The Soil Science Literature

Systematic soil research started in the 19th century. There were groups that worked in laboratories and here soil investigations were part of agricultural chemistry (Davy, 1813). Scientific breakthroughs were made by J. von Liebig and his contributions to soil science and plant nutrition have been well documented (Brock, 1997; van der Ploeg et al, 1999). Liebig was influential and in the 19th century most soil science books focused on soil chemistry, manures and the management of soil fertility (eg Ruffin, 1832; Dana, 1842; Johnston, 1845; Kent, 1856; Johnson, 1870). Darwin’s book on earthworms (1881) was largely overshadowed by the views that only chemistry was beneficial to agriculture. In the 1830s, this was expressed as follows: ‘Soils are so extremely varied, both in their composition and in the proportions of their component parts, that certain plants will grow, and even luxuriate in one soil, that will scarcely exist in another; a knowledge, therefore, of their peculiarities cannot but be interesting to the farmer, but chemical investigation alone can enable him to ascertain these peculiarities with accuracy and precision’ (Baxter, 1832). Pedological or field investigations were relatively scarce and the books by F. A. Fallou (1862) laid the foundations for the great soil works of V. V. Dokuchaev (Dokuchaev, 1883) and his disciples N. M. Sibirtsev (1900) and K. Glinka (1914).

In the beginning there were only books and monographs. A large number of books were published around the turn of the 20th century (Barnard, 1894; King, 1895; Snyder, 1899; Hall, 1903; Fletcher, 1907; Roberts, 1907; Lyon and Fippin, 1909; Hopkins, 1910, 1911; Russell, 1912; Hunt and Burkett, 1913). Most of these books had a strong edaphological character (Bockheim et al, 2005) and focused on soil management and soil fertility; there were far fewer books that focused on soils and their genesis (Merrill, 1897; Hilgard, 1906; Ramman, 1911).

Soil science boomed at the beginning of the 20th century and several new journals were started. Table 0.1 lists the main soil science journals and also the agricultural and agronomic journals – many of which had, and continue to have, articles on soil investigations. Soil science rapidly branched out after World War 1 (WWI) and from the 1970s onwards soil research was also published in environmental journals (e.g., Journal of Environmental Quality, Environmental Science and Technology). Currently, only 16 per cent of all soil science publications are published in primary soil science journals (Minsay et al, 2007).

There have been several estimates of the total number of soil science articles (Yaalon, 1964, 1989; McDonald, 1994; Hartemink, 1999; Minsay et al, 2007). Figure 0.1 shows the annual number of soil journal articles in Commonwealth Agricultural Bureau (CAB) Abstracts (1910–2007) with a rapid increase in the 1930s, a decrease during World War 2 (WWII) and a linear increase until the 1970s, followed by a decade with little growth. Thereafter, a linear increase in the 1980s continues to the present day. In 2007, more than 17,000 articles were published according to the Institute for Scientific Information (ISI) Thomson databases. Between 1910 and 2007 about half a million articles were published.

<table>
<thead>
<tr>
<th>Journal</th>
<th>Year</th>
<th>Journal</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pochvoedenie</td>
<td>1899</td>
<td>Canadian Journal of Soil Science</td>
<td>1957</td>
</tr>
<tr>
<td>Journal of Agricultural Science</td>
<td>1905</td>
<td>Australian Journal of Experimental Agriculture</td>
<td>1961</td>
</tr>
<tr>
<td>Agronomy Journal</td>
<td>1907</td>
<td>Australian Journal of Soil Research</td>
<td>1963</td>
</tr>
<tr>
<td>Soil Science</td>
<td>1916</td>
<td>Geoderma</td>
<td>1967</td>
</tr>
<tr>
<td>Tropical Agriculture</td>
<td>1924</td>
<td>Soil Biology and Biochemistry</td>
<td>1969</td>
</tr>
<tr>
<td>Experimental Agriculture</td>
<td>1933</td>
<td>Communications in Soil Science and Plant Analysis</td>
<td>1970</td>
</tr>
<tr>
<td>Soil Science Society of America Journal</td>
<td>1936</td>
<td>Catena</td>
<td>1973</td>
</tr>
<tr>
<td>Journal of Soil and Water Conservation</td>
<td>1946</td>
<td>Agriculture, Ecosystems and Environment</td>
<td>1980</td>
</tr>
<tr>
<td>Plant and Soil</td>
<td>1948</td>
<td>Fertilizer Research/Nutrient Cycling in Agroecosystems</td>
<td>1980</td>
</tr>
<tr>
<td>Advances in Agronomy</td>
<td>1949</td>
<td>Biology and Fertility of Soils</td>
<td>1985</td>
</tr>
<tr>
<td>Australian Journal of Agricultural Research</td>
<td>1950</td>
<td>Soil Use and Management</td>
<td>1985</td>
</tr>
<tr>
<td>Netherlands Journal of Agricultural Science</td>
<td>1953</td>
<td>Land Degradation and Rehabilitation/Development</td>
<td>1989</td>
</tr>
</tbody>
</table>
How Are these Four Volumes Arranged?

