Commission on the History, Philosophy and Sociology of Soil Science
International Union of Soil Sciences
and
Council on the History, Philosophy and Sociology of Soil Science
Soil Science Society of America

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NEWSLETTER

Introduction

It is encouraging to note that the number of visitors to, and hopefully readers of, our Newsletter, as part of the IUSS website, is growing all over the world. However, the responses to its content is still low and the number of contributors is rather limited.
The editors hope that by including abstracts of some relevant papers presented at the 2004 joint meeting of the Soil Science Society of America and the Canadian Society of Soil Science more readers may wish to put their research results, including literature studies, or their ideas about the historical development of our science at the disposal of the Newsletter. Besides these abstracts and some meeting reports, we are fortunate to have several papers about the historical developments of soil science in different countries, information about the activities of our commission at the IUSS Congress in 2006, an interesting paper about the value of the polypedon concept (asking for comments!), the relationship between soils and archaeology, the recollection of a post-doctorate stay in Europe in the 1950s, book reviews, and information about the plans for the Smithsonian Soil Exhibit in the United States. Not of the least importance: an interesting new book is announced, which will be available at the WCSS congress! Read more in this Newsletter 12!

The present Newsletter and four preceding issues can be found, and accessed by all who are interested, on the IUSS website: www.iuss.org.
Please let us have your comments, sugges-tions, and your contributions!

The next issue will appear in 2006, and will be distributed at the World Congress of Soil Science. Let your contribution be part of it! Please see the last page for details about the submission of texts and photographs.

Dr. Dan H. Yaalon reading the Newsletter

Last, but not least: we congratulate Dan H. Yaalon with his 80th birthday! Many happy returns, and good health, Dan! We trust you will continue your varied activities in the field of soil science sensu largo! A special session of his department at The Hebrew University of Jerusalem was organized to celebrate this occasion with some lectures.

The editors

Contents

18th World Congress of Soil Science, Philadelphia, July 9-15, 2006

The 18th World Congress of Soil Science will be held in Philadelphia, Pennsylvania, USA, under the title: Frontiers of Soil Science, Technology and the Information Age.
In total, 80 symposia were selected for presentation. Our **C4.5 History** Commission **is organizing** one oral symposium: History of soil science in developing countries, and one poster symposium: The history of soil sciences: past accomplishments to future perspectives.

Oral Symposium 4.5A.

History of Soil Science in Developing Countries.

Most of the history of soil science is known from reports and descriptions of developments in Russia, America and Europe, with relatively little known from developing countries, many of which were former colonies. This symposium seeks to explore the history of soil science in these and other countries. Among questions to be discussed, with respect to developing countries or specific regions, are: how soil survey was initiated, how local soil experimentation developed, to what extent was local ethnopedological knowledge incorporated? Experience of the past, both achievements and failures, will enrich our understanding of current requirements from soil science in the developing world.
Convenor: Eric Brevik (USA), email: ecbrevik@valdosta.edu
Co-convenor: Dan Yaalon (Israel), email: yaalon@vms.huji.ac.il
Co-convenor: Anthony Young (U.K.), email: anthony.young@land-resources.com

Poster Symposium 4.5P.

The History of Soil Sciences: Past Accomplishments to Future Perspectives.

Understanding and appreciation the historical foundations of a particular field of soil science and welcoming the new challenges of the future permit a bridging of generations to advance science. An enlightening series of papers will present informative views on the development of essential fields of soil science. Examples of key historical achievements that propelled a particular field of soil science through today's cutting edge research and future outlook are welcomed.
Convenor: Kirk Scheckel (USA), email: scheckel.kirk@epa.gov.
Co-convenor: Benno Warkentin, email: benno.warkentin@oregonstate.edu.

Dates to Remember:
- January 1, 2005. Registration for Congress available at: www.18wcss.org. Abstracts can be submitted at the same website.
- September 15, 2005. Deadline for abstract submission.
- January 15, 2006. Authors will be notified on the status of their papers.
- May 1, 2005 Presenters not registered will be dropped from program and abstracts withdrawn from the CD-ROM. Scientific program will be finalized.

A New Publication to be ready for the 2006 WCSS!

"Down to Earth: A Soil Science History"
B.P. Warkentin and D.H. Yaalon

Although the title is still tentative, the preparation of this commemorative volume on soil science history and its accomplishments is nearing completion and will contain some 20 chapters. The book will be distributed at a much reduced price during the 18th World Congress of Soil Science. For a description and full list of chapters see the Third WCSS Announcement in August 2005 (www.18wcss.org) or the IUSS website www.iuss.org.

Reports of Meetings and Abstracts of Papers

International Geological Congress (IGC), Florence, Italy, August 21-28, 2004.

The 32nd IGC Congress with nearly 7000 participants and 336 sessions was held in Florence . The IGC organizers requested the IUSS, through the Secretary General Prof. W. Blum, to organize a session on soils and geology. Prof. E. Frossard, the chair of IUSS Division 4, jointly with W. Blum, B. Warkentin and U. Wolf arranged a symposium on "Function of Soils for Human Societies and the Environment." Eight oral papers and ten posters were presented. Speakers were requested to show how soils contributed to the understanding and use of earth science information for human needs. Though the audience was small, it was felt that the message was being heard.
Abstracts can be downloaded from the website of the International Geological Congress: www.32igc.info/igc32/search/. The Geological Society of London has agreed to publish the symposium in book form.

The titles and authors of oral presentations were:
Winfried Blum
Alteration of Parent Materials, Biological Processes, Soil Structure and Soil Porosity: The Link Between Soil and Regolith
Fiorenzo Ugolini and Benno Warkentin
Historical and Future Perspectives on the Relationship Between Soil Science and Geology
Ahmet Mermut and Dan H. Yaalon
Interrelationship of Pedologic and Geological Mapping
Jacques Berthelin
Soils Huge Reservoirs of Microorganisms, Major Earth Compartment of Gene Controlling Geochemical Processes
Johan Linderholm
Soil as a Cultural and Natural Heritage, Conserving Paleontological and Archaeological Assets
Lars Bergström
Soil as an Important Interface between Human Activities and Ground Water - Soil Functions in the Vadose Zone
Wolfgang Burghardt
Soil Sealing and Sealing Related Soil Properties
Luca Montanarella
Policies for a Sustainable Use of the Soil Resource

There is increasing interest in "cultural geology" A number of sessions exposed such aspects as risk, hazards, education, ethics, history, deterioration of stone buildings, urban geology and terror, as well as our soils session. The annual meeting of the Italian Geological Society, which was held at the same time, had as its theme, "A New Relationship between Geology and Society" This is similar to the trend in soil science, and relevant to C4.5 interests in history and sociology.

There was also a session on "Institutions, Museums and Scientific Societies in the History of Geosciences." The International Commission on the History of Geological Sciences (INHIGEO) is affiliated, like our C4.5 IUSS History Commission, with the International Union of the History and Philosophy of Sciences. The INHIGEO is a small, close-knit group of enthusiasts. Its Newsletter 36 for 2003 included an article by Dan Yaalon, entitled "Historical developments in soil Classification".

B. Warkentin

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Eurosoil 2004 Meeting, Freiburg, Germany, September 5-11, 2004

This was a very successful meeting with over 1000 participants from over 70 countries, with many interesting papers arranged in 25 symposia and 4 poster sessions with more than 500 posters. A number of field trips were also organized. The congress was efficiently organized by Prof. Ernst Hildebrand and Dr. Thorsten Gaertig.

All papers can be downloaded from the Eurosoil website: www.bodenkunde.uni-freiburg.de/eurosoil as a ZIP-file (100MB).

B. Warkentin

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Joint Meeting of the Soil Science Society of America and the Canadian Society of Soil Science, Seattle, Washington, USA, October 31–November 4, 2004.

The SSSA Council on the History, Philosophy, and Sociology of Soil Science (S205.1) enjoyed one of its most successful meetings in the past several years at the 2004 Soil Science Society of America-Canadian Society of Soil Science joint meetings in Seattle, WA. The number of sessions sponsored, papers presented, and people attending all exceeded the same numbers from recent meetings. Three sessions were sponsored or co-sponsored by S205.1. These were the Lewis and Clark Expedition – Soils and Agriculture, organized by Maxine Levin; People, Places, Perspectives: Historical Research in Soil and Plant Sciences, organized Ed Landa; and Hazardous Materials in Fertilizers, organized by Joe Heckman and co-sponsored by Divisions S-4, S-8 and A-9. A total of 36 papers were submitted to these three sessions, with 19 in the People, Places, and Perspectives session, 7 in the Lewis and Clark session and 11 papers in the Hazardous Materials session. Titles and authors, with abstracts when provided, for the papers presented at each of the three sessions can be found at http://chiron.valdosta.edu/ecbrevik/2004_Abstracts.htm.

A symposium organized by Maxine Levin looked at the "Lewis & Clark Expedition-Soils and Agriculture." Papers include:

Douglas Helms
Are Davidson soils the early cradle of presidents?
W. Raymond Wood
Landscape use by Native Americans of the Missouri Valley
Jim Gertsma
The soil and face of the country
Andrea Laliberte
Through the eyes of Lewis and Clark: wildlife abundance and distribution 200 years ago
Robert Diffendal
Geological observations of Lewis and Clark across the Great Plains, 1804-1806
C. J. Heidt
Soils and landforms related to observations made by the Lewis and Clark expedition in North Dakota
Mark Spence
The Empire of Property: Surveys, soils and Jefferson's agrarian dream

A session organized by Edward Landa examined: "People, Places, Perspectives: Historical Research in Soil and Plant Sciences." Papers include:

Lloyd Ackert
The Russian influence on the development of American soil science, 1880-1930
James B. Beard and P. Cookingham
William J. Beal, A pioneer applied botanical scientist and research society builder
W. Boehm and Rienk Van der Ploeg
Julius Adolf Stoeckhardt (1809-1886), pioneer in agricultural chemistry
Johan Bouma
Soil science in a changing Dutch society
Nyle Brady and R. Weil
Eighty year evolution of the textbook: The Nature and Properties of Soils
Eric C. Brevik
Collier Cobb and Allen D. Hole: Geologic mentors to early U.S. soil surveyors
Ming Chen
An overview of ideological disputes in modern soil science development in China
Richard Gill
The legacy of grazing mountain meadows: Insights from historical and modern research
Jennifer Harden, A. Lapenis. M. Torn
Lawrence and A. Timofeev
The value and rarity of historic archives of soil samples
Don Johnson and Dan Yaalon
Darwin--The pedological innovator

Ahmet Mermut
History of pedological mapping in relation to geological mapping
T. N. Narasimhan
Buckingham, 1907: An appreciation
T. N. Narasimhan
Soil Science: A hydrogeological perspective
Carolyn Olson
Soil geomorphology: The legacy of Robert V. Ruhe
John Tandarich, C.J. Johannsen and Hans van Baren.
The importance of archival sources in soil science history research
Charles Tarnocai
History of northern soil research in Canada
Robert Tate.
"Soil Science": A record of development of a discipline
Richard W. Unger
Drink consumption and land use in Europe in the Middle Ages and the Renaissance
Antoinette WinklerPrins and B. Weisenborn
Geography and soil science: A history of their overlap and synergism.

