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

'erändertes Lebensraum - gestern, heute und morgen".
Loess Letter LL60 October 2008

LL60. This is the DEQUA issue; a special issue to celebrate the meeting in Vienna in 2008 of the Deutsche Quartarvereinigung. Within this meeting is a gathering of the INQUA Sub-Commission on Loess Stratigraphy to consider 'Danubian Loess'. For details of the Danubian Loess discussions and the Loess Stratigraphy Sub-Commission contact Ludwig.Zoeller@uni-bayreuth.de. For DEQUA details go to www.dequa.de; for meeting details go to www.baunat.boku.ac.at/10215.html. The meeting theme is 'Veränderter Lebensraum - gestern, heute und morgen' which we translate as 'The changing environment - yesterday, today and tomorrow'.

Julius Fink 1918-1981. We celebrate several aspects of Fink's life. Thirty years ago he organised the DEQUA meeting in Vienna; and here we are again - an anniversary to note. In 1961 Fink set in train the events which led to the formation of the INQUA Loess Commission - an amazingly successful Commission which supported and encouraged loess research and study for over forty years. The publication of the INQUA Loess Map of Europe in 2007 means that the last great Loess Commission project has been completed. For map details see LL59, or contact Dagmar.Haase@ufz.de.

Loess Letter. LL is an INQUA newsletter for students of loess and airborne dust. It is published twice a year, usually in April and October, by the Giotto Loess Research Group of the Waverley Materials Project at Nottingham Trent University.
(editor: ian.smalley@ntu.ac.uk). There is a parallel web existence at www.loessletter.com and www.loess-lexicon.net. LL has links to the INQUA Sub-Commission on Loess Stratigraphy and the European Centre for Loess Research at the University of Novi Sad in Serbia. LL was launched in 1979 at the New Zealand Soil Bureau; we look forward to 2009 and modest celebrations of 30 years of continuous publication.

**Biobibliography.** The Loess Commission Biobibliographical Project has been slowly generating material for many years, and producing a series of low-key publications. The basic idea is to look at the study of loess via the practitioners; it's maybe a *non sequitur*? but loess research is done by the scholars and researchers. We see key events and progressions by way of the investigators involved. Progress is marked by the publication of 'Loess-Lithology and Genesis' in the Benchmark series in 1975, 'Loess-A Partial Bibliography' in 1980, and loess history papers as part of the LoessFest 1999 presentations. In LL60 we offer a brief study of 12 more loess scholars, and set the scene for more studies. One day we identify 100 key contributors.

**Keilhack 1858-1944.** 150 years since the birth of Friedrich Ludwig Heinrich Konrad Keilhack, another anniversary. FLHKK was the first person to produce a map of world-wide loess distribution- which was reproduced in LL59, and in Benchmark 26. (see the blog section in LLO).

**Liu Tung-sheng.** LL60 is a tribute issue for Liu Tung-sheng, who died 6 March 2008. We reproduce the piece from Progress in Physical Geography which presented his 1988 book on 'Loess in China' as a geographical classic. We also offer the title 'Loess Letter' written by Liu Tung-sheng during his visit to the New Zealand Soil Bureau in 1980. A memorial piece of calligraphy from a great loess scholar.

**Charles Darwin, 61 & 62.** 2009 will be the 150th anniversary of the publication of 'Origin of Species' and LLs 61 and 62 will commemorate this great moment. In the meantime- a quotation: "We have evidence in the loess of the Rhine of considerable changes of level in the land within a very recent geological period, and when the surface was peopled by existing land and fresh-water snails." Actually we think this is the only mention of loess in the great book.

**Danubian Loess.** LL contributes to the Danubian Loess discussions by reproducing some parts of a very important paper by B.Buggle et al. This is a significant paper because it shows some intrinsic differences between loesses in Serbia, in Romania and in Ukraine. There are some interesting source implications, certainly for the Serbian and Ukrainian loesses. LL welcomes the idea of studying the whole
Danube basin as a loess region. 2008 is the 30th anniversary of the publication of the pioneering paper by Smalley & Leach in which they reviewed sources and distributions of loess in the Danube basin. The Buggle paper represents a significant advance.

Covers. The front cover features the Giotto robot doing his party trick and producing a complete circle; the back cover features the ‘Venus of Willendorf’ – who was discovered in a loess deposit beside the Danube 100 years ago. The inside covers are due to Walt Whitman and Saul Steinberg who carry the right alliterative baggage to feature in LL.

