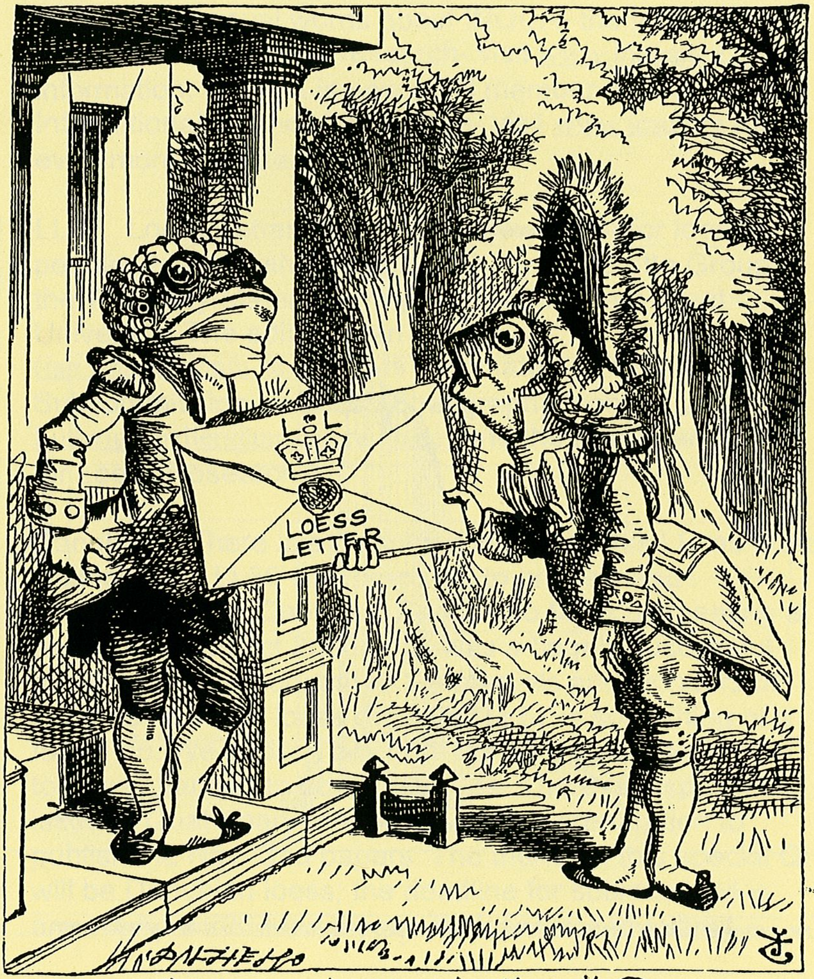
XVII INQUA
NOTTINGHAM TRENT UNIVERSITY
LL57 April 2007
ISSN 0110-7658

LOESS LETTER 57

An INQUA Newsletter for Students of Loess Material, Loess Deposits, Loess Ground, Loess Soils & Loess as a 'Climate Register'. Founded in 1979 at the New Zealand Soil Bureau.



"Its a Loess Letter" 57

PARTICLE SIZE DISTRIBUTION

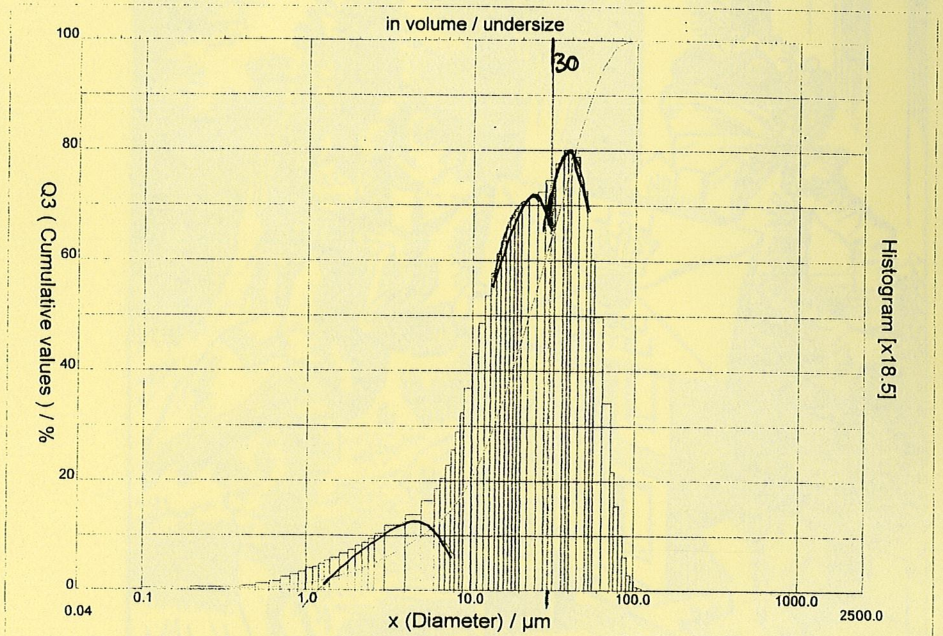
TITEL PLATEAU
Oct 2006
see p13 →

CILAS 1180 Liquid

Range : 0.04 µm - 2500.00 µm / 100 Classes

Sample ref.	: Mean Loess US max
Sample Name	: Loess titel 1 2 10 06
Sample type	: 1180L Sn1283
Comments	: Lot xxxx
Liquid	: Water (eau)
Dispersing agent	:
Operator	:
Company	:
Location	:
Date : 07/03/2007	Time : 09:40:04
Index meas.	: 775
Database name	: ValidationDJD3

Ultrasounds	: 0 s
Obscuration	: 18 / 0.40 %
Diameter at 10%	: 5.07 µm
Diameter at 50%	: 22.39 µm
Diameter at 90%	: 53.39 µm
Fraunhofer	
Density/Factor	---------
Specific surface	---------
Automatic dilution	: No / No
Meas./Rins.	: 60s/60s/4
SOP name	: Loess titel



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17th INQUA. The 17th INQUA Congress will be held at Cairns, Queensland, Australia from 28 July to 3 August 2007. Get the details from www.inqua2007.net.au. LL sends greetings to organisers and delegates- have a great conference. Look for the elusive Australian loess. Vote for somewhere loessic as the site of 18th INQUA in 2011.

INQUA. Our usual words about INQUA- the International Union for Quaternary Research- visit www.inqua.tcd.ie for information. INQUA is now a full member of ICSU- the International Council for Science- visit www.icsu.org for even more information.

LL57. Loess Letter is an INQUA newsletter for loess people. It is published, for INQUA, by the Giotto Group of the Waverley Materials Project at Nottingham Trent University. The editor is Ian Smalley (ian.smalley@ntu.ac.uk). It is associated with the INQUA Subcommission on Loess Stratigraphy (contact via Ludwig.Zoeller@uni-bayreuth.de) and the European Centre for Loess Research.

Danubian. There is a Danubian aspect to this LL, as there was to LL56. LL56 was prepared to preview and complement the Danubius Pannonico Mysicus meeting at Novi Sad Sept/Oct 2006. This was a hugely successful meeting and demonstrated the marvels and wonders of the great Serbian loess deposits. LL57 is something of a follow-up. We publish bits from the field guide, and hope to draw attention to some key sites. There is a special issue of Quaternary International QI in preparation to publish the Novi Sad papers. The theme of this special QI will be Danubian loess; the deadline for submissions is around April 2007 but if you are desperate to submit contact Slobodan Markovich (zbir@im.ns.ac.yu). A lot of material relevant to the Novi Sad meeting is available on the Loess Lexicon website (www.loess-lexicon.net) .