As mentioned before, the SSSA Council also organized jointly with Divisions S-4, S-8 and A-9 a session on Hazardous Materials in Fertilizers. The titles are not mentioned here, but are available at the internet address mentioned above.

Abstracts of some papers presented at the above meeting:

"Soil Science": A Record of Development of a Discipline

R. Tate, USA

In January 1916, Soil Science, A Monthly Journal Devoted to Problems in Soil Physics, Soil Chemistry and Soil Biology was first published. That this journal was meant to serve an already established and flourishing discipline is shown, at least in part, by the fact that page one was not dedicated to a statement of how the publication would spur great discovery but rather by a statement on the life of one of the pillars of soil science, Eugene Woldeman Hilgard.This was followed by a statement by the editor-in-chief, Jacob G. Lipman. Much of Lipman's introduction was devoted to justifying, or maybe "defending", the importance of specialization in both knowledge and publication, i.e., a defense of the importance of soil science—an action that continues to current times. As the look back at Hilgard's life reminds us of the continuity of science discovery, a glance at Jacob Lipman's words and the contents of volume one reveal the continuity of soil science. The need for a new journal was presented in part with the statement "not infrequently six months or more elapse between the writing of a paper and of its appearance in print." In volume 1, topics include effects of climate on soil properties, soil enzyme levels and microbial populations, and soil fertility assessments. The list of contributors reads like a "who's who" of soil science. The record of growth and maturity of the discipline of soil science as revealed in the publications of Soil Science will be examined further.

Speaker: Robert Tate, Rutgers University, Department of Environmental Sci., 14 College Farm Road, New Brunswick, NJ 08901-8551, USA. Email: tate@aesop.rutgers.edu

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Soil Science in a Changing Dutch Society

J. Bouma, The Netherlands

Continued economic growth, rapid technological development and a steady increase in the flow of information in a globalizing world with networks of interacting people, challenges researchers to change the way they research and communicate. A plea is made to distinguish between soil as an object ("true" soil); soil in society ("right" soil), and soil as it is being experienced (" real" soil). More attention is needed in future for the "real" and the "right" soil by interdisciplinary and interactive work. Basic research on the "right" soil remains, however, essential to feed the interactive processes. Expressing risk and uncertainty in research becomes increasingly important in our risk and experience society and a combination of pedology and hydrology in hydropedology is seen as effective when studying dynamic soils in a landscape context. Soil scientists have to be more aware of different policy functions, such as signaling, preparation and implementation. Possibilities of internet should be tapped to establish communities of practice, connecting and stimulating the many people that are interested in soils. Soil scientists can be effective members of such communities.

Speaker: Johan Bouma, Spoorbaanweg 35, 3911 CA Rhenen, The Netherlands. Email: johan.bouma@planet.nl

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The Importance of Archival Sources in Soil Science History Research

J.P. Tandarich, USA, C.J. Johannsen, USA, and H. van Baren, The Netherlands.

Archival materials, such as correspondence, diaries and photographs, cement together a person's life, unlike most published works. For example, daily correspondence between Louise Moomaw and her father, Curtis F. Marbut, pries open his philosophy and Unitarian religious beliefs that he held in common with his mentors, Nathaniel Southgate Shaler and William Morris Davis. Marbut's concern about world hunger, his service to humanity, and his use of soil science to help countries become self-sufficient in food production are only revealed through materials in the Archive of Soil Science. The Archive is a cooperative arrangement developed by the SSSA Council on the History, Philosophy and Sociology of Soil Science with the Western Historical Manuscripts Collection of the University of Missouri to promote archival preservation and research. Without such resources, Marbut and other scientists would become one-dimensional men. The Archive welcomes all soil science-related manuscript materials. In addition, members of the Council and its counterpart in the IUSS, Commission 4.5, are compiling a worldwide reference list of archives for publication.

Speaker: John Tandarich, Hey and Associates, Inc., Hey and Associates, Inc. 1141 Commerce Drive, Geneva, IL 60134, USA. Email: jtandarich@heyassoc.com

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The Value and Rarity of Historic Archives of Soil Samples

J. Harden, USA, A. Lapenis, USA, M. Torn, USA, and A. Timofeev, Russia

Archives of soil samples - along with archival notes of locations and field context – are the rosetta stone of terrestrial carbon cycling because (1) atmospheric CO2 has been spiked with radiocarbon by aboveground weapons testing and offers a tracer for C in soils (2) soils in many regions have been disturbed by land-use and are no longer available in their natural chemical, biological, and physical form and (3) soils everywhere have been affected by atmospheric change, including temperature, moisture, N and S deposition as well as various anthropogenic emissions. With accurate notes of locations and settings, sampling sites can be reoccupied and comparisons can be made to evaluate changes in soil chemistry. In areas where significant development or disturbance has occurred, archival samples offer truly unique and irreplaceable measures of soils in their associated landform and ecological setting. Archival/resampling studies from Russia (1850 v 1990) and California (1960, 1980, 1990) have contributed unique perspectives to studies of carbon cycling and acid rain deposition. Methods of pedology, including detailed description and sampling, survived several cultural revolutions, two continents, and two languages in these collections. Our search of over 30 institutions for such sample collections is testimony of their rarity. The foresight of the pedologists and their associated (and successive) institutions is to be commended.

Speaker: Jennifer Harden, US Geological Survey, 345 Middlefield Rd ms962, Menlo Park, CA 94025, USA. Email: jharden@usgs.gov

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Darwin—The Pedological Innovator

D.L. Johnson, USA, and D.H. Yaalon, Israel

In 1837 Darwin, then trained far more in geology than biology, presented a paper on how animals (worms) form soil, published in 1838. He produced other papers on this theme in 1840, 1844, and 1869. In 1881, the year before his death (in 1882), he published a synthesis titled On the Origin of Vegetable Mould, Through the Action of Worms, with Observations on Their Habits. This last work, which proved to be his last book, summarized 44 plus years of laboratory and field observations of worms and their effects on soil. Darwin showed how worms -- as a result of their bioturbational lifestyles (ingesting soil at depth and depositing it at the surface as fecal casts) -- caused stones and artifacts (Roman stones and coins) to be lowered to form a stone layer (stone-line), and in the process produce soil horizons. His was the first book on process pedology, an approach also used in his earlier papers. His 1840 paper, which expanded his 1837 paper, contained a woodcut that displayed bioturbationally produced soil horizons, to which he later assigned A, B, C and D notations. Ironically, Darwin’s work was given little credible visibility in the agronomically inspired late nineteenth and early twentieth century treatises on soil formation, treatises that led to the current soil genetic paradigm. The reasons are many and discussed.

Speaker: Don Johnson, Univ. of Illinois, 713 S Lynn St., Champaign, IL 61820, USA. Email: dljohns@uiuc.edu

Collier Cobb and Allen D. Hole: Geologic Mentors to Early U.S. Soil Surveyors

E.C. Brevik, USA

Since the inception of the United States soil survey program in 1899, the maps and other information generated/published by the National Cooperative Soil Survey have had a profound influence on soil science in the United States. Yet, many of the individuals involved in the early US soil survey program were trained as geologists rather than agronomists or soil scientists. This presentation looks at the professional history of two early mentors of these geologists turned soil surveyors and some of the students they sent on to the US soil survey. Collier Cobb sent over 10 students to the soil survey starting in 1900 when US soil survey was in its infancy, including individuals of note such as Hugh H. Bennett, George N. Coffey, Williamson E. Hearn, and Thomas D. Rice. Allen D. Hole worked on soil surveys for the state of Indiana and sent over a dozen students on to soil survey careers between 1911 and 1937, including Mark Baldwin and James Thorp. Francis Hole and Ralph McCracken, other students of Allen Hole, also went on to have distinguished soil science careers. Through their mentorship of individuals who made outstanding contributions to soil science and particularly US soil survey, Cobb and Hole have a legitimate place in the history of US soil science and agriculture.

Speaker: Eric C. Brevik, Valdosta St. Univ., Dept. of Physics, Astronomy, and Geosciences Valdosta State University, Valdosta, GA 31698-0055, USA. Email: ecbrevik@valdosta.edu

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Eighty year evolution of the textbook "The Nature and Properties of Soils"

N.C. Brady, USA, and R. Weil, USA

We report examples of the incorporation of new knowledge in the 13 editions of the most widely used soils textbook of the past century, including: 1) soils are natural individual bodies subject to classification and study (8th ed.); 2) the structural framework of silicate clays govern their properties (7th ed.); 3) most soil water phenomena are governed by energy of attraction among water molecules and between them and soil solids (6th ed.); 4) cation exchange is a miracle process, especially for plants and other organisms (5th ed.); 5) aluminum reactions largely control soil acidity (7th and 13th eds.); 6) conservation tillage reduces erosion and runoff losses (9th ed.); 7) the soil is both a source and a sink for environmental pollutants (8th ed.) 8) soil geographic information is critical for natural resource management (11th ed.); 9) integrated nutrient management is key to sustainable plant production; 10) soil quality is a measure of the soil's sustainable usefulness (12th ed.). The length of the textbook has increased nearly 4 fold in 80 years, but most of the increase is in Tables and attractive Figures, Photos and Boxes. In the 13th edition, more than 40% of the page space is occupied by these teaching aides which include 67 color plates. A glossary was added (7th ed.) as were appendices for soil maps etc. (10th ed.)