The four volumes follow the knowledge discovery structure (with Divisions and Commissions) formulated by the International Union of Soil Sciences (IUSS). Within each Division there are several subdivisions that describe separate subject areas, although in a number of instances there is considerable overlap between two or more of these areas. The Divisions and subdivisions are as follows.

Volume 1 – Soil in Space and Time
1.1 Soil morphology and micromorphology
1.2 Soil geography
1.3 Soil genesis
1.4 Soil classification
1.5 Pedometrics
1.6 Palaeopedology

Volume 2 – Soil Properties and Processes
2.1 Soil physics
2.2 Soil chemistry
2.3 Soil biology
2.4 Soil mineralogy
2.5 Soil chemical, physical and biological interfacial reactions

Volume 3 – Soil Use and Management
3.1 Soil evaluation and land use planning
3.2 Soil and water conservation
3.3 Soil fertility and plant nutrition
3.4 Soil engineering and technology
3.5 Soil degradation control, remediation and reclamation

Volume 4 – The Role of Soils in Sustaining Society and the Environment
4.1 Soils and the environment
4.2 Soils, food security and human health
4.3 Soils and land use change
4.4 Soil education and public awareness
4.5 History, philosophy and sociology of soil science

Volume 1 contains papers that look at the soil as a natural body and speculate on how it was formed, the extent of its global coverage, and the many complex interactions with the biosphere, hydroosphere, atmosphere and lithosphere. It focuses attention on the 'what' of the pedosphere and the extent of its current understanding. Volume 1 deals with the 'body' of soil in a landscape context. It quantifies pedogenic processes responsible for spatial diversity in soil cover within landscape, geomorphic and geographic patterns. It includes the scaling of soil morphology from micro-
macro-levels of generalization, calibration of morphology to pedogenic processes, and integration of this pedosphere knowledge with that of the biosphere, atmosphere, lithosphere and hydrosphere of present and past environments.

Volume 2 has papers with the ‘how’ or the fundamental science behind our discipline, which leads to an understanding of fundamental processes. It is concerned with the integration of physics, chemistry, biology and mineralogy to understand fundamental soil properties and processes that control transport, cycling, speciation and the bioavailability of elements or molecules. These phenomena are studied at multiple scales ranging from atomic to global.

Volume 3 contains papers on ‘why’ soil science is important to society. It is the application of fundamental knowledge to solve social, economic and environmental challenges of major societal and scientific interest. It can be considered to be the applied segment of the science. Papers in Volume 3 focus on how we use the soil and how it links to the knowledge base of papers in Volume 1 and 2 in order to ensure that soils are used and managed in a sustainable manner. Activities to remediate degraded soil, arising from the agricultural misuse of soil or contaminations resulting from non-agricultural activities are part of the scientific area of this volume. The aim of this volume is to ensure that through our knowledge and understanding of soil properties and processes, and the distribution of soils within the landscape, soils and soil quality are maintained and improved.

Papers in Volume 4 are more general and entail the transfer and outreach of our knowledge base to segments of our society where soils and soil science are frequently misunderstood or sometimes under-appreciated. It takes the soils information generated in the other three volumes along with developing new scientific information and addresses public literacy in soil science, education, international conventions, consequences of human activities on soil ecosystems, policy issues, food security, and the philosophy and history of the discipline. This volume integrates the scientific body of knowledge so that scientists, policy makers and those specialists remote from soil science may become better informed about the utility of the soil for sustaining society and the environment.

Methods for Selecting the Papers

These four volumes contain 86 articles or about 0.02 per cent of all articles that have been published between 1910 and 2007. How did we select them? First an editorial board was appointed with the following members: M. Bierkens (Netherlands), B. Minasny (Australia), P. Smith (UK), C. Walter (France) and B. Yaron (Israel). We used our personal libraries, Web of Science, Scopus and Google Scholar to select articles and occasionally drew from the proceedings of the World Congresses of the International Society of Soil Science. The main criteria for selection were that the article had to be seminal, didactic and influential (for which we used number of citations as a proxy). We mainly aimed to select articles that contained

an original idea, concept or description of a new technique of significance. These ideas, concepts or techniques should be ones that set off a chain of events and a new paradigm in some cases. The article should have induced many scientists to follow.