Pictures/Anniversaries etc. We thank Sir John Tenniel for providing illustrations for LL57.
The piece from PIPG which we reproduce is a tribute to Liu Tung-sheng, doyen of Chinese loess investigators. PIPG managed to publish the item to coincide with Liu's 90th birthday. LL sends congratulations, and reprints the PIPG article as a further tribute.
Julius Fink, who invited Liu to that world-changing INQUA meeting in Poland in 1961, was born on 18 April 1918. If he had lived he would have been 90 next year. He transformed the loess world from his base in the Danubian region. We prepare to celebrate and remember next year, possibly in Budapest.

Where is the loess?(and why?). Reprinted from New Zealand Soil News. An interesting piece from Soil News on 'Rivers & Loess' is available on Loess Lexicon. The old Danube research programme is still accessible at www.loessletter.com . If you Google loess you get 2,150,000 hits; try Loess Letter and you get 131,000.

Particle size analysis of loess from the Titel Plateau, Voyvodina, Serbia. The result on p.2 (inside front cover) is a size analysis of loess from Titel, collected during the field excursion associated with the Novi Sad'06 meeting. It shows the interesting 'twin peaks' phenomenon. This was first observed by Dennis Eden in the Essex loess in 1980, and latterly by Bjoern Machalett et al in the Kazakhstan loess. How to explain the closely associated modes either side of 28μm? Is there a climatic explanation? Is it somehow intrinsic in the nature of loess material? Suggestions required.

Autonomus Provine of Vojvodina Secretariat for Science and Technological Development

University of Novi Sad Faculty of Sciences

International Union for Quaternary Research

Municipality of Indjija

Danubius Pannonico Mysicus
Space of challenges

An International meeting in celebration of the 280th Anniversary of publishing of the first multidisciplinary research about the Middle and Lower Danube Basin written by Luigi Ferdinando Marsigli

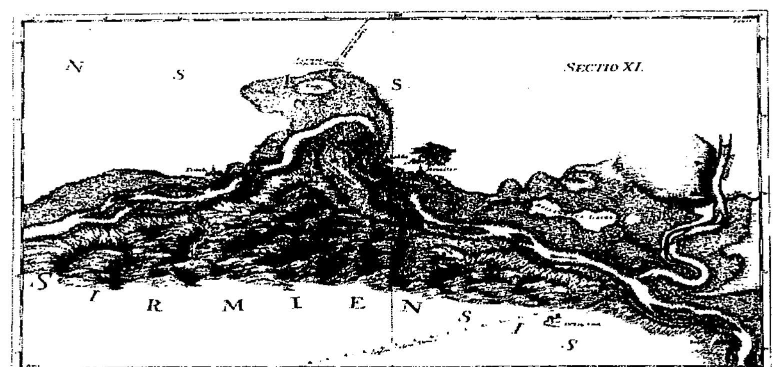
MARSIGLI'S LOESS TOUR

Edited by

Slobodan B. Marković, Mladjen Jovanović, Ulrich Hambach, Pierre Antoine and Mark Bokhorst

Field Guide

Field excursion 1st and 2nd October 2006



Novi Sad, MMVI

THE FIRST SCIENTIFIC DESCRIPTION OF EUROPEAN LOESS-PALEOSOL SEQUENCES

Marković B. Slobodan & Jovanović Mladjen

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This short communication highlights importance of our excursion area (*figure 1*) to loess research in Europe, beginning with the work of Count Luigi Ferdinando Marsigli (*figure 2*).

During the last decade of 17th century Marsigli was employed to arrange the boundaries between the Turkey, and Austrian Empire. As high officer of Austrian army Marsigli spent a lot of time in Patrovaradin, Titel and Stari Slankamen forts (*figure 1*).

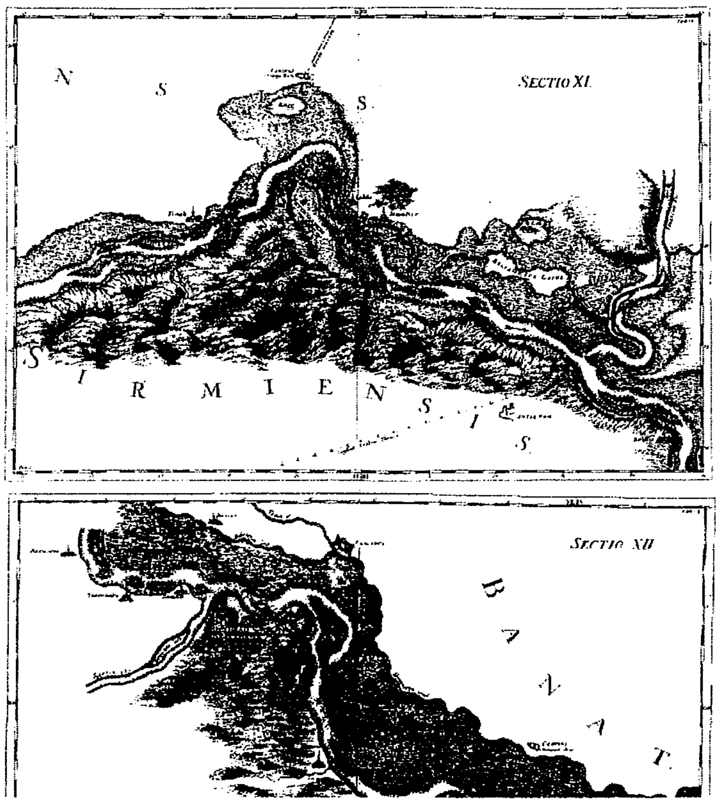

Figure 1 Maps of excursion area (Marsigli, 1726)

Italian soldier and scientist, at the same time worked on his military duties and also investigated loess-paleosol exposures situated near to these fortifications. Noticeable loess-paleosol exposures along Danube river valley have been drawn by Marsigli in his outstanding six volume book ***Danubius Pannonico Mysicus*** (1726). Cont Marsigly described lithology of loess bank of Danube river, respectively, modern soil (marked with A in *figure 2*) as *Terra fructifera pinguis nigra et creatacea* (black fertile carbonate soil), paleosol (B) as *Terra nigra fructifera pinguis* (black fertile soil) and between them loess layer (C) as *Terra lutosa cinerive et in fragmento creatacea priabilis* [yellow-cinerary layer with carbonate fragments (concretions)] (*figure 2*). To summarize, it is evident that many sedimenthological characteristics of loess-paleosol sequences as recognized by Marsigli remain valid to this day (Marković et al., 2004).

Figure 2 Cont Luigi Ferdinando Marsigli 1658-1730

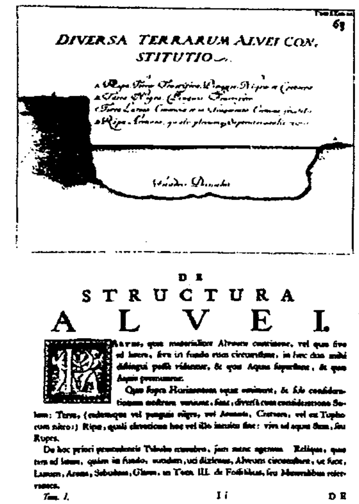

Figure 3 Description of loess-palesol bank of Danube River (Marsigli, 1726).

Marsigli's observations of loess-paleosol sequences was published one century before pioneering work of von Leonard's (1823/1824) about characterization of loess deposits (Zoeller & Semmel, 2001). Ever since the initial study of Marsigli loess research around the world have been established as one of the most promising archaives for understanding of Quaternary plaeoclimatic evolution.

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Marsigli, L.F., 1726, Danubius Pannonico Mysicus; Observationibis Geographicis, Astronomicis, Hydrographicis, Physicis; perlustratus: The Hague and Amsterdam, Grosse, P., Alberts, Chr., de Hoodt P., Herm. Uytwert & Franc Changuion.