Speaker: Nyle Brady, Cornell University (Emeritus), 521 South Catalina St., Gilbert, AZ 85233, USA. Email: ncbrady@worldnet.att.net

Submitted by Eric.C Brevik and Edward Landa.
Emails: ecbrevik@valdosta.edu, erlanda@usgs.gov

Has the Polypedon's Time Come and Gone?

Craig A. Ditzler, USDA-NRCS, National Soil Survey Center, Lincoln, Nebraska, USA.

A few months ago one of the editors of this Newsletter, Dr. Dan Yaalon, initiated a discussion regarding the polypedon in the Soil Taxonomy Forum (now at http://forum.agecom.vt.edu.showThread.aspx). After I expressed my thoughts on the topic, Dr Yaalon asked me to share them here. In this brief article I will discuss the definition of the term as it was first used in Soil Taxonomy, summarize some of the criticism about the concept, and provide the most recent viewpoint about the polypedon concept as it appears in the *Soil Survey Manual* and in *Soil Taxonomy*, 2nd edition.

The definition of the Polypedon
There are many definitions in use of the "polypedon". I recently entered the term "polypedon" into the Google search engine. It returned 245 Web pages containing the term. Most of them provided some sort of definition, and I list several of them here.

- A group of contiguous similar pedons.
- A group of contiguous pedons that belong to the same soil series.
- A collection of pedons that are much the same.
- Functionally equivalent to soil series.
- Polypedon is to a pedon as a population is to an individual among living things; a swarm of gnats to a single gnat, a forest to a single tree, etc.
- Union of soils whose forming factors are so similar that they give morphological and functional characteristics which fall into specific ranges.
- A volume, to the depth of the solum, of relatively uniform soil material.
- Smallest area of any one kind of soil.
- Basic soil object (soil body) for classification in the field.
- A three-dimensional body with definite recognizable boundaries.
- The soil in the landscape that contains many pedons.
- Many pedons together in one area; the soil unit used in preparing soil maps.
- A soil volume that consists of more than one pedon.
- The basic mapping unit.
- The smallest unit of soil that totally describes the soil variability in terms of horizontal and vertical dimensions.

- A number of pedons that are associated with one another.
- A volume of relatively uniform soil.
- A volume of soil having properties within the limits of a soil series.

Clearly, many definitions of the term "polypedon" are being used. I found it somewhat amusing to even have found a reference explaining the workings of computer programs that check spelling. It seems to assume that polypedon is not a real word and suggests an appropriate correction for "polypedon" is "polyhedron."

When it was published in 1960, the Seventh Approximation did not include the term "polypedon." Rather, it included a discussion of "The Soil Individual" (p. 4): "The soil individual, or 'a soil' consists of one or many contiguous pedons, bounded on all sides by 'not-soil' or by pedons of unlike character in respect to one or more characteristics diagnostic for a soil series."

The motivation for devising the polypedon concept was that the pedon, while useful as an entity for sampling, was too small to reflect the shape characteristics of the soil surface or to show the full range of properties for the series. In an article titled "The Pedon and the Polypedon" published in 1963 as part of a Soil Science Society of America Symposium held in 1961, Johnson introduced the term "polypedon" for the soil individual. He wrote: "The polypedon is defined as one or more contiguous pedons, all falling within the defined range of a single soil series." He went on to state that polypedons "are the real objects that are placed in classes of the lowest category of the system. They are comparable to individual pine trees, individual fish, and individual men."

In the first edition of *Soil Taxonomy* (1975), a section titled "The polypedon, a unit of classification" (p. 5) states that the polypedon "consists of contiguous similar pedons bounded by 'not soil' or by pedons of unlike character." It goes on to state that "the limits of the polypedon are also the conceptual limits between soil series, which are the classes of the lowest category in this system."

Note that the polypedon concept as it developed in the context of Soil Taxonomy included the following points:

1) Pedons making up a polypedon are all members of a single series, and
2) The polypedon is the object (individual) we classify.

Criticism of the Polypedon

Soon after Johnson's article appeared in 1963, Knox (1965) published a thoughtful piece titled "Soil Individuals and Soil Classification." He pointed out a critical weakness with the concept of the polypedon. He argued that the polypedon cannot effectively be the individual we use to classify the soil because you must first know the series placement of all the pedons *before* you can determine which can be grouped together to make up the polypedon. Defining polypedons as consisting of pedons from a single series and then saying that we use the polypedon as the object we classify clearly is a circular argument because you must already know the classification before you can identify the polypedon. So Knox convincingly states, "Accordingly, polypedons seem to be of little significance or utility with respect to the placement of soil into classes."

The requirement for polypedons to be made up of pedons that are all members of a single series results in real difficulty because soil series limits do not necessarily reflect natural bodies of soils but instead are constrained by the limits of the family and higher categories. Soil series are human constructs. They are defined, and frequently revised, on the basis of our concepts about the soil. Series are defined to meet the needs of soil surveys; some are defined narrowly, some more broadly, depending on anticipated use of the information. They may reflect observations of natural soil bodies, but they are not themselves natural soil bodies. As Knox pointed out, "Because polypedons have no existence apart from series classification, their significance as individuals seems less than the significance of individual pine trees, individual fish, and individual men."

Another difficulty is that it is not practical to determine the proper series placement for all pedons that are potentially members of a polypedon. To reliably determine which pedons meet the series criteria, one would need sufficient data to confirm all relevant diagnostic properties, such as mineralogy, clay activity class, base saturation, and organic carbon content. Given these constraints, if one could actually observe and delineate a "polypedon," it would surely resemble a Swiss cheese with many holes in it! Note that because the polypedon is constrained by the limits of the series, it cannot be equated with a map unit delineation, which typically has more than one soil taxa (some of which are referred to as "inclusions"). The polypedon cannot be observed in any practical sense in the field.

Furthermore, what are we to do in areas where we have not developed soil series concepts? In Alaska, for example, many areas are mapped at relatively small scales and map units are correlated to taxa at levels higher than the series. Should we conclude that there are no polypedons in these areas? Does the polypedon now become all contiguous pedons in a particular family, subgroup, or great group?

Recent viewpoints about the Polypedon in the U.S. Soil Survey

The concept of the polypedon was addressed when the Soil Survey Manual (1993) and the 2nd edition of Soil Taxonomy (1999) were updated and published. The authors recognized the shortcoming of the polypedon concept. As a result, the polypedon's flaws were acknowledged and its importance was minimized. It was effectively dropped.

In the *Soil Survey Manual* a discussion of the polypedon states (page 19):

In practice, the concept of the polypedon has been largely ignored and many soil scientists consider a pedon or some undefined body of more or less similar soil represented by a pedon large enough to classify. Polypedons seldom, if ever, serve as the real thing we want to classify because of the extreme difficulty of finding the boundary of a polypedon on the ground and because of the self-contradictory and circular nature of the concept. Soil scientists have classified pedons, regardless of their limited size, by deliberately or unconsciously transferring to the pedon any required extensive properties from the surrounding area of soil."

The 2nd edition of *Soil Taxonomy* refers to the polypedon in chapter 5 (pages 116 and 117). In part, it states:

Applying the pedon and polypedon concepts to mapping and classification has been the subject of debate and a source of misunderstanding in soil survey for decades (Hudson, 1990 and 1992; Holmgren, 1988). Some notable problems are that in reality soil profiles rather than pedons (i.e., three-dimensional volumes) are really sampled and classified (Holmgren, 1988), that soil property variation prohibits the selection of one profile or a few profiles to represent variation within delineated soil bodies (Hudson, 1990), and that soil-landscape units and soil map units are composed of more than one polypedon (as Application of Soil Taxonomy to Soil Surveys defined by USDA, SCS, 1975) and contain soils with properties outside the ranges of established taxa.

So I think the polypedon concept is limited in its usefulness. It is of interest in the historical context of the development of ideas in soil classification. Additionally, when series concepts are tested, we can consider, at least for easily observable properties, what a polypedon might look like based on our understanding of the landscape. This informal process helps us to refine series concepts so that more pedons fit within the defined range of the series. However, the concept of the polypedon is fatally flawed because:

1) It is not a natural entity in its own right, and its existence depends on the limits of the series;
2) As series limits are refined, presumably the boundaries of the polypedon would expand or contract;

3) It is not clear what the polypedon consists of where series have not yet been established; and
4) There is no practical way to observe a polypedon in the field.

Despite the shortcomings of the polypedon concept, soil scientists working in the soil survey program have found it possible to describe, sample, classify, and map soils without giving the polypedon much thought. There is no need to revise the polypedon definition because we simply do not need it. The polypedon's time has come and gone.

Craig Ditzler (email: craig.ditzler@usda.gov)

The list of references can be obtained from the author.

History of Soil Science Development in Slovakia

Pavol Bielek, Emil Fulajtar, jun., Jaroslava Sobocka and Pavel Jambor.
Soil Science and Conservation Research Institute, Bratislava, Slovakia.

Abstract
This paper outlines the historical development of soil science in Slovakia. The oldest references go back to the era of the Austrian Monarchy in the 18th century, when the first land inventory was made, and the first practical manuals referring to soils were published.
More systematic soil survey and mapping started at the end of the 19th century, and in the 1920s he first agricultural institutes were established. In the 1930s and 1940s the first monographs about the soils were issued.
The most significant persons in Slovak soil science are mentioned, including their share in de development of the science.
In the 1960s a new soil science research institute was founded, which carries out till today the soil survey, including such issues as soil monitoring and land evaluation, of the whole of Slovakia.
Over time, other specialized research institutes and universities with their own aims and activities were established as well.

