma. He states "Soils have different functions . . . and each function will require different indicators, *which is no problem as long as it remains clear which function is being addressed* [emphasis added]." Unfortunately, *it is a problem*, because managers and the soil environment do not operate in a universe of individual functional selectivity. All functions

are occurring at all times, and many have multiple and conflicting function-dependent soil property optima. Important conflicts arise because attributes favoring production are often at odds with attributes needed to protect the environment.

On the other hand, we applaud Bauma's listing of soil organic matter among the properties that "cannot act as distinguishing features for soil qualities as they have no direct, but only an indirect relation with soil functioning." This statement, however, will likely cause some frustration among concept proponents, who see soil organic matter content as the single most potent component of any soil quality indexing strategy. Sanchez et al. (2003) noted that use of soil organic matter content *per se* has little meaning; they proposed instead evaluating soil productivity by relating top soil organic carbon content to its undisturbed state, suggesting 80% as a critical value. The two chapters on soil biodiversity deserve credit for considering the arbitrariness of selective biodiversity achievable or desirable under agrarian monoculture and explore, but do not resolve, how to define optima for systems where true biodiversity (which would include pathogens and inefficient organisms as well as beneficials and symbionts) is really not desired.

We were also struck by the extent to which the organization of the individual property chapters and the technical presentations in them were simply "traditional edaphology." In most of these chapters, soil quality is used more as a generic term, without strong linkage to a defined holistic quantitative indexing regimen. Which prompts the question: What is it about these presentations that distinguishes them from the vast literature of soil property interpretation? Beyond that, this organization of the book underscores one of the practical drawbacks of using the soil quality concept, namely that any complex multifaceted index that produces an integrated score must ultimately be deconstructed back to individual inputs to diagnose and interpret the score for use by a manager. Since astute soil managers are usually acutely aware of the individual soil properties most prone to degradation in their situation, the value of comprehensive holistic indexing as a management tool may be less than perceived and lauded by concept proponents.

To their credit, Schjønning et al. conclude their book with two chapters that consider the challenges of implementing the soil quality concept under the constraints of systems analysis and logic, plus a chapter that surveys the current use of the soil quality concept (or other more traditional management-directed indexing tools that accomplish similar ends) in both developed and underdeveloped nations. There is a final chapter by the editors themselves that synthesizes their perception of the contributions and progress achieved in the preceding seventeen chapters. Whereas these concluding chapters were more optimistic in their assessments than ours would have been, they deserve recognition for being more explicit in identifying the number and magnitude of the challenges to realistic implementation of soil quality indexing than has previously been acknowledged. Rattan Lal notes that in the tropics alone, indices must overcome the specificity requirements of thousands of soil series and be robust enough to cope with varying degrees of macro-scale and micro-scale soil variability. He also lists ten different approaches in current use for assessing sustainability or soil quality. All these, he notes, must further meet the constraints of a series of contrasting value issues between the developing and underdeveloped world. Others have listed additional related and traditional indices in past or current use and various multiplicative constraints on index formulation and interpretation (Singer and Ewing, 2000; Sojka et al., 2003; Letey et al., 2003; Stenberg, 1999). Version 4 of the soil Fertility Capability Classification system (FCC) provides quantitative indicators with interpretations for different land uses (Sanchez et al., 2003).

Even as acknowledged skeptics of the soil quality concept, we recognize that this is a valuable addition to the soil quality literature. It may even be a breakthrough treatment of the topic in the sense that it chronicles some initial efforts to construct and deploy indices. The focus on the difficulty, while recognizing the paramount necessity, of identifying index thresholds is entirely appropriate. Yet we are struck by how, as the soil quality concept is further developed, it begins to look more and more like traditional edaphology, although perhaps invigorated by its holistic liaisons along the journey.

Robert E. Sojka
Northwestern Irrigation and Soil Research Lab

Pedro Sanchez
The Earth Institute, Columbia University
DOI: 10.1097/01.ss.0000149360.43194.e4

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