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STOP 1A

THE MIDDLE AND UPPER PLEISTOCENE LOESS-PALEOSOL SEQUENCE AT RUMA BRICKYARD, VOJVODINA, SERBIA

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INTRODUCTION

The Ruma loess-paleosol section is exposed in an excavation of a local brick factory on the left bank of Jelence Stream in the central part of the south slope of Fruška Gora. Geographical coordinates of this site are 45°00' N Latitude and 19°51' E Longitude (figure 1). The 20 m of thickness of the Ruma profile includes 5 fossil soils separated by 6 loess layers, which formed during the later part of the Middle and Late Pleistocene.

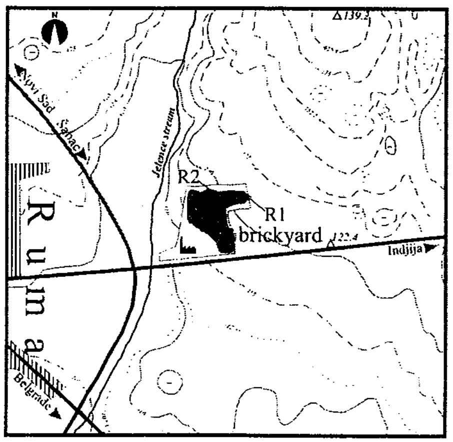

Figure 1 Topographic map of the area surrounding the Ruma brick mine

SAMPLING AND METHODS

Investigations of the loess-paleosol sequences of the Ruma quarry began in 1997. There are two exploitation levels of about 10 m thickness that were sampled in the northeast part of the quarry (fig. 2). Samples were collected at 5 cm intervals for sedimentological analysis, and at 25 cm intervals for malacological studies. Grain size fractions (<2, 2-10, 10-20, 20-200, >200 μm) were measured by sieving and pipeting and carbonate content was analyzed gas volumetrically. Magnetic susceptibility (MS): Measurements were done in the field using a portable Bartington susceptibility meter. MS was measured at 5 cm intervals; at each level, 10 independent readings

Five paleosol and six loess layers are distinguished at the Ruma quarry (fig. 3). Although we provide a general overview here, details of paleosol stratigraphy and sedimentology are described by Marković et al. (2004). The two younger paleosol sequences show variable morphological characteristics. These soils were formed partly in paleo-depressions that are represented topographically as depressions in the present loess plateau surface (figure 2). Paleosol horizons developed in these paleo-depressions have greater thickness and darker color (Marković et al., 2000). These paleo-depressions are not noticeable in older fossil soil sequences.

Previous chronostratigraphic investigations of Serbian loess-paleosol sequences indicated that the loess horizons formed during glacial periods, and each paleosol developed during an interglacial phase (Marković, 2000, 2001). Based on these data, Marković and Kukla (1999) designated the units by names that follow the Chinese loess stratigraphic system (Kukla, 1987), beginning with the prefix "SL" referring to the standard section at the Stari Slankamen site.

Stratigraphy of the loess-paleosol sequence at Ruma is shown in figure 3. Only the uppermost part of SL L4, the oldest loess layer, is exposed. The oldest exposed paleosol, SL S3, is a strongly developed forest soil. From bottom to top, this paleosol complex includes a 105 cm thick C_k horizon (10 YR 7/3-5/4, Munsell colors) with many carbonate concretions and strongly developed humus infiltrations; 25 cm thick BC horizon (10 YR 7/3-5/6) with small spherical carbonate nodules; 75 cm thick reddish B_t horizon, 10 YR 4/3 to 7.5 YR 3/2; with a 15 cm thick nearly indistinguishable elluvial layer at the top of the paleosol.

Loess layer SL L3 (2.5 Y 8/2 – 10 YR 6/3) is about 200 cm thick and is relatively homogeneous silt to fine sand. Overlying this loess is SL S2 SS2, a 115 cm thick chernozem-brown forest soil paleosol complex. The lower C_k and B (10 YR 6/3-4/4) horizons are 50 and 25 cm thick, respectively. Crotovina are scattered throughout the upper lighter colored (10 YR 5/4-4/3) 40 cm thick AB horizon. Subunit SL S2 LL1 is 75 cm thick weathered loess separating the

STOP 1C

THE MIDDLE AND LATE PLEISTOCENE LOESS-PALEOSOL SEQUENCE BATAJNICA

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Loess sequences in the Vojvodina region reveal a continuous record of paleoclimatic variations since the late Lower Pleistocene. The most detailed stratigraphic information on Vojvodina's loess comes from natural exposures on the cliffs of right Danube bank from Vukovar to Belgrade. The Batajnica loess section has been recognized as one of most complete Middle and Late Pleistocene records in this area (Marković-Marjanović, 1970; Butrym et al, 1991; Kostić and Protić, 2000).

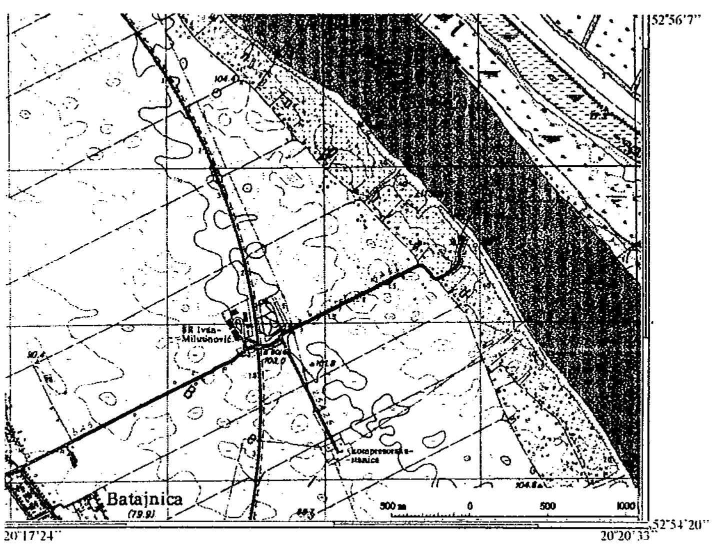

Figure 1 Geographical position of Batajnica exposure

The Batajnica loess exposure is situated about 15 km northwest of Belgrade (44°55'29'' N and 20°19'11'' E). The analyzed profiles are exposed in steep cliffs of the Danube bank The modern soil (S0), the last glacial loess L1 and palesol S1 represent profile A. Profile B is located

STOP 1E

THE PALEOCLIMATIC RECORD OF STARI SLANKAMEN LOESS-PALEOSOL SEQUENCE DURING THE LAST 850 ka

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INTRODUCTION

The pionir paleomagnetic investigations of Central Europe loess (Bucha et al., 1969) have provided cronostratigraphic framework for Kukla's (1970, 1975, 1977) correlation between paleoclimatic fluctuations recorded in land and deep-see sediments. This was an overture for Chinese loess research "revolution" which started after Heller and Liu (1982, 1984, 1986) published the first reliable magnetostratigraphic zonation of about 2.5 Ma old Luochuan loess column and established magnetic susceptibility (MS) as one of the most sensitive paleoclimatic proxies. Afterward those many paleomagnetic studies of Chinese, Central Asian, European, New Zeland's, North and South American loess deposits made an advance in reconstruction of Pleistocene natural processes (Heller & Evans, 1995; Evans & Heller, 2001). This research trend detoured around Stari Slankamen loess exposure, in spite of its noticed scientific importance (Bronger, 1976, 2003; Singhvi et al., 1989). Paleomagnetic data presented in this study confirm and moreover emphasize significance of this section for understanding middle and late Pleistocene paleoclimatic history in Central and South-eastern Europe.