Introduction
Comparing to other natural sciences, soil science is a very young science. However, many practical problems require attention and the first investigation of soil began in many countries a long time ago. Each science is developing historically, primarily through series of practical recognitions in nature, experiments based on theory and experience of observations. Those were supported by analytical methods to practical use of findings, reflecting new needs and practical requirements. Agricultural land use is very narrowly connected with soil knowledge.
Agriculture has spread to the recent Slovak territory from south-east in 6th millennium B.C. The first Neolithic farmers were moving from Balkan Peninsula along the Danube River, they penetrated to Carpathian Basin and settled in warm and fertile areas especially in hilly lands with loess. Since that time the development of agriculture in Slovakia was continuous and archaeological evidences show that many flourishing civilizations occurred, especially in south-western and south-eastern Slovakia. Only considerably later the agricultural settlement penetrated to intra-mountainous basins of Central Slovakia. This colonization was attractive also because of mining possibilities in mountainous areas. Important metallurgical centers with well-organized export of arms occurred in basins of Liptov and Turiec already in bronze age (2nd millennium B.C.).
First written record on prosperous crop production referring to the territory of Slovakia was provided in 6th century B.C. by the Greek historian Herodotus. He mentioned the settlement of *Leukaristos* (Lat. *Laugaricio*, Slov. Trencin) occurring in the middle of the agriculturally cultivated region.
Since 5th century B.C. Slovak territory was populated by Celtic tribes. Some indications show, that Celtic farmers knew already the liming of acid soils, therefore the agricultural

colonization was spreading to less fertile areas and the population density in mountainous basins of Central Slovakia increased considerably. In 1st century B.C. the colonization by Germanic Quadi tribes followed and soon after that the Romans occupied the left banks of the Danube and western Slovakia became exposed to intensive influences of the Mediterranean civilization. Romans and Quadi tribes were mutually competing and the present Slovak territory was often used as a battlefield. Romans brought to our territory vine growing with adequate care for land cultivation (terracing, trenching). Marcus Aurelius, the Roman Emperor and philosopher wrote on the territory of Slovakia his work "*The talks to myself*". Among the Roman authors especially Columella can be cited as an early agricultural specialist, who considered crop rotation, growing of bean (*Vicia faba*) as a crop, as well as several forms of tillage good agricultural practices.
In early Slavic period (6 - 10th century) shifting agriculture was successively replaced by permanent farming and the crop rotation based on a three year cycle (winter crop - spring crop - fallow) was introduced. This enabled the development of permanent settlement. The archaeological evidences show that many villages exist at the same place since 8 - 9th century. The change from shifting agriculture to permanent farming was the most important milestone since the introduction of agriculture.
After the period of chaos and decay in 10th century, caused by invasion of Hungarian tribes and breakdown of Great Moravian Empire, a consolidation followed in 11th century when Hungarian kingdom was established. The population growth occurs again in 12 - 13th century. This leads to first attempts to establish organized land management. This is indicated by a Royal decree from late 13th century on amelioration of the land along the Danube River. The construction of dams and drying of swamps continued since that time periodically.
In later period the shepherd colonization interfered significantly with agricultural settlement pushing in pasture land. Mining, forestry and charcoal production pushed the forest border higher in the mountains and formed conditions for wider farming land use and created conditions for extensive large-scale erosion.

Earliest period
The first attempt to evaluate the soil and its fertility occurred in the second half of 18th century. At that time Slovakia was part of the Austrian Empire. The Austrian Empress, Maria Teresa initiated the inventory of all agricultural land and its ownership. This land registration was of great significance for owners and land users. Agricultural land was delineated according to a classification in 8 classes. This system served for administrative purposes even till second half of 20th century. The first studies observing the soil from a scientific point of view occurred in Slovakia at the end of the 18th century. Matus Pankl, professor of Royal Academy in Bratislava (Academia Istropolitana) published the first manual on agriculture. He paid much attention to soil properties in his *Handbook of Agriculture* (several editions: 1790 in Latin with Latin - Slovak - German - Hungarian dictionary, 1793, 1797, 1810 all three in Latin, 1964 in Slovak.). He characterized the soil physical properties, explained the importance of soil texture and organic matter. He studied the organic matter mineralization and propagated a new manure approach.
At the same time Juraj Fandl (1750-1811) edited the *Agricultural Encyclopedia* in 6 great volumes (Trnava, 1792), in which he also propagated modern knowledge on soil properties and land management methods. The great advantage of this book, written in Slovak language, was that it could be understood by the farmer community.
The beginning of treating soil science as a serious science in the modern sense in the territory of Slovakia was in the second half of 19th century. Dionyz Stur (1827-1893), one of the best Slovak geologists - becoming later the director of the Imperial Geological Institute in Vienna - published his study "The influence of soil on the spatial variability of vegetation" (1856-1858). This study, written in German, was the first study of the soils from the point

of view of natural sciences. It became well-known at international level.

In the last decades of the 19th century several specialized agricultural schools were established. The first one was opened in 1871 at Liptovsky Hradok. Later nine other agricultural schools were established, the last one in 1913. The agricultural school in Kosice was transformed to an Agricultural Academy, the first agricultural high school in Slovakia. These agricultural schools served as background of the first institutional base for soil research. However, the attention was paid mainly to manure and only little attention was paid to other soil aspects

An important role was played by Gregor Friesenhof (1840-1913), a rich landowner who is one of the founding members of Matica slovenska, the first Slovak scientific institution. He was interested in agro-meteorology and he initiated voluntary activities to educate farmers and to improve their life standard. He propagated cooperative farms, and despite he was of German-Russian origin, he published papers about modernizing agriculture in Slovak language. His most successful achievement was the construction of a new type of plough (plough of Nedanovce-Brodzany) and its introduction in daily use among Slovak farmers.

Despite all activities at agricultural schools and by volunteers such as Gregor Friesenhof, the development of soil research during the last decades of the 19th century was limited. Since 1867, when Hungary obtained autonomy within the Austrian Empire, all Slovak cultural institutions were exposed to political pressure, and Matica slovenska as well as almost all Slovak schools were closed. This severe restriction affected also the agricultural schools. The lecturing in Slovak language was forbidden and replaced by Hungarian. This created a great limitation for the application of agricultural knowledge among Slovak speaking farmers.

In the first decade of 20th century the agro-geological survey was organised by the Hungarian Royal Geological Institute at Budapest. This survey started only shortly after the Russian geologist Vasilij Vasilievich Dokuchaev (1846-1903) formulated his definition of soil and the theory of soil genesis and zonality. He perceived soil science as an independent scientific discipline. The agro-geological survey was the first soil survey in Slovakia. Unfortunately, it covered only part of the lowlands in West Slovakia. The leading person was Heinrich Horusicky (1849-1929), a soil scientist and agro-geologist. The majority of the survey of this area was performed in the years 1902, 1903, 1905, 1908, 1909 and 1912, and by Imrich Timko in 1904 and 1905. The soils were classified according to parent material and texture. Soil types were also mapped according to geological and hydro-geological soil parameters. The soil parameters studied were analyzed by their relationship to productivity potential as well as with respect to effective soil exploitation (sources of raw materials, rocks and water). Study works were edited and focused on rural areas of Slovak regions Trnava, Senec, Surany, Komarno, Sturovo.

Horusitzky was a dominant personality in the group of Hungarian soil scientists, with active international contacts and he participated also in the organization of the first soil science conferences in the first years of 20th century in Budapest and Prague. In his group were active also I. Timko, B. Inkey and Z. Laszlo. Both Horusicky and Timko were of Slovak origin.

Another important soil scientist during the first decades of 20th century was Jan Lendvai-Lusnak (1881-1931). He studied humus, colloidal chemistry and soil capillarity. During the period of Austria-Hungary he lectured in several Hungarian universities. After establishment of Czech-Slovak Republic he was active within the State Research Institutes of Agriculture in Bratislava.

The period 1918-1945

After the foundation of Czech-Slovak Republic in 1918, soil science in Slovakia entered a period of fast development. Firstly, Slovak soil science was developing under the rule of a young generation of Czech soil scientists, as some pedologists active in Slovakia till 1919, emigrated to Hungary. The Czech soil scientists belonged to the school of Josef Kopecky (1865-1967). In the state framework, the leading personality in Slovakia

for several decades was Vaclav Novak (1888-1967).
In 1920 within the State Research Institutes of Agriculture (ŠVÚP) two institutes: for Agro-pedology and Bioclimatology (Bratislava, Kosice) were established. They were first really scientific institutions for soil science with famous representatives: Frantisek Kyntera (1897-1958, pedologist, agro-meteorologist), P. Kucera, and K. Kohout. The mentioned soil scientists came from Bohemia, where the scientific life was much more free than in Slovakia under the Hungarian rule. Soon the first modern scientific studies in Slovak language was published by F. Kyntera (1926, 1931), K. Kohout (1928) and some other studies about Slovak soils were written in Czech language (P. Kucera, 1935). F. Kyntera is the author of first Map of Soil Types in Slovakia.
The research was organized in several branches of soil science, such as soil physics, hydro-pedology and soil chemistry. A great advance was achieved in soil classification and soil genesis. The principles of genetic soil classification, developed in Russia and adapted for Central European conditions in Germany, were applied also to soils of Slovakia. A few local soil surveys were performed. During this time a new generation of Slovak soil scientists such as K. Nikitin, O. Kozuch and V. Pecho-Pecner was educated. K. Nikitin (1931) began with investigation of saline soils. Soon F. Kyntera (1937) wrote the monograph on saline soils. It was the first Slovak book in pedology. Viktor Pecho-Pecner (1899-1978) represents Slovakian soil activities in thirties of 20th century. He was employed in the State Agricultural Research Institute (SVUP) in Bratislava (in years 1938-1945 was director of this institute). He studied and worked mainly in soil chemistry (nutrient dynamics, pH, soil colloids).
The promising development of soil science continued also in the 1940s, despite the war conditions. In 1939 the Regional Agro-pedological Institute in Kosice was moved after the occupation of this city by the Hungarians to Spisska Nova Ves. The leading personality among young Slovakian soil specialists was Ondrej Kozuch (1896-1944). He implemented numerous investigations in several Slovakian regions – Spis, Gemer, Liptov, Orava, Turiec, Horehronie – occurring mainly in central and northern parts of Slovakia. He planned and arranged detailed soil survey of all Slovakian farmland. His most important works were: Soils of Slovakia and their Relationship to Cultivation of Agricultural Production (1943); Applied Soil Science (1944); and Plant Nutrition from the Soil (1946, 1951, both editions published after his death).
O. Kozuch was the most successful soil scientist of this period. Unfortunately, he was killed in the military action during the Slovak National Uprising which rose in summer 1944 against the occupation of Slovakia by German fascists.