L for Leicester. Another anniversary: 50 years of the University of Leicester. LL acknowledges significant input from the University of Leicester - LL was produced at Leicester from 1986 to 1995, with some help from the Royal Society. In 1995 LL moved to Nottingham Trent University and has been very comfortable there since then. In LL59 we honoured the 550th anniversary of the Albert-Ludwigs-Universitat in Freiburg; Leicester, in comparison, is a new arrival, but it grows in experience and maturity.

Name of Russia. The quest is underway to find the ‘Name of Russia’, one Russian from history who should go down as a national symbol and the nation’s biggest hero. The shortlist will certainly include Peter the Great and Alexander Pushkin; as an international journal LL feels qualified to make a proposal. We propose (of course) Vladimir Afanas’evich Obruchev as Name of Russia. If you would like to see a brilliant sketch of Obruchev go to www.loessletter.com where he presides over the pages.

Andrei Dodonov. LL has learnt of the death of Andrei Dodonov of the Russian Academy of Sciences - we send our sympathies and condolences to family and friends. Dodonov was a major loess scholar and will be sorely missed by the loess community. He was largely responsible for the INQUA Loess & Carbon meeting in Moscow in 2003, which produced a memorable edition of Quaternary International. Some pictures from the 2003 meeting are still available on the Web; go to www.quarter.ginras.ru/loess2003, click photos and see Dodonov in his proper environment. LL bids adieu to a stalwart colleague.

INQUA. The Internationale Quartarvereinigung INQUA became the International Union for Quaternary Research INQUA, which continues to support and encourage research into all aspects of the Quaternary sub-period, around about the last 2.6 million years; see www.inqua.tcd.ie. INQUA is a full member of ICSU the International Council for Science. The work is carried forward via five commissions; loess research has relevance to the Stratigraphy & Chronology Commission, and the Terrestrial Processes Commission, and perhaps to the Palaeoclimate Commission - more information on the INQUA website. Next INQUA Congress Bern 2011.
Classics in physical geography revisited


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 Hongan, Wu Zrong, Yuan Baoyin, Wen Qizong, An Zhesheng, Han Jiamao, Qiao Yulon, Huang Baolin, Shen Chengde, Zhou Mingfu, Zheng Shachua, Gao Fuqing, Sun Fuqing, Chen Denliu, Gao Jiaxiang, Zhou Kunshu, Lin Shaomeng, Liu Ruiling.

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/paleosol sequences in illuminating the nature of a complex Quaternary period, but more than anything it places Liu Tungsheng into position as

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breakthrough in loess stratigraphy. Loess now came to have 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 1980s, John Hardcastle examined the beach sections at Timaru and he realized that loess could function as a 'climatic register'. As far as we know, this was the first time that the explicit loess/climate link had been made. His paper (Hardcastle, 1990), 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 Quaternary 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 Kilduff, in particular, developed the idea of a complex stratigraphy of 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 the 9th 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 Baojin, 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 (Liu, 1966), 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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1. Introduction

“Loess is not just the accumulation of dust” (Pécsi, 1990). This phrasal originally referred to the diagenetic processes involved in the transformation of dust into loess. Beyond this, we like to reformulate it to “Loess is not just accumulated dust” emphasizing the multiple importance of loess for geosciences. First and foremost to mention is the relevance of loess deposits with intercalated paleosols, so-called loess-paleosol sequences, as potential climate archives (e.g. Kukla, 1977; Catt, 1991; Derbyshire et al., 1997). Furthermore, distribution and origin of loess can give important information about paleowind direction (Pye, 1995; Muhs and Budahn, 2006). Even paleowind strength can be reconstructed by grain size distribution (Xiao et al., 1995). Loess is also considered as an average sample of wide areas of the earth’s surface and thus may be suitable for reconstructing the element composition of the upper continental crust (Taylor and McLennan, 1985). However, the origin of loess is seen as important for understanding the mechanisms connected with the forenamed multiple archive functions of this sediment in a region (Pye, 1995). During the last 15 years, geochemically
based provenance studies gained increasing attendance (e.g. Muhs et al., 1990; Schnetger, 1992; Jahn et al., 2001; Muhs and Benedict, 2006). Element fingerprints proved to be a powerful tool in evaluating the contributions of different dust source areas, even in a (semi)-quantitative way (Muhs and Budahn, 2006). Meanwhile, many loess regions of the world are geochemically well characterized (e.g. Taylor et al., 1983; Schnetger, 1992; Gallet et al., 1996, 1998; Muhs et al., 2001; Smykatz-Kloss, 2003; Muhs and Budahn, 2006). However, this is not the case for the Vojvodina loess in the southern Pannonian Basin, the Romanian loess in the lower Danube Basin and at the Dobrudja loess plateau and the loess of the Dnieper area, though loess deposits of these areas represent extensive, several decameters thick and far back reaching sediments of the Quaternary in Europe (Bronger, 1976, 2003; Marković et al., 2003, 2006, 2007, 2008; Buggle et al., submitted for publication; Fuchs et al., in press). Even the most profound study on the origin of these loesses, given by Smalley and Leach (1978), is based mainly on a review of the geomorphodynamic system of the region. We therefore see the need for a basic geochemical characterization of these European loesses with respect to provenance. Therefore, the objectives of this study are