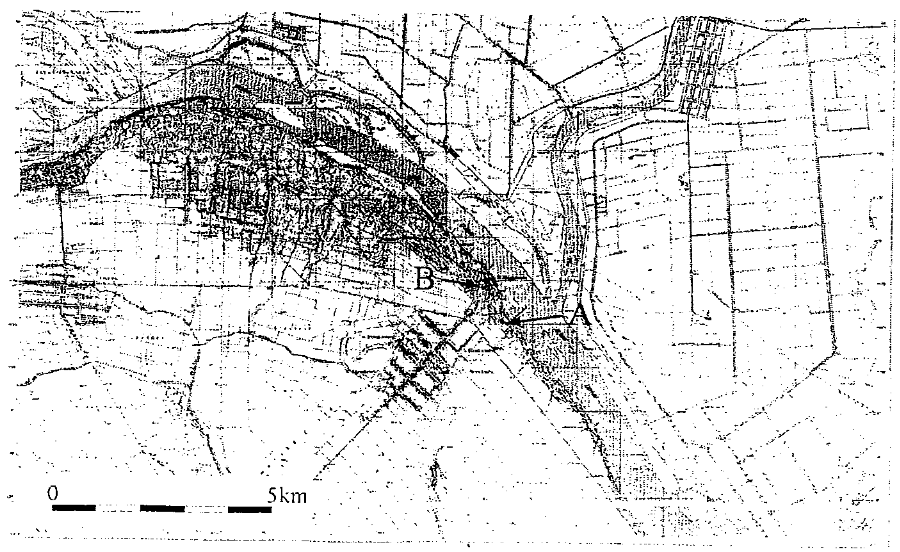

Figure 1 Geographical position of Stari Slankamen exposures

LOCALITY DESCRIPTION

The Stari Slankamen section is located in the north-eastern part of Srem loess plateau on the right bank of the Danube river, opposite Tisa (Tisza) junction. Geographical coordinates of the Stari Slankamen site are 45°7'58'' N Latitude and 20°18'44'' E Longitude (fig. 1).

Detailed exposure description was presented by Marković-Marjanović (1972), Butrym (1974), Bronger (1976), Butrym et al. (1991) and Marković et al. (in preparation) figure 2. The nearly 40 m thick step loess cliff intercalated with 10 fossil soils. Bronger's (1976) paleopedological data suggest gradual environmental transition from humide and warm to colder and drier paleoclimate along the Stari Slankamen loess-paleosol sequence deposition. Erosion layer with many small rock blocks is interposed at 1,5 m below of paleosol SL S1 (fig. 2). The same erosion level is visible also at 1.1 km distant exposure in deep loess valley, between Stari and Novi Slankamen (B). After a careful cleaning of the section during the field investigation in 2004, we observed that erosion event caused missing of lower part of loess horizon SL L2, paleosol SL S2 and upper part of loess unit SL L3.

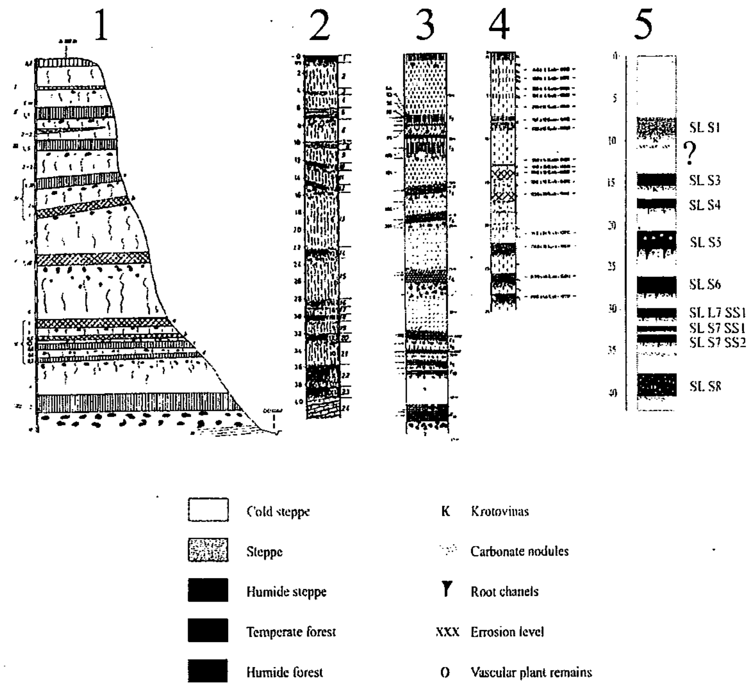

Figure 2 Comparison of Stari Slankamen loess-paleosol sequence descriptions
1. Marković-Marjanović (1972); 2. Butrym (1974); 3. lithology according to Bronger (1976) TL ages after Singhvi et al. (1989); 4. Butrym et al. (1991); 5. our interpretation

Marković and Kukla (1999) designed the units according to names which follow the Chinees loess stratigraphic system (Kukla, 1987) but carry the prefix "SL", referring to the Stari Slankamen site.

STOP 2A

THE LATE PLEISTOCENE LOESS-PALEOSOL SEQUENCE AT TITEL OLD BRICKYARD EXPOSURE

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The Titel plateau is a uniquely table-shaped and isolated loess plateau of about 55 m high. It is cut-off on both sides by the rivers Danube and Tisa and located near the confluence of these rivers (*figure 1*).

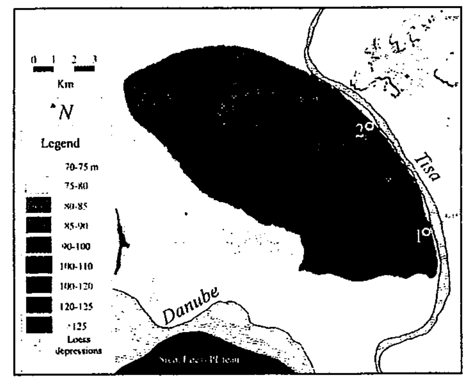


Figure 1 The Titel plateau between Danube and Tisa. The section Titel old brickyard is located at point 1 and point 2 indicates a second sampled and analyzed section

The plateau is characterized by extraordinary thick Late Pleistocene deposits (mainly last glacial loess L1). The section Titel (described by Bokhorst et al, submitted), near the east point of the plateau, is a former brickyard. It exposes a seventeen meter thick L1 and a three meter thick S1 (*figure 2*). S1 can be interpreted as a chernozem. We correlated this soil with Marine Isotope Stage (MIS) 5. The last glacial loess L1 shows some incipient soils between 3 and 10 m below surface, marking MIS 3 and early MIS 2 equivalent deposits. Grain size results (figure 2) and 5 IR-OSL age estimates confirm that L1 can be divided in 7 m MIS 4, 5 m MIS 3 and 5 m MIS 2 equivalent deposits. The MIS 4 equivalent deposits are probably the thickest in Europe and were probably deposited in a paleo-depression. The deposits are relatively coarse and sandy (>40% is coarser than 44 μm), indicating fast winds and high availability of coarse material in de direct surroundings of the plateau. MIS 3 was characterized by more regular sedimentation rates, indicating the paleo-depression was almost filled up by this time. The incipient soils are weakly developed, indicating a relatively constant sedimentation.