The period 1945-1960

The end of Second World War was a significant milestone is soil science development. Immediately after its end new research activities began and a new generation of pedologists became active. Frantisek Hrosso, Jozef Mrakic and Bohuslav Malac became leading personalities in this period. In 1945 the “Agropedological Soil Survey" as a first large soil survey at national level started. In the period 1945-48 within this survey the action "Liming Need on Soil of Czech-Slovak Republic” was carried out and focused to acid soils requiring liming. This survey covered mainly North and East Slovakia. Successively after that (1949-1951) a new soil survey was organised to complete the results of the former survey in those areas which were not covered. Thus the first national soil survey of the entire country was completed.
However, the further development of soil science was limited in 1950 by the administrative re-organization of agricultural research. Both Regional Agro-pedological Institutes were closed and the soil research was split into several small working places, subordinated to various institutions such as the Academy of Sciences, the Central Testing Institute for Agriculture and the Agricultural and Forestry University in Kosice. Some pedologists were facing serious obstacles in new political situation. Despite these political

troubles, three fundamental books summarizing the pedological knowledge in Slovakia were written in this period:
F. Hrosso: Soil Science (1958): F. Hrosso: Soil Fertility and its Improvement (1961) and
B. Malac: Main Soil Types of Slovakia (1962).
Another important publication was Proceedings on Soil Erosion in Slovakia (S. Bucko, 1958) providing an overview of the result of erosion research, among which the Map of gully erosion of Slovakia at a scale of 1:500,000 by S. Bucko and V. Mazurova was most valuable.

The modern period
The new political regime emerging after Second World War under the political influence of Soviet Union resulted in a new type of agriculture and fundamental changes in political and public relations to soil. The agriculture in Slovakia was collectivized and large scale co-operative and state farms were established. National self-sufficiency in food production became one of the main political aims. At the highest political levels the ideas about the needs to increase the soil potential exploitation and the increase of the agricultural production were adopted. At the end of the 1950s the responsible political forces started to understand, that the decision to close the agricultural institutes in 1950 was wrong. It became obvious that the scattered soil research institutions could not deliver the required results.
This resulted in founding a specialized scientific institution for soil science in Slovakia - the Laboratory of Soil Science in Bratislava in 1960. Later this institute worked under the name Research Institute of Soil Science and Plant Nutrition (RISSPN). Founder of the institute was Juraj Hrasko. During next decades this institute went through several transformations. Although working under different names such as Soil Fertility Research Centre (SFRC) in second half of 1980s, Soil Fertility Research Institute (SFRI) in the 1990s and recently the Soil Science and Conservation Research Institute (SSCRI), this establishment has been a leading soil science research body.
Since the foundation of RISSPN as a solid institutional basis for the development of soil science, a new generation of pedologists has been educated. It was much more numerous compare to earlier times. This allowed much better specialisation and many researchers (especially J. Hrasko, Z. Bedrna, M. Dzatko, E. Fulajtar, B. Jurani, F. Zrubec, V. Linkes, C. Juran, P. Bielek, B. Surina, P. Jambor, J. Curlik, J. Karnis, etc.) became leading personalities in different fields of specialization.
Since the 1960s soil science is developing at several universities. At Comenius University soil geography was taught in the1960s (L. Mician). In 1990s the Department of Soil Science was established here by a group of researchers from SFRI under the leadership of B. Jurani. At Agricultural University in Nitra the agricultural aspects of soils were studied under the leadership of S. Sotakova, K. Holobrady, J. Hanes, A. Zaujec and their successors. At Forestry University in Zvolen the forest soils, their genesis and soil erosion was studied by R. Saly, D. Zachar, P. Midriak, E. Bublinec and many others. All Slovak soil science research institutions work in mutual cooperation. For better exchange of information, the Slovak Soil Science Society (Societas pedologica slovaca) was established in 1992. It provides a communication forum for a whole pedological community in Slovakia.
Slovak pedologists were working in close cooperation with main specialists in Czech Republic such as V. Kosil, J. Pelisek, J. Nemecek, R.Vaculik, A. Prax, J. Janecek J. Kozak, P. Novak, and others. Close cooperation was maintained also with Russian soil scientists, since several Slovak soil scientists studied at Russian universities. At the end of 1960s they had intensive relations with soil scientists in The Netherlands and several researchers from RISSPN studied there. In the 1970s and 80s the international cooperation was again limited to eastern countries. Since the beginning of 1990s the research became much more diversified and the intensive cooperation especially with European countries and USA began.

Major achievements

The most important activity which was performed by the Research Institute of Soil Science and Plant Nutrition during the years 1960-1970 was the General Soil Survey of Agricultural Soils. During this relatively long period of survey detailed information about the agricultural soils of Slovakia was obtained. The density of sampling was 1 site per 16 ha of agricultural land. More than 10 000 map sheets at a scale of 1:5,000 and analytical data from 18 000 soil profiles are available until today to provide information about agricultural soils of Slovakia. The archive of soil samples is also an important heritage of this soil survey. As a result of this soil survey, Slovakia (as well as Czech Republic) was at the beginning of 1970s one of the countries in the world with the most precise information about its soil resource and thanks to new survey activities this inventory is kept up-to-date.

Soil maps with general characterizations and proposals for soil amelioration and land management changes were offered to each co-operative and state farm as an implementation of actual information to the agricultural practice. The soil survey data provided important and helpful information to improve the decision making activities in agriculture and to achieve higher standards and yield in agriculture practice.

Later the soil survey of forest land was performed by research groups working in forest pedology in Zvolen, although in much less detail compared to General Soil Survey of Agricultural Soils. Finally, the data on both the agricultural and forest soil survey were compiled together on a general Soil Map of ČSFR at the scale 1: 500,000 (1973). Afterwards several regional soil maps were published. The latest approximation of Soil Map of Slovakia at a scale 1:400,000 was published in 1993.

Based on the data of the general soil survey many other new important interpretations were made, published and implemented in practice. Already before the finalisation of this survey numerous studies on soil genesis were published. The new knowledge was summarized in a new general book (Bedrna, Hrasko, Sotakova, 1968).

In the 1970s the preparation of theoretical principles for evaluation of soil production potential was the new important task that came up. Based on the General Soil Survey results, land evaluation maps at a scale of 1: 5,000 were produced. Leading persons were M. Dzatko and V. Linkes. The principles of subsidies and taxes in agriculture were deduced and the price of soil was determined on the "pedo-ecological units“, the elementary mapping units of the land management maps. With the help of these maps land use is planned, crop rotation approaches are recommended and rates of fertilisers are advised for individual parcels and crops.

The soil survey results were systematically complemented with other information about the Slovak soils. One of the most important innovations was the construction of a data base about soil pollution. The survey of soil pollution in Slovakia has shown "hot spot" regions of contamination. About 30 - 40,000 ha of agricultural land are over the limit of contamination (1.2 - 1.6 % of the total agricultural area). Polluted soils are continuously monitored and investigated with the aim to solve the problems.

Very fruitful results in Agrochemical Soil Testing are progressing. This started in 1955 and is still carried out. Available forms of nutrients, pH and need for liming is determined for the topsoil of each soil parcel. The results are evaluated in 5-year (3-year respectively) cycles. Based on the results of the Agrochemical Soil Testing the individual fertilisation plans have been elaborated for farmers (individual, co-operative, state).

Since the beginning of 1980s in the Soil Science and Conservation Institute Bratislava the Geographical Information System about the agricultural soils was created. It includes a huge amount of data and graphical interpretations (maps) about the soil cover.

In the 1990s several new challenging tasks emerged. First of all it was the Partial Soil Monitoring, which is running already more than 10 years and provides basic information on the development of all important soil properties under changing environmental conditions. It comprises 288 permanent monitoring sites, where many relevant soil

parameters are determined. Simultaneously, other specific monitoring systems are performed. Among very important results of soil research should be included the works by P. Bielek that were concentrated on soil biology and nitrogen dynamics in soil.
The next new task was the monitoring of influence of Gabcikovo Hydro-work at Danube on the soil properties, especially the soil water regime, soil physical status and possible salinization. Another new task was preparation of the Soil Geochemical Atlas with maps of the distribution of selected elements in soils of Slovakia.
Important task of SSCRI apart of the research is to deal with many commercial activities related to land evaluation and land inventories. Services are provided to the Ministry of Agriculture, cooperative farms and small land owners.
The institute initiated the innovation of national soil classification and the new classification was successfully introduced in cooperation of all relevant soil science working places and at the platform of Slovak Soil Science Society. SSCRI is also responsible for research of soil science development, environment conservation as well as in advisory services for agricultural practice using latest technology and innovation tools. It is involved in several international research projects and is regarded as an excellent centre for soil science in Europe. Many scientific books, papers and applied handbooks and brochures were published especially since second half of 1990s, when SSCRI established own edition centre.
Valuable results were provided also at other soil research organisations, or in cooperation between these institutions and SSCRI. L. Mician from the Department of Physical Geography of the Comenius University, together with Z. Bedrna from RISSPN made in 1960s a major contribution to understanding the geographical distribution of soils. They introduced the concept of piedmont zonality, explaining the distribution of soils at Slovak Lowlands. The Department of Pedology at Comenius University is lecturing modern aspects of soil science and educating a new generation of soil scientists
The results of some researchers from Slovak universities were published internationally. Probably the most successful was the book on soil erosion of D. Zachar based on the long lasting research done at Forestry University in Zvolen. This book had two Slovak editions (1960, 1970) and one English edition by Elsevier (1980). Many other authors published their studies in international journals and thus contributed to overall development of soil science at international level.

Conclusion
Most accounts of the history of soil science have focused upon development in Russia, America and Europe as a whole, but much less is known about the growth of the subject in small countries like Slovakia. Some broad phases can be distinguished:
1st - a pioneering phase (before 1918) characterized by isolated initiatives,
2nd - a development phase, divided in periods 1918-1945 and 1945-1960, when soil studies expanded rapidly in the context of agricultural and forest development,
3rd - a modern consolidation phase (after 1960) when scientists largely expanded and renewed soil science development.