After a year of careful reading and selection, we had a list of 247 papers that we considered to be major reference works or classic papers in soil science. As only 80–90 papers could be reproduced in these four volumes, a radical reduction was needed. First, and at the recommendation of the publisher, we selected papers in English only; there were several papers in French and German but they could not be included. Successively, the three editors with the help of B. Minasny went through the longlist and selected 86 papers that met most of the criteria just described (see Figure 0.2). The oldest paper is from 1911, the newest from 2005 (see Figure 0.3). All the papers from the longlist of 247 that have not been selected to be reproduced in these four volumes are listed at the end of each Editorial Introduction as Further Reading.

These four volumes bring together some of the most classic papers in soil science. Assembling classic studies in science has been done before, e.g. *Classics in Environmental Studies* (Nelissen et al, 1997), but this is the first book that brings together a wide-ranging set of classic soil science papers. It can be used in teaching soil science as well as in research for students and professional soil scientists. Many of the papers listed form a good introduction to generic topics such as soil physics
or soils and the environment. With its broad scope of subjects it can be used in introductory as well as advanced soil science courses. The four volumes can also be used in studies on the development of ideas and concepts in soil studies.

References

Barnard, C. (1894) Talks About the Soil in Relation to Plants and Business, Funk & Wagnalls Company, New York
Baxter, J. (1832) The Library of Agricultural and Horticultural Knowledge; With Appendix Containing and Abridgement of the Principal Laws Relating to Farming and Rural Affairs, G. Baxter, London
Dana, S. L. (1842) Auck Manual for Farmers, James P. Walker, Boston
Devv, H. (1813) Elements of Agricultural Chemistry in a Course of Lectures for the Board of Agriculture delivered between 1802 and 1812, 1st edn, Longman, Hurst Rees Orme and Brown, London (2nd edn (1814); 3rd edn (1821); 4th edn (1827); 5th edn (1836); 6th edn (1839))
Dokuchaeva, V. V. (1883) Russian Chernozem. Selected works of V.V. Dokuchaeva, Volume I, translated in 1967, Israel Program for Scientific Translations, Jerusalem
Fallou, F. A. (1862) Pedologie oder Allgemeine und Besondere Bodenkunde, Schönfeld Buchhandlung, Dresden
Hopkins, C. G. (1910) Soil Fertility and Permanent Agriculture, Ginn and Company, Boston
Hunt, T. S. and Burkett, C. W. (1913) Soils and Crops With Soils Treated in Reference to Crop Production, Orange Judd Company, New York
Kent, J. E. (1856) The Farmer's Lighthouse – Chemistry Applied to Agriculture the Only Profitable Mode of Tilling the Soils, Higginson and Bradley, Boston

Figure 0.3 Percentage age distribution of selected papers overall and per volume, and age distribution of papers per volume
Editorial Introduction to Volume I

A. B. McBratney, A. E. Hartemink and R. E. White

Introduction

Precociously recognizing the natural diversity of soil, Shakespeare’s Henry IV remarked:

Here is a dear, a true industrious friend,
Sir Walter Blunt, new lighted from his horse.
Stain’d with the variation of each soil
Bewrith that Holmendon and this seat of ours.

This volume concerns the natural distribution and evolution of soil in space and time, and as such it largely refers to pedology. Etymologically, pedology is the scientific study of soil, including its origin, characteristics and uses. Within the realm of soil science, a narrower definition of pedology is used: the study of the formation, properties, classification and management of soil. More simply, pedology is the study of soil as a natural phenomenon in its environmental setting, and has often been further abridged to the study of soil genesis and soil classification.

Although humanity has used the soil for some ten millennia and soil husbandry has developed with the continual waxing and waning of societies over that time, the study of soil of itself is relatively new to natural science, having emerged as a discipline in the 19th century. The concept that soil could be studied as a natural body came from the latter half of the 19th century although descriptions were extant prior to that. The German scientist F. A. Fallou introduced the term ‘pedology’ (Fallou, 1862). The Russian scientist V. V. Dokuchaev is regarded as the person who rendered pedology a scientific discipline in its own right (Evtruhov, 2006). He did so by recognizing that soil is an ‘independent natural-historical body’ and that the formation of soil is governed by five factors, namely, climate, organisms, topography, parent material and (geological) age. The subsequent 100 or so years have seen a thorough exploration of this idea aided by new technologies and ideas from other disciplines. The early work concerned mapping of soil for land taxation, agricultural development or proper husbandry (which continues to this day), the latter work has concerned detailed understanding of processes of soil