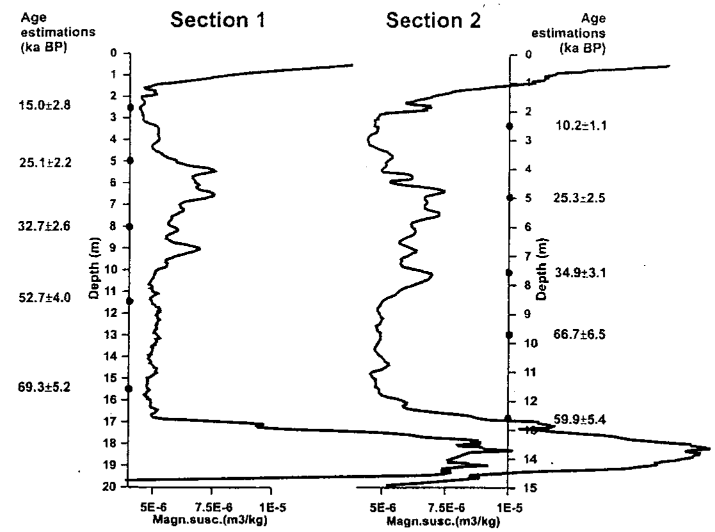
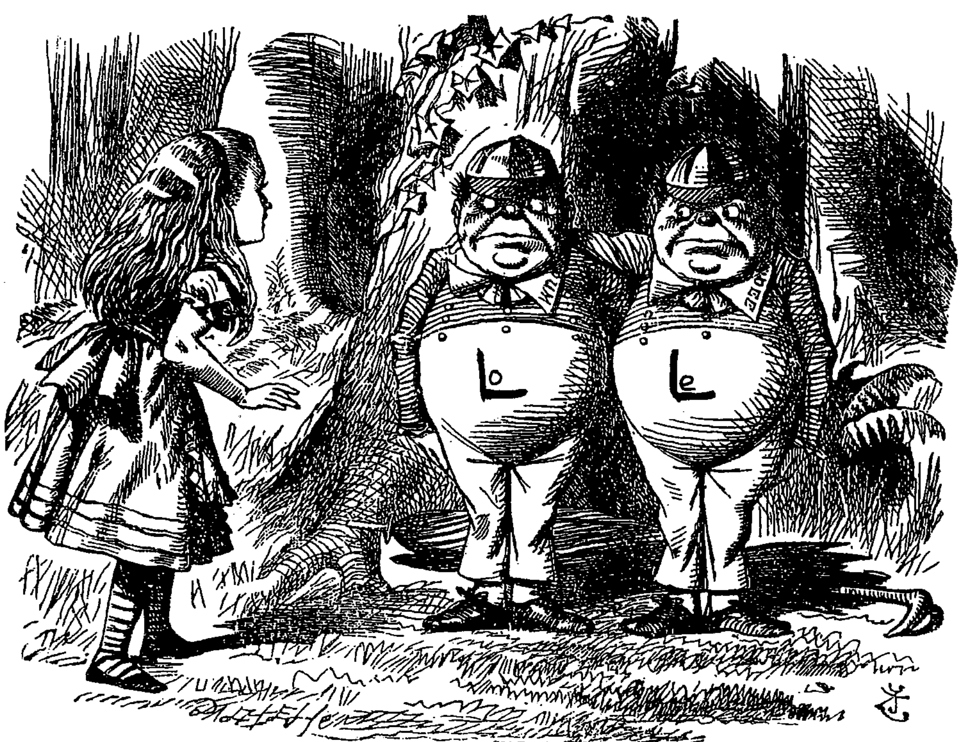


Figure 3. Magnetic susceptibility results of sections 1 (old brickyard) and 2 on the Titel plateau (figure 1). Both records are separated 5 km and show high similarity. The main difference between de sections is the thickness of sediments deposited during MIS 4 (between 10-17 m (section 1) and between 8.5 and 12 m (section 2)).



Progress in Physical Geography 30, 5 (2006) pp. 673–676

Classics in physical geography revisited

Liu Tungsheng 1988: *Loess in China* (second edition). Beijing: China Ocean Press, Berlin: Springer-Verlag, 224 pp.

Figure 1 Liu Tungsheng (on the right)

This is an important book, a true classic; it stands for many things, it represents and symbolizes the arrival of the Chinese loess on the world stage in geographical research, it demonstrates the role of loess/palaeosol sequences in illuminating the nature of a complex Quaternary period, but more than anything it places Liu Tungsheng into position as one of the very greatest of loess investigators. An attempt has been made to demarcate the 12 most significant loess scholars (Smalley *et al.*, 2001); read this book and see why Liu is secure among the chosen 12.

Before the book is discussed there is some bibliographic housework to be done. The book is an attractive production in the Springer series in Physical Environment, and bears on the cover the title *Loess in China*, the author's name 'Liu Tungsheng' and the information that it is the second edition. Only one of these pieces of information represents the absolute truth. The title is fine, but Liu is the editor rather than the author, and it is the first edition of that particular work. There was an earlier work called *Loess and the environment* published in English by China Ocean Press in 1985, but this deserves a separate bibliographical entry. It was the forerunner of *Loess in China* but it was a separate work; it was the basis for *Loess in China* but it was a separate book. Linking them together as first and second editions causes confusion (see, in particular, the Library of Congress listing in *Loess in China*). Liu was very careful in the Introduction to point out that many authors contributed. It may be rather prolix to list them all but major contributions were made by: Lu Yanchou, Zheng Honghan, Wu Zirong, Yuan Baoyin, Wen Qizong, An Zhisheng, Han Jiamao, Qiao Yulon, Huang Baolin, Shen Chengde, Zhou Mingfu, Zheng Shaohua, Gao Fuqing, Sun Fuqing, Chen Deniu, Gao Jiaxiang, Zhou Kunshu, Lin Shaomeng, Liu Ruiling,

 10.1177/0309133306071148

Zhu Yishi, Hu Biru, Wei Lanying, Gu Xiongfei, Diao Guiyi, Yu Suhua, Xiang Mingju Chen Mingyang, Geng Ansong, Lu Longhua, Yu Zhicheng, Zhang Shouxin and Li Huhou. A lot of people made major contributions to this study of loess in China; the inspirer and organizer was Liu Tungsheng.

In 1961 Liu went to Poland for the 6th Congress of the International Union for Quaternary Research (INQUA). This is one of the critical moments in the Liu story and will be explored at some length. Liu was in Poland at the invitation of Julius Fink of the University of Vienna. Fink was a major loess scholar and he wanted to organize, within the INQUA structure, a research group to look at loess stratigraphy in Europe. He was convinced that loess stratigraphy would reveal interesting aspects of the Quaternary (and he was of course absolutely right). He organized a loess symposium at 6th INQUA and a range of papers was presented. Liu presented some Chinese results (Liu and Chang, 1964) and as far as we know this was the first major demonstration, on an international stage, of the wonders of Chinese loess stratigraphy. One diagram in particular showed a 120 m thick section at Wucheng which contained 17 palaeosols – and hence demonstrated at least 17 significant climatic cycles in the Quaternary. Remember that back in 1961 most people thought of the Quaternary via the old Penck and Brückner Alpine model which indicated four major events (Günz, Mindel, Riss and Würm). Here was a sudden vision of a much more complex Quaternary. These early Chinese loess results, together with Central European observations by Fink and George Kukla and associates, and the complex studies of oxygen isotopes in deep sea cores, are credited with initiating the change of vision – towards a complex Quaternary. The Wucheng section diagram has been reproduced many times, in popular and historical works (eg, Smalley, 1997; Smalley and Rogers, 1995; 1996; Smalley *et al.*, 2001). The publication of the Liu and Chang (1964) paper in the Proceedings of 6th INQUA was a major breakthrough in loess stratigraphy. Loess now became a very special window on to the Quaternary. Prior to Liu, and Fink, and a few other pioneers, loess had been merely a sediment or a geomorphological 'draping' across the landscape; now it became a treasure house of Quaternary data – and the rush was on to develop new techniques for extracting this data. At the 1961 INQUA Congress, Fink took the first steps towards the formation of the INQUA Loess Commission, which delivered so many wonderful results over the following 40 years. One of his most inspired actions was to invite Liu to the Warsaw meeting and allow the world to see just how remarkable loess stratigraphy was to become.

Loess stratigraphy began in New Zealand. In the 1880s, John Hardcastle examined the beach sections at Timaru and he realized that loess could function as a 'climate register'. As far as we know, this was the first time that the explicit loess/climate link had been made. His paper (Hardcastle, 1890; see Smalley, 1983) was published in a New Zealand journal and had no impact on the world of science at large. The time was not right for loess stratigraphy. The next major step forward came from Wolfgang Soergel in Germany. His 1919 book was much better placed to have an impact and a continuing influence. It was becoming apparent in the twentieth century that loess offered a historical context, that a stratigraphical dimension was available, and this led to Julius Fink forming the INQUA Loess Commission to examine and exploit the loess in Europe. But, although the idea was growing, there was no truly dramatic example with which to demonstrate the richness of the climatic data held in the loess; until Fink invited Liu to participate in the Loess Symposium at the 6th INQUA Congress, and the Wucheng section was revealed with its amazing palaeosols. Loess became important, China was revealed as a Quaternary treasure house, Liu made an indelible mark. Fink's Loess Commission was off to a good start.