Additional information and the full list of cited references can be obtained from
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Micromorphological Studies in the Russian Federation

A Brief History and Overview

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History of studies
Special micromorphological studies in Russia were initiated in 1947 under the supervision of Academician B.B. Polynov, head of the

Laboratory of Soil Mineralogy, V.V. Dokuchaev Soil Science Institute. They were devoted to the formation of primitive soils on granite. E. Parfenova and E. Yarilova described stages of granite weathering under lichens and neoformation of clay aggregates. Another co-worker of Polynov, I. Feofarova, studied accumulations of soluble salts (carbonates and sulfates) in arid and salt-affected soils.
The works by R. Brewer and, especially, his "Fabric and Mineral Analysis of Soils" (1964) stimulated micromorphologlcal investigations in Russia, particularly on the differentiation of fine--dispersed and optically oriented material in soil profiles. Original studies in this field were performed by N. Minashina, E. Parfenova and E. Yarilova, V. Targulian, and L. Karpachevskii. The next impetus was given by the session of the International Working Group on Micromorphology held in Moscow in 1971 and chaired by Academician I. Gerasimov. Reports on micromorphological features of Red Ferrallitic soils (A. Romashkevich), Solodic and Solonetzic soils (T. Tursina), and Brown Forest soils (M. Gerasimova) were presented. These three ladies organized the discussion on Russian approaches in micromorphology before the session and prepared a book "Terms and Definitions in Micromorphology" that served as a desktop reference for soil scientists in the former Soviet Union.
In 1975, the Laboratory of Micromorphology was organized at the Dokuchaev Soil Science Institute and headed by T. Tursina. Micromorphological features of the main types of soils in the Russian Federation were investigated: Podzolic soils (E. Parfenova, N. Rubilina, E. Kulinskaya, M. Verba), Chernozems (S. V. Ovechkin), Chestnut soils (M. Gracheva), Vertisols (E. Dostovalova, D. Morozov), Grey Forest soils (E. Skvortsova), Salt-Affected soils (I. Yamnova). Besides the samples of these soils, a considerable collection of thin sections from soils in different parts of the world were analyzed. The results of these investigations were generalized by T. Tursina in her doctoral thesis "Micromorphology of Virgin and Anthropogenic Soils of Russia" (1988).

Major micromorphological studies in Russia

Studies of extensive soils
Micromorphological investigation of podzols and podzolic soils began in the 1970s and continues up to the present day. Seminal works in this field belong to E. Parfenova, G. Rusanova (Komi region), N. Rubilina (Valdai region), M. Gerasimova (Central Russia and Komi region), V. Targulian (Moscow region), M. Verba (northern part of the Russian Plain) and T. Tursina (from Karelia to the Ural region). Major accent in these studies was made on the microfabric of the main soil horizons, composition and degree of weathering of soil minerals, microstructure and distribution of plasma in soil profiles, neoformation of skeleton, plasma, and mobile components (humus, iron, manganese, etc.), and pedological features typical of podzolic soils. Some new interesting facts were discovered with the help of micromorphology. Thus, it was found that in some profiles of podzolic soils, the eluvial (A2 or E) horizon can be subdivided into two parts having different compositions of skeleton grains; often, these parts are separated by the buried humus horizon. The microstructure and fabric of the Bt horizon may vary considerably (from aggregate to masepic fabric) even in a given soil profile. The character of the Bt horizon depends on the character of the soil-forming rock. Typical micromorphological features of Bt horizons in podzolic soils developed from glaciofluvial, glaciolacustrine, moraine, and other types of sediments were established.
Micromorphological studies of chernozems were performed by E. Yarilova (Tambov region), S. Ovechkin, A. Polyakov, E. Prikhodko (Volga region), and T. Tursina (Ukraine, Moldova, North Caucasus). Chernozems are marked by a good and stabile aggregation of humus-clay soil mass with intense biological processing of soil material (as seen from abundant coprolites and excrements of soil mesofauna). Even heavy agricultural loads on chernozems do not destroy their aggregation, though they lead to some re-arrangement of the soil pore space. However, irrigation results in the

disappearance of the initially perfect structure of chernozems. Only primary aggregates are preserved.
Different microforms of humus in the profile of chernozems are worth noting: crumb humus predominates in the upper part and coal-like forms predominate in the middle part of the profile. Calcareous pedofeatures - modules and concretions - bear traces of hydromorphism of chernozems in the past. Thus, two major stages in the development of chernozems can be distinguished: an ancient hydromorphic stage and a modern automorphic stage.
Interesting results were obtained during the study of red ferrallitic soils in the FSU and tropical countries. A. Romashkevich studied these soils in the Caucasus; I. Sokolov in the Caucasus, Laos and Polynesia; T. Tursina in Georgia, Laos, India and Nicaragua. One of the genetic problems related to red ferrallitic soils is their occurrence with brown soils or vertisols under very similar conditions. Sometimes, different soil types can be found in a given pit. The morphological differences between these soil groups are very considerable. Red ferrallitic soils are characterized by .a sharp differentiation of the profile, very high iron content in the B horizon, and the presence of perfect non-weathered minerals (like biotite) and unusual crystalline forms of quartz and high-temperature iron minerals. These features made it possible to suggest a new hypothesis of the origin of red ferrallitlc soils. It was supposed that the development of these soils was conditioned by the upward movement of heated hydrothermal solutions. The following sequence of horizons is formed during this movement (from the bottom to the top): (a) deep saprolite horizon, the horizon of high-temperature alteration of enclosing rocks; (b) the horizon of strongly leached and bleached whitish clay that was formed under the impact of aggressive heated hydrothermal solutions; (c) the plinthite horizon with mottled colour pattern and with a high content of clay and sesquioxides; and (d) the upper lateritic horizon enriched in hard iron concretions and often cemented by iron oxides (the horizon of final accumulation of sesquioxides removed from the lower part of the profile and their precipitation at the oxidation barrier). The upper part of the profile of red ferrallitic soils developed under the impact of pedogenesis proper. It can be referred to as the elueat horizon and is characterized by the weathering of primary minerals and loss of clayey plasma under direct impact of soil mesofauna. (Stoops, 1985; Sokolov, 1989). The humus horizon develops in the uppermost part of the elueat horizon.
Comprehensive studies were performed on the micromorphology of other soil types, including brown forest soils, chestnut soils, solonetzes and salt-affected soils, and alluvial soils in different zones of Russia. E. Yarilova and I. Feofarova studied micromorphological features of soils from Central Asia; M. Gerasimova investigated soils of the Carpathian region; S. Shoba and P. Balabko contributed to our knowledge of pedogenesis on flood plains in European Russia and Siberia; T. Tursina investigated soils of the Caspian Lowland and Central Asia. Traditional micromorphological descriptions of these soils were made. Special attention was paid to the structure and organization of soil material at the microlevel.

<u>Studies of unique soils</u>
By this term, we denote the soils that do not occupy extensive areas. Some of them are found in complexes with other soils. Their micromorphological studies have contributed significantly to our understanding of soil genesis.
Thus, gazha soils (soil developed from alm) were studied by N. Minashina in Azerbaijan in the 1950s. It was shown that the enrichment of these soils in gypsum is due to the effect of ascending movement of salt solutions. The concentration of gypsum is very high; gypsum grains occur in the form of small spherical crystals. These soils have very good aggregation and loose fabric. However, they cannot be used for agricultural purposes without special ameliorative measures.
Granuzems were first described by I. Sokolov in the Putorana Plateau of Central Siberia. These soils develop from loose clayey derivatives of mafic rocks accumulated in river valleys of the Nizhnaya Tunguska basin.

Being very rich in weatherable materials, granuzems are characterized by a perfect structural arrangement at the micro- and macro levels. Perfect aggregation of plasma inhibits the development of eluvial-illuvial differentiation despite cold humid climatic conditions and taiga vegetation.
Solod soils are soils of depressions within chernozemlc areas. They are widespread In Asia and Europe. Their detailed study was performed by T. Turslna in the early 1960s. Year-round observations made it possible to study the regime of solodic processes. It was found that three major processes are responsible for the development of solod soils. In the spring, when the depresslons are filled with snowmelt, Eh values drop below 200 mV and gleyzation develops. In the summer, under strongly acid conditions (pH 3), these soils are subjected to podzolization. In the falI, solodization proper takes place. It consists of the dispersion of clay material under the impact of sodium ions getting into the upper part of the profile with rising groundwater. As a result, the iIluviation of plasma from the E into the Bt horizon takes place. IIluviation features are seen well in thin sections, as well as the formation of iron nodules and, sometimes, calcareous nodules within the capillary fringe of the groundwater.
Palevye (Pale) soils were studied in Central Yakutia by I. Sokolov and T. Tursina (1970). These soils are formed under conditions of an extremely continental cold semiarid climate. They are developed from clayey or silty substrates enriched with primary minerals under forest (Iarch taiga) vegetation. Their profile is slightly differentiated. Soil structural organization is very good, but not as perfect as in granuzems. Pedological Edoma deposits (ice complex) are loess deposits containing buried soils in the frozen state and dissected by a network of ice wedges. Their micromorphological study was performed by T. Tursina on the basis of samples taken by E. Naumov, V. Tomirdiaro, and I. Sokolov in northeastern Siberia and Chukotka. The genesis of these deposits is open to argument. Micromorphological data, together with field observations, confirmed the eolian hypothesis. First, these deposits have a specific eolian-type particle-size distribution with the predominance of silt-size fractions; second, all elements of the relief are covered by edoma deposits of the same composition. Humus horizons of buried soils have very good aggregation; their humus was formed under more arid conditions than the humus of surface soils. Edoma deposits do not contain iron nodules and concretions and other features related to gleyzation (or contain them in minor quantities). This casts doubt on the hypothesis of their hydromorphic (alluvial) origin. On the contrary, edoma deposits often contain Ca concentrations related to the aridity of the climate and the possibility of the development of eolian sedimentation.

Contribution of micromorphological research In Russia to theoretical pedology

The development of micromorphology in Russia contributed to the theoretical basis of pedology and several new ideas and approaches should be mentioned.
(1) Lithological heterogeneity of the soiI profile is a normal situation. It is created by several cycles of deposition of soiI material and can be registered by studying mineralogical composition and particle-size distribution of skeleton grains, fabric and composition of clay plasma, distribution of phytoliths in the soil profile, the presence of litho- and pedorelicts, distribution of cutans and other pedological features in the soil profile, and fabric of soil horizons.
(2) In the genetic analysis of a soil profile, it is important to distinguish between the features of modern pedogenesis and the features inherited from the parent material and originated during the previous stages of pedogenesis {relic paleosol features, e.g. the second humus horizon).
(3) The main type of zonal soils have a polygenetic character, which can be established on the basis of their micromorphological features, including microforms of humus, phytoliths, pedological features, etc.
(4) Micromorphology is a helpful tool in determining the mineralogical and chemical composition of salt accumulation in the soil profile; their direct determination in thin

sections might be more effective than the study of soluble salts in water extracts.
(5) A separate, actively developing branch of micromorphology that yields important information on environmental conditions of pedogenesis is the phytolith analysis.
(6) Micromorphological monitoring of irrigated and meliorated soils makes it possible to notice the first changes in the soil structure and fabric, not diagnosed by other methods. Thus, the prediction and control of adverse changes in these soils is possible with the help of micromorphology.
(7) Stage-by-stage analysis of soils, starting from field investigations of soilscapes, foIlowed by the analysis of macro- and mesomorphological peculiarities of soil profiles (V. Targulian), and then by micro- and submicromorphological studies (S. Shoba), makes it possible to obtain the most complete information on the genesis and composition of soils.