(1) To establish a geochemical discrimination and characterization of loess deposits in the southern Pannonian Basin (Vojvodina, Serbia), in the lower Danube Basin/Dobrudja (Romania) and in the Dnieper area. Possible source areas will be evaluated using a promising combination of a geochemical and geomorphodynamic approach. Since the loesses of the Vojvodina and the lower Danube Basin/Dobrudja should originate predominantly from Danube alluvium (Smalley and Leach, 1978), we expect these two areas to have a similar geochemical composition. Due to the proximity of the glaciofluvial deposits of the Fennoscandian ice sheet, representing a likely dust source, the loess of the Dnieper area should show a distinctly different element fingerprint. These hypotheses will be tested.

(2) To check whether Taylor and McLennan’s (1985) proposal that loess deposits should provide information about the average element composition of the upper continental crust, is also valid for the Danube and Dnieper loess areas.

Fig. 1. Location of the studied loess—paleosol sequences in a schematic map.

5.1.2. Batajnica/Stari Slankamen section
5.1.2.1. The Danube alluvium—the major source for Danube basin loess. For the Danube Basin, Smalley and Leach (1978) considered the Danube alluvium as the important source of loess. This is also supported by the paleowind direction reconstructed by Rozyczki (1967) and Marković et al. (2008). According to their results based on orientation of gredas and loess isopach mapping, respectively, northwesterly and northerly winds prevailed in the Pannonian Basin during the periods of loess formation, except for the region southeast of the present day Danube–Tisza confluence, for which Marković et al. (2008) reported southeasterlies. Silty material potentially could have been uptaken by these winds, and after a certain
distance of transport deposited to form thick loess plateaus, as they can be found in the Vojvodina region (Smalley and Leach, 1978). Lacking any other possible major dust sources in the area, we follow this idea. The strong similarities between the element composition of the Serbian and Romanian section are an additional confirmation. Whereas the loess of the Dnieper area is characterized by higher Zr, Hf and Si content and mineral sorting, probably due to glaciofluvial reworking of the source material, the near Danube loess show higher contents of Al, Fe, Ti, Rb and associated elements, as revealed by discriminant analysis and the UCC-normalized element fingerprint. In other loess deposits, aluminum content is generally found to be enriched with decreasing grain size, especially in the clay fraction. The same holds true for Fe, Ti and Rb (Chapman and Horn, 1968; Reeder et al., 2006; Yang et al., 2006). Thus, discriminant function 1 can also be interpreted as negative grain size function. Additionally, the Fe/Ti and Al/Ti ratios point to a higher clay content (Muhs and Bettis, 2000; Muhs et al., 2001) of the near Danube loess compared to the Dnieper loess. This fits to the supposed alluvial origin (Stoïlov, 1984, cited in Jordanova and Petersen, 1999). However, grain size analyses would be required to confirm our conclusion. Nevertheless, with the Danube alluvium representing the source of the loess material, the exceptional thickness of the Vojvodina loess deposits can be explained. In the Vojvodina region, the Danube river turned from South to East, during the considered time period of loess formation, as it is today (Gábris and Nádor, 2007; Ruszkiczy-Rüdiger, 2007). Exactly here is the transition zone between the northerly and southeasterly winds in the southern Pannonian Basin, where material of the Danube alluvium potentially could be blown together from two directions.

5.1.2.2. Sources of alluvial silt. In their profound work, Smalley and Leach (1978) evaluated the relative contribution of different source areas of alluvial silt by considering the settings and processes of the geomorphodynamic system of the Danube Basin.