By a dreadful irony, just at about the time when these advances in loess stratigraphy in China should have been impressing the world of Quatemary science, the Cultural Revolution arrived and all appeared lost. A new dark age intruded and Liu was exiled to the north to work in agriculture. This unwelcome hiatus in Chinese loess studies allowed the Europeans to catch up somewhat in the region of detailed stratigraphy and Kukla, in particular, developed the idea of a complex stratigraphy and established relationships with the records from the deep sea cores. There was about a ten-year gap in Chinese loess activities and then contacts were tentatively renewed, in particular via visits of chosen scholars to see the geographical wonders of China. In November 1975 a group of five Australian Quaternary scientists visited China and were impressed by the loess. Jim Bowler of ANU was particularly impressed; he was to write of his vision of 'the Grand Canyon of Quaternary stratigraphy'. A similar group of geographers went from the UK and one of these, Edward Derbyshire, was similarly impressed by the loess – and, in fact, went on to become a world-renowned loess scholar. At 10th INQUA in Birmingham in 1977, Bowler established the Western Pacific Working Group (WPWG) of the Loess Commission, with a particular aim of forming scholarly links between the Chinese loess community and those of Australia and New Zealand. This led to three notable field excursions. Liu visited Australia in 1980 for the Bowler-led field trip around the parna country in the southeast. He led a Chinese party which consisted of An Zhisheng, Yuan Baoyin, Wu Zirong, Zheng Honghan and Wen Qizong – a notable subset of the authors listed above. This was a great step forward and Bowler communicated to Liu his great desire to have the Chinese loess results available in English, which helped to promote the publication *Loess and the environment* in 1985. This was nicely timed to coincide with the Chinese part of the WPWG programme.

The book *Loess in China* appeared in 1988. It contained the results of over 30 years of research by a large and dedicated team. If a starting point for their efforts is to be identified, it probably lies in the investigation of water and soil conservation along the Yellow River for the Sanmenxia Reservoir Project of 1953. Then in 1958 there was reconnaissance along ten major geological profiles on the Loess Plateau. In 1958–61 there were loess surveys outside the Plateau, in Shandong, Qinghai and Hebei provinces, and the compilation of the 'Map of loess distribution in China'. In the early 1960s, two monographs were published in Chinese; these were *The loess along the middle reaches of the Yellow River* (Liu, 1964) and *The loess deposits of China* (Liu, 1965). The Luochuan loess was investigated for the first time and then the monograph *The composition and texture of loess* (Liu, 1966) was published. These three books provided much of the material for *Loess and the environment* which in turn supplied virtually all of the text and illustrations for *Loess in China* – the book which finally revealed the wonders of the Chinese loess to the wider world.

Loess research was certainly one of the growth areas in Quaternary science in the second half of the twentieth century. Of course all aspects of Quaternary studies developed, in particular because of the growing interest in climate change and the growing realization that this had practical consequences. The realization that the thick loess deposits carried a detailed climatic record coincided nicely with a growing interest in climate and the availability of sophisticated tools of investigation. At the 13th INQUA Congress in Beijing in 1991, there were over 250 papers on loess. Most of these were by Chinese authors and most drew their inspiration from the work of Liu Tungsheng. At the INQUA Congress in Poland in 1961, there were 11 papers in Fink's loess symposium; in 30 years enormous progress had been made, again largely due to the pioneering studies of Liu Tungsheng – so nicely displayed in *Loess in China*.

The two great themes in the book are the loess itself, the great loess deposits of northern China, and the use of these deposits as storehouses of data on Quaternary climates and environments, but the book ranges over all the areas of interest to loess scholars. It has sections on the engineering problems of loess deposits, in particular hydroconsolidation and subsidence, on soil erosion and land loss (loess soils are the most erodible), and it discusses the sedimentological aspects of particle size distribution and particle formation. Sun Jimin, one of the relatively recent recruits to Liu's research group, has now shown that the silt material for the great deposits was formed in the mountains of High Asia and not, as was widely believed, in the northern deserts. Shifting monsoon patterns are revealed by the loess and its importance in climate change studies increases steadily. It is tempting to wonder if there is within the loess another great source of information. The twentieth-century leap was from sediment to temporal matrix – a wonderful leap with Liu at the centre of the action. Is there another unexpected leap to be made? What amazing new concept or leap of the imagination will be revealed next week/year? There is of course no trace of this speculation in the book. This is a work of proper elegant science carried out and meticulously reported by pragmatic investigators. The European loess romantics have their place in the developing study of loess but *Loess in China* is a twentieth-century statement which embodies all the virtues of perception and persistence and accuracy and truth.

On the famous WPWG field trip in Australia the party paused to admire a gigantic fig tree growing in the forecourt of the motel in Narrandera; this provides an image for what loess study has become – a mighty growth firmly rooted in silty soil. A tiny seed planted by Hardcastle, tended by Soergel and Fink, but brought to wonderful maturity by a group of Chinese scholars led by Liu Tungsheng.

Acknowledgement
Thanks to professor Edward Derbyshire for supplying the picture of Liu Tungsheng and for a critical reading of the text.

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Where is the loess? (and why?)

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Loess is widespread in New Zealand. Eden & Hammond (2003) reported that loess 1m or more thick covers at least 10% of New Zealand's land surface and soils with a loessial component cover approximately 60% of the country. Loess occurs mostly on late Pleistocene or older river terraces and marine benches. It is also present in soils developed on downlands and hills, especially downwind of river floodplains. Deposits vary greatly in thickness, with maximum of about 20m. The loess has been derived mainly from dust deflated from broad, braided, river floodplains, usually by prevailing westerly winds. The dust was largely produced by cold climate processes (e.g. freeze and thaw and perhaps glacial grinding) in mountain areas, and by river abrasion, comminution and fluvial sorting. If a category is required it might be described as 'mountain' loess.

Within this small but perfect summary of NZ loess we detect three factors that need to be discussed in a simple, but wide-ranging, study of worldwide loess distribution. How is the loess material formed (and do material forming processes have a role in the description and classification of loess?); how is the loess material moved across the landscape- what is the role of the different transportation processes?; and how and where is the material deposited? Make, move, place- and possibly some thoughts on post-depositional processes in so far as they effect the basic, recognised nature of a loess deposit, or a loess-derived soil, or loess ground, need to be considered. In general the silty, modal, material for loess is made by very energetic geo-processes and as a result loess is associated with places where there was large late-Tertiary and Quaternary geo-activity (as Chesworth(1982) so percipiently pointed out). Long distance transport of loess material is by rivers (e.g. from the Canadian border to the Mississippi delta; from the Alps to the Black Sea) – which is followed by a short aeolian move, which introduces most of the characteristic properties into the deposit. And the deposition is where formation and transportation factors allow it to be. There is a lack of information on the actual mechanics of deposition; Cegla (1972) did some sterling pioneering studies, but this is the neglected loess factor. Rates of deposition are now being studied (see Eden & Hammond (2003), Derbyshire (2003)) and this will stimulate interest in the deposition process.