Recollections of a Post-Doctorate stay in Europe in the 1950's

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When I finished graduate school in the 1950s, the professional path in soil science led from degree to permanent job. And I made applications, successfully. But I had also applied for and been awarded an overseas post-doctoral fellowship from the Canadian National Research Council (now the National Science and Engineering Research Council), which I accepted. It seemed more exciting. The decision was—where? Soil chemists were drawn to the ETH in Zurich in the second third of the century by the fame of Wiegner and his successors. In the mid-1950s, it was Professor Hans Deuel, who was beginning a program on organic matter. A second possibility, and the one I chose, was to work with Dr. R.K. Schofield. He had accepted the position of Reader in Soil Science at Oxford University, and moved from Rothamsted.

Some five years before, Schofield had spent a few months at Cornell, and introduced ideas on the diffuse ion layer around clay particles. He had published a small paper showing that this model predicted measured anion exclusion. This, and the theoretical work done by the Dutch school of colloid chemistry, led to several years of soil chemistry and soil physics studies at Cornell. Part of my thesis was on using this theory to explain swelling pressure exhibited by clays on wetting.

Jane Anne and I boarded the ship to sail from New York to Rotterdam. There was a month of being tourists in Europe in the cold August of 1956, before attending the 7th World Congress of Soil Science in Paris. Papers were still given in English, French or German, with simultaneous translation to the other two languages. The translators were not subject-matter specialists, so the results were sometimes a little rough. No posters. The arrangements for the hours outside the soils meeting were, of course, beyond anything we had experienced—this was an old European city. Dr. Schofield invited us to lunch for our first meeting. It was also in Paris that I learned of his hobby—playing the pipe and drum for Morris Country Dancing. He entertained a boatload of congressists on the Seine with his music. We saw and heard much more of it in the next 12 months.

At Oxford, I continued measurements of swelling pressure of bentonite at high water content, and we published a paper; but I considered the year an opportunity to meet people and to learn how others understood soil science.

At a meeting of the British Society of Soil Science, I first met Russian soil scientists. Different nationalities had visited Cornell in my time there, but I do not remember any Russians. They came to England with caviar and vodka, which became lunch. Caviar was not a food of preference for many of the attendees, so I was among those who had more than I would see again for many years, and washed down with vodka. The pattern for

Russian visits was what we would see for several decades, four or five scientists, usually including one woman, accompanied by an interpreter or two, with one senior scientist contributing to the discussion. Few new ideas came from Russian soil scientists working in agriculture; they were concerned with increasing food production after the shortages and starvation during the war. There was more emphasis on physical condition of the soil than seen in USA, where all the emphasis during the maximum production phase of the 1950s and 60s was on increased fertilizer use. Possibly the lack of fertilizer in the USSR prevented them from ignoring the decreasing tilth, and maybe there was still a residue of the V.R. Williams emphasis on soil structure and the beneficial effect of grass roots.

I had previously read some papers in Pochvovedenye, thanks to the translations provided by the Israeli Translation Service and available through USDA. The papers in the colloid science journal were by contrast, up to date. Derjaguin was publishing his work on "disjoining pressure" of water on clay surfaces. He was a classical scientist; I met him at later meetings. Agricultural research had by now been taken from the USSR Academy of Sciences, and placed under an Academy of Agriculture. This may not be the best way to foster search for more basic answers to agricultural problems. But the caviar and vodka were good.

There were at this time two ideas on the source of charge on kaolinite, either due to some small amounts of isomorphous substitution or to broken bonds at the surface. Dr. J.J. Fripiat at Louvain had recently come back from working at INEAC, the large Belgian research establishment in the Congo, and was continuing his work on clays at Louvain. He invited Dr. Schofield to come to Louvain to evaluate the evidence; Dr. Schofield invited me to come along. I had met some of the Belgian scientists in Paris, so I was familiar with both the situation in the Congo as well as the bilingual arrangements in Belgium. There were similarities to the Canadian political and cultural situation; the provision of government services in two languages was much further advanced in Belgium. The two linguistic groups were more evenly balanced in numbers. Lectures at the University were given in both French and Flemish, which sometimes meant having two people teach the same course. Later the New Louvain was founded, with the studies dominantly in French.

We sat for two or three days, discussing kaolinite. Much of the information was new to me; I had little background in mineralogy. We did not resolve the source of charge, but I learned about research organization from this first exposure to the European model of a research leader, the professor, with several research associates working first on their Ph.D. degree and then at the Ph.D. level continuing to work on different aspects of the same questions posed by the professor. Several of these researchers later moved to positions in Canada.

I also learned that what we termed a banquet in America would scarcely earn the name in Belgium. From food to ambience, it was a memorable occasion for fellowship. Dr. Schofield had brought his pipe, one of the waitresses brought out several large biscuit tins from which he chose one with the right sound, and the entertainment was there.

The Road Research Laboratory at the Department of Industrial and Scientific Research in Britain had an active soil physics program, initiated to understand why moisture collected under road surfaces in the tropics, resulting in broken pavement. Croney was the engineer and Coleman made the soil/water measurements. They used Schofield's pF/water content concepts to measure the soil water potential gradients for water movement. The apparatus used to measure the water retention curves at different pF values showed the engineering influence, it was designed for the purpose and had a minimum of different devices tacked on. Their paper "Soil Structure in Relation to Soil Suction (pF)" (J. Soil Sci. 5:75-84, 1954) has been often quoted in the soil physics literature.

Discussions with Croney and Coleman, added to some acquaintance with soil mechanics at Cornell, led to the development of my interests and my studies on mechanical properties of soils in the 1960s. It was also my introduction to the work in Australia, where soil science was a large component in soil mechanics under Gordon Aitchison's leadership in CSIRO. At this time the national research laboratories (CSIRO) were well-funded by the government. The understanding and management of swelling soils were important in countries with large arid regions; Australia, South Africa and the U.S. Southwest were the leaders in research and practice. The early ideas came from soil mechanics, soil science with its base in agriculture took up the work later in unsaturated water movement and infiltration. My early association with the soil mechanics community carried on into research studies and writing in the 1960s.

The Soil Science Laboratory of the Department of Agriculture was a minor component of Oxford University. The Professor of Agriculture claimed that he did not require extensive animal facilities—animal science could be learned from voles. The Reader in Soil Science along with a group of graduate students followed research interests; and one person taught a course in soil science to undergraduate students.

Morry Fieldes from New Zealand spent six months at the Laboratory during the year I was there. He pondered the ion structure of the clays from volcanic soils on the north island of New Zealand. Our discussions confirmed my difficulty to think in three dimensions, which excluded any serious future studies in clay mineralogy. I did learn a lot about volcanic soils and about New Zealand, which was useful background when I finally saw these soils with their lilting Maori names many years later, and when I worked with the ICOMAND group on the Andisol order.

In the 1950s most of the research studies on physical properties of volcanic soils reported in the English language literature came from New Zealand. Many were measurements of mechanical properties used in soil engineering. My first acquaintance with the unexpected dispersion properties of these clays had come five years earlier with some samples from southwest Washington State that flocculated on adding sodium silicate, a dispersant then used in grain size analysis. I was puzzled. All this was an introduction to my own later work on physical properties of Andisols in the Caribbean, when many of these ideas came together.

Dr. Schofield had studied physics at Cambridge, with post-doctorate work on kinetic theory of surface films, and later, electric properties at interfaces. He had published several papers on properties of colloids before he went to work at Rothamsted. He taught physics at Durham for two years and moved to Rothamsted in 1928 where B.A. Keen was in the Physics Department. Surface properties was the thread through much of Dr. Schofield's research work and it was the basis on which he approached a range of problems in soil science. The detailed nature of soil surfaces is again a major focus of soils research. His interests at Rothamsted ranged widely from evapotranspiration to soil chemistry, and were concentrated on soil phosphorus chemistry when I was there. He had studied rheology of pastes, soils and flour, soil water, the diffuse ion layers surrounding soil particles, and phosphate in soil solutions. He is best known for his 1935 paper on soil suction given at the Third International Congress of Soil Science, where he defined to pF scale and discussed methods to measure soil water potential. This was a different model for a career in soil science than I had been exposed to, and if it did not steer me in the direction of trying different areas of earth and environmental sciences, it certainly legitimized a natural tendency. He also made me feel better about not keeping a good card catalogue of references.

On weekends, Dr. Schofield provided music for Morris dances in the greens of different small centers around Oxford. He provided the music while the dancers twirled and stomped and the wooden horse asked the spectators to put pennies in its mouth.

From contacts with people who came from different academic and cultural backgrounds, from observing how they approached soils problems and which problems they studied, I either developed, or had strengthened, a wide range of interests.

