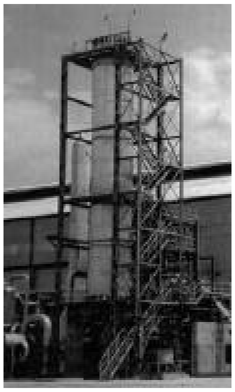
in 1909. Carl Bosch shepherded development of the industrial processes for commercial production.



An ammonia converter 23 meters high installed at the Aonla plant in India by Haldor Topsøe. From *Enriching the Earth.*

The ramifications of this development can hardly be exaggerated. Of the world's six billion people, the author estimates "nearly 2.5 billion are here because proteins in their bodies are built of amino acids whose nitrogen came--via plant and animal foods—from Haber-Bosch synthesis" (Page 221). Smil's command of the sources and his ability to explain the technical and scientific aspects are indeed impressive. His goal was to make the survey comprehensive and interdisciplinary--understanding that some specialists may read only parts of the book. Smil explains the flows and sources of nitrogen in traditional and pre-industrial agriculture. Mining of guano and Chilean nitrate is also explored. The history of science and technology emphasis is to be found in the discussion of the Haber-Bosch process and its improvement. Agriculturalists and soil scientists will enjoy the exposition of how synthetic fertilizers have transformed agriculture. The increase in the quantity and quality of food and improvement in human diets has not come without a price. Smil examines the consequences of reactive nitrogen in the system—a condition which has been much overshadowed by the focus on carbon dioxide. Smil's book deserves a place on the bookshelf not only of scholars of the history of agriculture and science, but also of policy makers.

Douglas Helms
Natural Resources
Conservation Service

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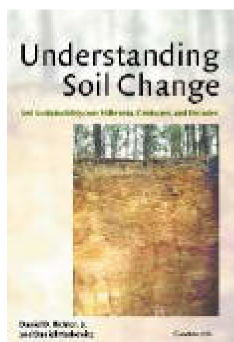
## Understanding Soil Change: Soil Sustainability over Millennia, Centuries, and Decades.




Daniel D. Richter and Daniel Markewitz, 2001. Cambridge University Press, UK, 270 pp., $ 70.00.

This review will be published in the journal *Soil Science* Vol. 167 (2002).

This book deals in a highly appealing way with the shift from nature-dominated soil genesis to human-induced soil changes. How are geo-ecosystems of Ultisols carrying mature hardwood in a humid climate changed after 200 years of cultivation? And how are cotton-growing soils then changed in 40 years of reforestation with pines? These are the major questions asked in this excellent book. The text is divided into five main parts, with Part I providing a general background of pedogenetic processes and soil management.

The core story of soil change is based on the alterations in the deep (~5 m) mature soil profile developed over millennia on gradually uplifted granitic gneisses of the southern Piedmont of the USA, described in Part II. Now in isostatic equilibrium, both with geomorphic and environmental forces, the dominant soils on gently sloping pedomorphic surfaces were previously called Red Yellow Podzolic and are now classified as "clayey, kaolinitic, thermic Typic Kanhapludult" (Cecil or Appling soil series on granitic gneiss). These are widespread in southeastern USA and hence also of wider interest for similar humid areas with advanced weathering. The Calhoun (South Carolina) forest soil profile and its chemical data are presented in detail. For the weathering process the authors concentrate on the process of acid hydrolysis and speculate on the source of the protons, whether from biogenic or carbonic acids. The soil hydrology is described in less detail. With an estimated 400 mm rainfall in excess of evapotranspiration (how much of this is surficial or lateral runoff?) the weathering rate at depth is considerable, but only the figures obtained by Pavich for the Virginia Piedmont (7 to 40 mm per thousand years) are quoted. Some more analyses of the soil solution and ground water would have been helpful to validate these rates.

Though alluvial bottomland Inceptisols were cultivated for maize by Native Americans for centuries, deforestation of the upland interfluves started only in the late 18th century for growing cotton and spread rapidly in the 19th century. When liming and nitrogen fertilization were introduced on these acid and nitrogen-poor soils, productivity improved, accompanied by profound changes in the soils, as described in detail in Part III. Acidity was partly neutralized but organic carbon content decreased by at least 40%. Gullies, created by accelerated soil erosion became a problem. The soil management details are valuable for a better understanding of the region and can be supplemented further by the recent account of Helms on *Soil and Southern History* (2000), though it deals more with the base-rich Alfisols.

Part IV, based on 40 years of pine reforestation at the Calhoun Soil-Ecosystem Experiment facility, deals with changes in these cultivated soils when abandonment of these Piedmont farms began in the 1930s. Dynamics of carbon, nitrogen, exchangeable cations and phosphorus were measured periodically though only to 60 centimeters depth. Soil re-acidification progressed rapidly, while soil carbon changes were limited to the top few centimeters only. For a better understanding of these processes, long-term monitoring is needed.

*Understanding Soil Change* is a pioneering book worthy of follow-ups. Part V ends with a strong appeal to establish in several critical regions similar long-term monitoring and research experiments of soil-forest-ecosystems, a program which hopefully will be taken up by the relevant institutions. The problems in evaluating historic trends in properties relevant to soil development and of understanding soil changes leading to sustainability in management would indeed be best served by such permanent or long-term networks. In each case a broad holistic approach, though costly, is needed. By comparison, selected, incomplete, or partly misguided data can lead to unconvincing conclusions about soil change as in the recent book of Lindert (2000) on arable soils in China and Indonesia, essentially aiming at a similar understanding as for the Piedmont Ultisols. We need to learn from both efforts.

The book is clearly written and well illustrated. It is used as a graduate text and is highly recommended to all soil scientists and their students--a fine example of a broad study of major soil changes and their relation to management. It should be no less relevant to ecologists, biologists and geographers, who too frequently, when describing or studying ecosystems, disregard the importance of soil characteristics, their dynamics and human impacts on soils.

***References***

Helms, D. 2000. Soil and Southern History. *Agricultural History* 74: 723-758.

Lindert, P.H. 2000. *Shifting Ground: The Changing Agricultural Soils of China and Indonesia.* XII + 351 pp. MIT Press, Cambridge, MA.

Dan H. Yaalon
Institute of Earth Sciences
Hebrew University

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# ARTICLES

## On the Dokuchaev Legacy

Vasili Vasilievich Dokuchaev (1846-1903) commenced the recognition of soils as a separate body of nature following the publication of a widely known and classical book *Russian Chernozem* (1883) as a Report to the Free Imperial Economic Society (FES) in St. Petersburg. He became known as the main founder of what is now known as pedology--the science of soils as a natural resource, dealing with their origin, nature, distribution and classification. It is an interesting example of a distinct science where the term pedology was coined (by Fallou in 1862) before the science as such was characterized. Dokuchaev died at a relatively young age and his bearded picture became a familiar addition to numerous memorials, celebratory anniversaries and reviews. He became a prominent figure of the pioneers of Russian science, honored by a large fine bust in the gallery of selected scientists at the prestigious Moscow State University and having a leading research institute and a museum named after him. At least two full-length biographies of