China was no.4 in the Smalley Vita-Finzi (1968) list of important loess deposits but in terms of significance and size and chronological potential and history of investigation it has to be the first, the 'primus inter pares'- the deposit against which others are measured. The material for the Chinese deposits comes from High Asia, that region where crustal overlap has produced the highest land and a continuing high level of geo-tectonic activity. High Asia is the classic zone of high geo-energy and this has the effect of producing vast amounts of silt material (see Assallay et al 1998). Silt moved to the east contributes to the massive and widespread deposits of north China. Silt moved to the south provides the rich alluvial soils of northern India; material moving west supplies the loess deposits of Central Asia. One can still read accounts of the Chinese loess material coming from the 'northern deserts' and this is a sort of half-truth. Much material goes into deserts and then progresses to become loess, but the origin of the material lies in the high, cold, active regions of High Asia. This could also be called mountain loess. The Yellow River moves material, and moves it again to form the North China Plain. The make, move, place sequence is fairly clear for China.

The Central Asian loess was no.3 on the Smalley Vita-Finzi list (NZ loess was no.7). The mountains are the Tien Shan and the rivers are the Syr'Darya and Amu'Darya. It is mountain loess again, but there is still a surprising amount of

discussion and controversy centred on these deposits. A long and complicated story could be told, starting perhaps with Pavlov and his 'proluvial' and 'deluvial' loess ideas, but the local workers are still much influenced by Mavlyanov's 'complex' theory (see Jefferson et al 2005).

The European loess is complex. We consider the conjecture by Smalley & Leach (1978) that European loess can be divided into two types: loess in the Northern band, and loess in the Danube basin. The Northern band loess was identified as glacial loess, ice-sheet loess, and particle making was ascribed to the actions of the Quaternary cold-phase glaciers which made up the great North European continental ice sheet. Smalley & Leach stated, very confidently, that the Polish loess was glacial loess; but now that we know a little more about mountain loess, and look at the courses of the Odra and Wisla rivers, this certainty looks a bit misplaced. However it seems likely that the loess in Britain is glacial loess (see Jefferson et al 2003a), and so is the loess in the northern parts of France. But the more interesting loess in Europe is the southerly loess, the Danube basin loess, the loess in Hungary, Romania, Bulgaria etc. This is mountain loess; a major source of loess material is the Alps, particularly the Alps in cold-phase time, and the material was transported to the east by the Danube river. This was a process identified and pointed out by Smalley & Leach, but while they identified the Alps as major particle suppliers they were surprisingly reticent about conferring major particle making status on other European mountains. In fact the Carpathians have a large contribution to make and even the Sudeten mountains and the Dinaric Alps contribute material. Hungary is a remarkably loess-rich country and it gets its loess from two main sources. Not just the Alpine loess delivered by the Danube but Carpathian loess delivered by the river Tisza. Two great loess streams flowed into Hungary (which is why Marton Pecsi was president of the INQUA Loess Commission for three inter-congress periods). If loess material was delivered to the south of the Carpathians to augment the Hungarian loess it is logical to assume that material travelled north. This is the material which might contribute to loess near Lublin and Krakow. And possibly near Wroclaw as well- this is the south-western loess and it is of great interest because of its position, about midway between the Sudeten mountains to the

all about it here and there. "Oh, how glad I am to get here! And what *is* this on my head?" she exclaimed in a tone of dismay, as she put her hands up to something very heavy, that fitted tight round her head.

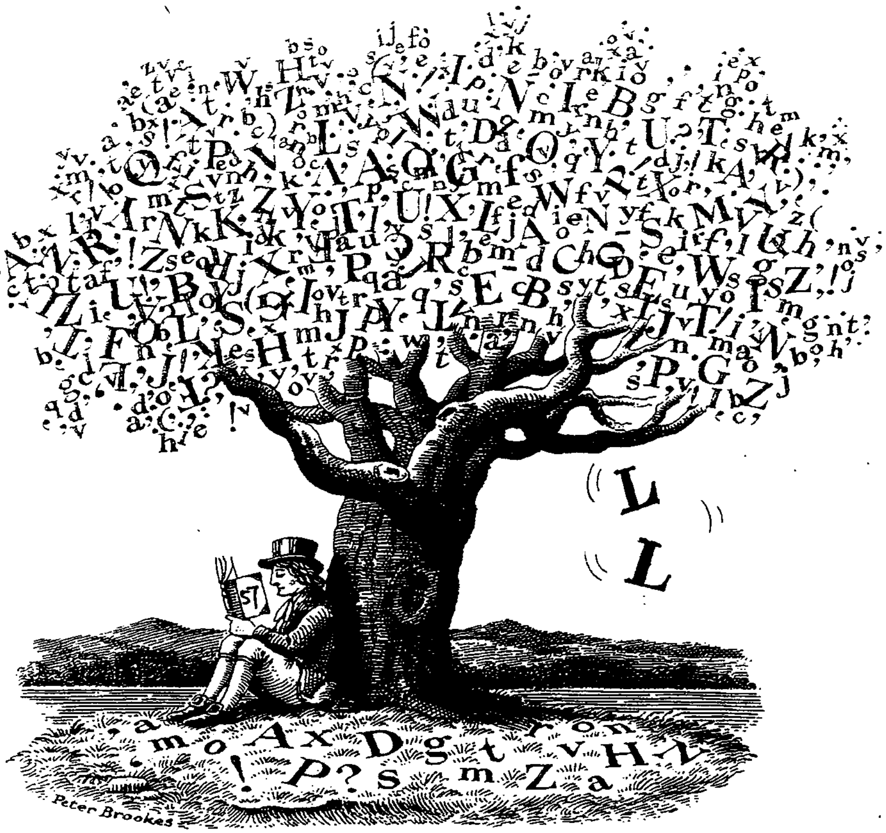
"But how *can* it have got there without my knowing it?" she said to herself, as she lifted it off, and set it on her lap to make out what it could possibly be.

It was a golden crown.

south, and the limits of the most recent glacial advance to the north. So is it glacial loess or mountain loess? it would be useful if an unambiguous test existed which could settle this question.

Loess in Russia; loess written about in the Russian language, loess in the Soviet Union, loess in countries that were part of the Soviet Union (in particular Ukraine and Uzbekistan)- some precision and terminological care is required here. Russian loess is loess like everywhere else but for around 50 years it was separate because of political barriers which were imposed on the scholars and students of the world, and recent history has not helped with sudden, huge boundary changes. We have to grow used to writing about loess in Uzbekistan, in Ukraine, in Russia- but in the literature from the relatively recent past we still have Soviet loess. As far as we can see nobody attempted to do a broad classification of Soviet loess and certainly no-one indicated source regions for particles and possible transportation paths. The first tentative attempts at a very simple outline were by Jefferson et al (2003b) and they proposed dividing Soviet loess into seven regions. This was attempted largely on the basis of the Abelev & Abelev (1968) map and it has to be seen as a very simplistic view of a complex and vast loess region. When communications with the Russian speaking world have improved further no doubt substantial improvements can be made. Seven proposed regions:

West- the western regions. By far the largest and most important region, which is essentially Ukraine-centred. The large river is the Dnepr which brings material from the glaciated north.
The Caucasus. A small region; local loess deposits made of material derived from the Caucasus mountains.
Middle Asia & southern Kazakhstan. This is the Central Asian loess- discussed above.
Western Siberia: Orsk-Omsk. This is a difficult region, as was acknowledged by Jefferson et al (2003b). In fact the whole concept of Siberia is difficult. It is hard to find an authoritative map which defines the borders of Siberia; Siberia appears to be more a concept- rather than a cartographic reality. It would be convenient to be able to write about 'The Loess of Siberia' but the boundaries



are fuzzy. However, the task should be attempted because the Siberian loess will be of great interest in the future; large deposits will become more accessible to scholarly scrutiny. The western part of the Orsk-Omsk region is associated with the Ural river which flows from the Ural Mountains to the Caspian Sea. Abelev & Abelev show deposits all down the Ural river from Orsk. The east of this region stretches towards Omsk and the Irtysh river. Abelev & Abelev show an extensive deposit all along the Irtysh south of Omsk- a striking illustration of a loess deposit associated with a river. The Irtysh delivers material directly from High Asia to the eastern part of the zone. This is mountain loess again.