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Book Reviews

Soils and Archaeology are Getting Closer Together

Current archaeology research is not only about looking for and documenting artifacts for interpreting ancient cultural and social history a bit better, but is more and more concerned with interpreting the accompanying environmental history of the site where the artifacts were found. Landscape development, soil science and paleosols pay an ever increasing role in this in explaining the development of our society in the past and present. A good example is the edited book by T. E. Levy "**The Archaeology of Society in the Holy Land**"(1995, XVI + 624 pp., Leicester University Press) which has 32 excellent essays exploring social and cultural changes in an archaeological and environmental context, discussing also soil, sedimentological and geomorphological issues. The eminent environmental historian and geographer Karl W. Butzer (University of Texas at Austin) concluded recently a significant article in the Journal of Archaeological Science (vol. 31, p. 1774, May 2004) by saying that "paleosols have gradually become a standard part of Quaternary studies".
Fortunately there have been recently a number of publications and textbooks dealing with soils and archaeology. The aim of this note is to draw the attention of our readers to these publications, especially to the new book by Vance T. Holliday "**Soils in Archaeological Research**" (2004, XI + 448 pp., Oxford University Press). It is a real gem of a book. Though targeted to geoarchaeologists to explain soils as a significant component for the integration of their studies with environmental interpretation, it reviews a wealth of relevant soil information (a large part of the 1300 references). There are fourteen chapters (including three appendices) dealing not only with how soils can be used in geoarchaeological contexts and explaining details of the methodology, procedures and possible environmental interpretation used. Actual case studies from several sites, countries or regions are briefly reviewed. Soil horizonation processes and bioturbation are described, with catenary relations and micromorphological aspects included. Methods of dating soils and the use of chronosequences are explained and discussed .There is a fine chapter on Human Impacts on Soils (Anthrosols). Both details and summaries for the 'big picture' are included and it doesn't refrain from expressing criticism where needed. For example it rejects Patton's 'New Global View' (p. 49-50), preferring Jenny's state factors approach to pedogenesis, and warns that the Retallack's carbonate leaching climate relations calculations and equation (p. 197) can be meaningless without taking into account other factors as well. A follower of B.L. Allen (Lubbock, TX) and Peter Birkeland (Boulder, CO), Vance Holliday (University of Arizona, Tucson) has produced an outstanding book which will serve as long-lasting reference for both pedologists and geoarchaeologists.

For those wishing to see in greater detail how such knowledge can be applied in practice, there is no better example than the recent book by M.M. Morris "**Soil Science and Archaeology: Three Test Cases from Minoan Crete**" (2002, 141 pp., Institute Aegean Prehistory, Academic Press, Philadelphia; reviewed in Geoderma 121: 155-156, 2004). For those wishing to acquaint themselves with the even broader ecological approaches of environmental archaeology, including the botanical (pollen) and faunal paleoecology aspects, which have been avoided by choice in these books, the text by D.F. Dincauze, **Environmental Archaeology: Principles and Practice**" (2000, 583 pp., Cambridge University Press), will serve as an excellent background foundation for the changes taking place in environmental history.

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Bodenwissenschaften und das Unbewusste – Ein Beitrag zur Tiefenpsychologie der Naturwissenschaften
(Soil Science and the Unconscious – a Contribution to the Depth Psychology of Natural Sciences). N. Patzel. Hochschulschriftenreihe zur Nachhaltigkeit 6; Ökom Verlag, München, 2003, 228 S., ISBN 3-936581-25-8. With English summary, about EUR 20 for paperback edition.

Patzel explored as disciple of the psychologist C. G. Jung and student of the soil chemist H. Sticher, both in Zürich, the question, whether *inner images could give substantial inputs for our understanding of soil and soil science.* Patzel describes at first the development of the thinking about soils by their protagonists as part of science. This seems to be possible, because thinking about nature since the ancient world followed the idea that nature is formed from the 4 elements *water, air, fire* (warmth) and *earth* (soil). He describes the history of *soil material science (Boden-Stoffkunde)* with the *mineral theory* (Palissy, Saussure, Sprengel, Liebig, Stöckhardt), the *soil transport and element fluxes* (Darcy, Darwin, P.E. Müller, Odum, Ulrich), the p*edology* with *soil description and genesis* (Sprengel, Fallou, Dokuchaev) and modelling (Jenny), the *soil fertility* (Bacon, Wallerius, Senft, Steiner, Scheffer), as well as the *soil qualities* (Columella, L. Holberg, M. Alexander, Warkentin & Fletscher) *and soil functions* (Schlichting, Haase, Sauerbeck). Folk beliefs, which were asked and documented by the folklorist W. Mannhardt, are described also, together with the so- called *Benandanti dreams* about *night fights for crops* of the 16th century in Italy. The materials were analysed from the viewpoint of depth psychology focusing upon archetypal images therein. Patzel gives known examples of the influence of dreams upon progress in science (e.g. the discovery of the benzene ring by Kekule). He describes Jung's method of *dream-interpretation*. He also presented his own dreams that occurred attending his diploma thesis on *Soil Fertility*, and his dissertation work on *Soil Science and the Unconscious* at the ETH Zürich. His main finding was that inner images are to be found in the background of soil science and that they can contribute to contemporary understanding of soil and soil sciences.
This book should be of main interest for those with interest in the history of soil science, as well as of those with interest in the ways of achieving knowledge in science.

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Evolution of Tropical Soil Science: Past and Future. G. Stoops, guest editor. Académie Royale des Sciences d'Outre-Mer, Bruxelles, 2003, 149 p. ISBN 90-75652-29-1. Softcover.

This publication contains the papers presented at a workshop, held Brussels in 2002. The workshop was attended by many experts in the field of tropical soil science, and the papers reflect the deep personal knowledge of their authors. To name a few of the speakers at this meeting: Dudal, Ruellan, Deckers, Pinto Ricardo, Guerra Reffega, D'Hoore, Van Ranst, Sys, Nachtergaele and Spaargaren. Their presentations are included in this book. The papers form an interesting account of the development of tropical soil science, especially in Africa, from the early years until now. Some of the remaining problems are briefly mentioned and these indicate the huge amount of work awaiting the attention of tropical soil scientists!
Price: EUR 16.50.

Orders to: Académie Royale des Sciences d'Outre-Mer, Rue Defacqz 1, boîte 3, B-1000 Brussels, Belgium. Fax: +32-2-539-23-53. Email: kaowarsom@skynet.be. Internet: http://users.skynet.be/kaowarsom.

(from IUSS Bulletin 105)

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Is Water Science or Agriculture the Basis of Civilization?

The Basis of Civilization – Water Science? IAHS Publication 286. J.C. Rodda and L. Ubertini, editors. International Association of Hydrological Sciences, Wallingford, 2004, 343 p. Softcover.

As a contribution to the UN sponsored *International Year of Freshwater* the International Association of Hydrological Sciences (IAHS) convened in December 2003 in Rome a Symposium with the intriguing name "Water Science - the Basis of Civilization ?" surveying the linkages between hydrology and society throughout history. Besides the activity reports on water projects of three UN agencies (UN/ESA, FAO, IAEA), this volume contains the common hodge-podge of invited and contributed papers of such conference proceedings, 34 in all, from data on climatic trends and drought in Italy, meadow irrigation in central Europe, flood control in China, to isotope hydrology and issues of governance and water supply developments.

There are only a few papers on the role of water in the development of civilization as hinted in the title – albeit ending with a question mark. These are of interest also to our readers. Noteworthy among these is the contribution by J.A.A. Jones (Aberystwyth) who explores the alternative of the common view (also mentioned in some of the papers) that civilization developed in the river valleys of Mesopotamia, the Nile, Indus and Yangtze valleys closely linked to the ability of harnessing and diverting river water for use in irrigated agriculture. Frequently called the *hydraulic civilizations* (e.g. by Witfogel, Butzer, a.o.) of four to six thousand years ago, hydrologist Tony Jones argues that civilization did not originate on river alluvial soils (Fluvents) as claimed for the hydraulic societies but in a variety of environments.
It is now generally accepted, based on dated archaeological evidence, that agriculture developed gradually in the semiarid hilly Near East on Aridisols. This is documented by extensive hilltops settlements (from 9000 BP) in Anatolia and Levant. The ability to adapt the hilly slopes and narrow valleys in semiarid environments and to produce surpluses of food enabling a division of labor and urbanization was the critical mark of civilization, which preceded the development of water manipulation technology in the large river valleys. Thus Neolithic civilization was the basis for the ancient hydraulic expertise and not the other way round. From my diverse studies in this region I fully support this notion and hope for its greater spread. Soil use management and water technology developments are inevitably closely interrelated, which unfortunately is not evident from many of the contributions in this volume. Several geo-unions, including IUSS, are now planning with UN the *Year of Planet Earth* in 2006/2007. One wonders what kind of symposia dealing with soil and society will be part of this initiative.
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Smithsonian Soil Exhibit

Soil is the reservoir on which most life on earth depends as the primary source of food and fiber. Soil plays a vital role in sustaining human welfare and assuring future agricultural productivity and environmental stability. The study of soil as a science has provided us with a basic understanding of the physical, chemical, and biological properties and processes essential to such a complex ecosystem.

The Soil Science Society of America (SSSA) is working with the Smithsonian Institution to plan a soils exhibit as part of their Global Links Gallery at the National Museum of Natural History in Washington, D.C.
The exhibit will include a display of state soil monoliths and an educational, interactive section to help the museum's 6–9 million visitors understand how soil is intricately linked to the health of humanity, the environment and the planet.
Related publications and web activities will reach millions of additional people. Never before have we had such an opportunity to advance the understanding of soil. This work will move forward our journey to sustain Earth and its people by showing visitors to the Smithsonian on the importance of soil and Earth sciences.

The National Museum of Natural History is the most visited museum in the world, hosting 6-9 million visitors a year.

Interactive educational soil display
The Soil Science Society of America wants to make sure soils are a key part of the Smithsonian's Earth system science message. The SSSA has organized a committee to help develop exhibit information, help distribute the educational information developed, and involve the profession through contributions of ideas, time and money, which are needed to develop the soils exhibit.

Tentative topics for the exhibit include:
- Soil as Life
- Role of Soil in the Environment
- Soil Supports Organisms
- Food from the Soil
- Medicine from Soil
- Careers in Soil
- Soil in Cultural History

"We have a remarkable opportunity to educate, promote, and ultimately advance the understanding of soil. I personally hope everyone gets involved in this worthwhile project at the Smithsonian."
- H.H. Cheng, Professor Emeritus, University of Minnesota, Smithsonian Soils Exhibit Committee Chair

Three major project elements include:
1. National Museum of Natural History Exhibit which includes two sections. A state soil monolith from each state will be displayed as a permanent exhibit. A multi-year interactive exhibit will explain soils to the 6–9 million museum visitors.
2. Educational Outreach Materials are planned that may include soil educational kits to be sent to librarians and teachers.
3. Web educational activities, career information, and resource lists will be available on the Smithsonian Institution and SSSA Web sites indefinitely.

Visit www.soils.org/smithsonian for more information about the plans.

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For additional information on activities, meetings, publications, other useful information and links, please consult websites: www.iuss.org and www.soils.org.

The editors would de pleased to receive material for inclusion in the next Newsletter, preferably as Word files, to: hans.vanbaren@wur.nl