Tomsk-Barnaul; in this region we have river channels flowing to consolidate into the River Ob, with deposits stretching south from Tomsk. Loess material from the south; rivers flowing north.

Kansk-Krasnoyarsk. In this region Abelev & Abelev showed an interesting loess region associated with the Yenisei river. The town of Kansk serves as a locator. Yenisiesk represents the northen limit. Loess material from the mountains to the south; again mostly carried by large north flowing rivers.

Irkutsk- the most easterly of the deposits; the deposits near Irkutsk lie along the Angara river. The geographical position of these deposits suggest a particle origin in the mountains to the south, with major transportation by the Angara river. Lake Baikal possibly has an important role to play; there are 300 streams feeding into Baikal, but only one outlet- the Angara river. Baikal may be an intermediate source for loess material.

The package of Soviet loess was dominated by great rivers: the Dnepr, Amu-Dar'ya, Syr-Dar'ya, Ural, Irtysh, Ob, Yenesei, Angara. The Dnepr, the river of Ukraine, supplied the large western deposits with glacial material; the rest of the Soviet loess was mountain loess, largely carried north out of High Asia, or to the west towards the Aral Sea. In the barest outline we can now see feasible make and move patterns, but it must be emphasized again that this is the sketchiest of outlines; much study and discussion is required in this region.

In North America the Rockies provide mountain loess and the continental glaciers of the northern ice sheet provide glacial loess. The loess system is

basically defined by the two great rivers- the Mississippi and Missouri which move loess material from north to south and provide interesting deposits en route. The state of Iowa is completely defined by the rivers (forming the eastern and western boundaries) and receives loess material from each one. The cold-phase glaciers made a lot of Canada available for distribution throughout the rest of North America and as they waned the cold Rocky Mountains took over as chief source and added the final layers to the continental stratigraphy.

The loess in Idaho, in Washington state and in Alaska can be described in terms of make and move, there are source regions available. The lack of loess in Canada may require more detailed consideration. There is virtually no loess in Canada; Sweeney & Smalley (1986) attempted an outline survey of the whole country, but little loess is available for description and investigation. It appears that the large continental glaciers, believed to be major suppliers of loess material, simply delivered this material into the marginal zones, whence it was transported south by the great rivers. There must be more loess in Rocky Mountain Canada than has been appreciated- a careful search would probably reveal interesting deposits. There is certainly some near Kamloops- there must be more.

Smalley & Vita-Finzi (1968) listed seven worldwide loess deposits. No ranking was implied, they were simply pointing to the visible deposits, those that had a viable literature attached. They were 1- Europe (which included western Russia, and Ukraine); 2 – Israel and the Middle East; 3- Central Asia; 4- China; 5- North America; 6- South America; and 7- New Zealand. Israel would not rank on any list of major loess deposits but the 1968 paper was on 'desert loess' (the paper that launched the great discussion) and a significant amount of the literature on desert loess emanated from Israel. Although the Israel deposit is small it has, like the equally tiny UK deposit, generated quite a substantial literature. Its not just dust on the ground that counts; its also people on the ground. A certain scholarly density is required to launch any deposit into view, and this problem has certainly affected the South American deposits. There are large and significant loess deposits in South America but it only now that they are beginning to make an entry into the world literature.

Zarate (2003) has written an elegant review; he identified Teruggi (1957) as a significant paper, in many ways the start of South American loess studies. Iriondo & Krohling (2004), working in this volcanic world, want to introduce new aspects into the make process- they wish to add volcanic silt particles.. Which has a certain resonance to the well known 'tephric' loess in NZ.

The minor deposits. That's not a good term; just because a deposit is small in area does not necessarily make it minor. Significant loessic data may emerge from small deposits. Or it may be appreciated that large deposits which were thought not to fit the loess criteria might actually be controlled by the factors which we now recognise as major loess factors. This obviously applies to the Australian material; there is wind blown silt in Australia, and arguments are being advanced that it should be included in ground category 'loess'. We quote Hesse & McTainsh (2003):

"Australian soil scientists have, in the past, tended to isolate themselves from the international loess community, by emphasizing the differences, rather than the similarities, between their loess soils and overseas examples... As a result, Australian soil scientists have not played a significant role in international loess debates, such as the desert loess debate... As the recognised Australian dust mantles have field characteristics in common with loess, particularly their massive earthy fabric, there is no good reason, in our view, to exclude these deposits from the broad usage of the term loess." (Hesse & McTainsh 2003, p.2026).

The desert loess debate is largely played out in Africa; around that greatest of deserts- the Sahara. If deserts generate loess material then the Sahara will be surrounded by great loess deposits- but it manifestly is not. Albrecht Penck, many many years ago, was pointing out that the Sahara lacked a loess girdle, but there are minor deposits on the perimeter which deserve study and explanation. Problems of terminology and usage arise here, and some peripheral discussion is required. We define 'large dust' and 'small dust'; large dust is airborne material in the coarse and very coarse silt size ranges, usually around 20-60um; small dust is airborne material in the fine and very fine silt ranges, say around 2-6 um. There appears to be a distinct bi-modality

in the world of airborne dust. The large dust travels in low suspension, for relatively short distances- say 50-100 km, and forms the basis of loess deposits. The geo-energy deployed at the make phase goes into producing these large dust particles. The small dust goes into high suspension and can travel for thousands of kilometres. Australian small dust falls on NZ; African small dust falls on the UK. At the centre of the desert loess problem is the lack of any specifically desert process which makes large dust size particles. We see vast amounts of dust rising from the Sahara desert, in particular from the region of old Lake Chad- but this is largely small dust, mostly on its way towards the west, out over the Atlantic Ocean. This is the small dust which fell on Charles Darwin as the Beagle sailed past on the Royal Navy's most significant voyage. This is the small dust which falls on the Canary Islands and forms the Canary Islands' loess'- which, on examination, turns out to have a mode size of 5 um.

The particles lifted from Africa have certain similarities with particles lifted from the inland basins in Australia (a comparison made by McTainsh 1989). A size control operates in lake sediments which tends to restrict derived particle size to the small dust range. A Monte Carlo simulation (Evans et al 2004) shows how packing factors restrict particle size. It was widely believed that Saharan dust somehow contributed to loess deposits- but it is not, by and large, the sort of dust which forms traditional loess deposits.

However, if the loess world is to be carefully expanded, as Hesse & McTainsh (2003) propose, it is these lake-derived sediments which will have to be considered. If large dust particles are derived from old lake basins and blown into position to form a distinctive deposit it seems reasonable that this deposit might be known as loess. Should this terminological allowance be extended to small dust deposits?- this may not be a large problem; by the very nature of its transportation mode (in high suspension over long distances) the small dust tends to be widely dispersed. It occurs as an admixture in many soils, often far down wind of source, but it tends not to form a distinctive separate deposit. The Canary Islands loess could be an exception, one of a very small number of small dust deposits.

The silt-sized clay-agglomerate particle, usually derived from an old lake bed could come to rank alongside coarse quartz silt as a significant loess material component. This would open up Africa and Australia to students of loess and may provide some relatively exotic connections. Jefferson et al (2002) have proposed that deposits in the Triassic of the English Midlands are very similar to aeolian deposits in Quaternary Australia, so possibly Leicester and Nottingham are underlain by ancient desert loess deposits.

The world of loess deposits will expand; there is loess in the Burren region of Ireland which has never been specifically investigated; there is loess in Saudi Arabia which is currently the topic of a major investigation; there is probably enough loess in Siberia to keep a whole generation of scholars fully occupied. Remember how recently it was that we realised that the North Island has significant and important loess deposits...

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An INQUA Newsletter for Students of Loess Material, Loess Deposits, Loess Ground, Loess Soils & Loess as a 'Climate Register'. Founded in 1979 at the New Zealand Soil Bureau.