Our geochemical approach to identify the areas of the Danube catchment that are most important for the Pleistocene delivery of silt sized alluvial sediments was partially successful. The comparison of the Serbian loess with floodplain sediments could not reveal a dominating source area. The major element composition (Figs. 4 and 5) of the Drava floodplain sediments, originating in the metamorphic, crystalline Eastern Alps (“F-Drava”), showed no clear differences to alluvial material of the Bohemian Massif (“F-BM”), the Western Carpathians (“F-WC”) and to the Vojvodina loess. With respect to geochemistry, none of these source areas could be ruled out as major supplier of sediments into the southern Pannonian Basin. However, Danube tributaries, draining predominantly the Eastern Alpine cover nappes area and glaciated alpine foreland
revealed relatively high Fe/Ti ratios in the floodplain sediments compared to the Serbian loess. True iron enrichment should increase both, the Fe/Ti and the Fe/Al ratio (Smykatz-Kloss, 2003), whereas increasing clay content should rise the Fe/Ti as well as the Al/ Ti ratio (Muhs and Bettis, 2000; Muhs et al., 2001). Since none of both can be observed, a combination of the two effects probably causes the Fe/Ti offset of the "F-AA" floodplain samples. Note that the Fe/Al ratio of loess and floodplain sediments is mostly in the range of the UCC. Thus, we suppose that reductive element removal during fluvial transport did not alter noteworthy the element ratios. To conclude, elevated Fe/Ti ratios indicate only a minor contribution of material from the Austroalpine cover nappes and deposits of the northern alpine foreland glaciation (not including the Inn area) to the Vojvodina loess.

6. Conclusions

(1) As already proved for several other loess regions such as the Chinese loess plateau (Gallet et al., 1996, 1998), Western Europe (Gallet et al., 1998) and the Midwest of the USA (Taylor et al., 1983), loess of the Danube Basin/Dobrudja and the Dnieper areas represent a representative sample of the upper continental crust.

(2) Compared to the upper continental crustal composition, loess shows general evidence of at least one previous recycling phase, which probably is an inherited signal from sedimentary source rocks. This is particularly obvious from the depletion of some elements, reflecting weathering resistance of their host minerals and element mobility. Further bias of initial average UCC composition is due to mineral dilution effects especially by quartz and—if not corrected for—by secondary carbonates, as well as mineral and grain size sorting.

(3) Loess of the Stary Kaydaky site (Dnieper loess area) is most likely derived from glaciofluvial sediments of the Fennoscandinavian ice sheet in the Ukraine and adjacent areas. Initial source rocks are proposed to be sedimentites of the Russian platform. Prevailing cold stage paleowind direction in the Ukraine was WNW (see Fig. 8) to N due to katabatic winds descending from the ice sheet.

(4) In the southern Pannonian Basin (Vojvodina, Serbia), where the course of the Danube river turns from South to East, thick loess plateaus build up by dust supply from two wind systems: N/NW winds, as they prevail in the main part of the Pannonian Basin and SE winds in the Southeastern part of the basin. This loess is confirmed by our geochemical results to originate from alluvial sediments of the Danube river. Due to the element composition, the area of the northern Alpine cover nappes and foreland glaciations (not including the Inn area), does not seem to be the dominant initial source. Weathering products of the Carpathian mountain range, drained by the Tisza River and several smaller Danube tributaries, and of the Austroalpine base nappes, drained by the Drava River, appear to be more likely source areas with respect to element composition. Though not evaluated geochemically, the Inn River is also considered as significant sediment supplier into the Pannonian Basin (Smalley and Leach, 1978).

(5) As in Serbia, the loess of the Dobrudja plateau (Romania) is predominantly derived from Danube alluvium. However, a minor but geochemically significant contribution of one or several additional source areas is evident. The prevailing paleowind direction was WNW in the Western Walachian plain and N to NE in the Dobrudja and eastern Walachian plain. Thus, the additional material input is supposed to be derived from the Ukrainian glaciofluvial deposits, probably with strongly variable contributions from local sand dune fields.

(6) Further research is needed for a better differentiation between the possible source areas of the Southeastern/Eastern European loesses. Isotope studies (87Sr/86Sr, 143Nd/144Nd, 187Os/188Os, 187Re/188Os, $\delta^{18}O$ of quartz) and element composition of different grain size fractions may be promising with this respect (Mizota and Matsuhisa, 1995; Hattori et al., 2003; Nakano et al., 2004; Honda et al., 2004).
Studies in the history of loess investigation: Twelve more loess people
In memory of Julius Fink 1918-1981

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Abstract
The first twelve people listed in the INQUA Loess Commission biobibliographical project were Leonhard, Lyell, Richthofen, Hardcastle, Tutkovskii, Obручев, Berg, Grahmann, Russell, Fink, Liu, and Kukla. Their achievements provided the basis for a study of the development of the science of loess investigation. The next twelve, considered here are: Butler, Frye, Haast, Kriger, Krokos, Lee, Lozek, Mavlyanov, Minkov, Pecsi, Soergel, and Tokarski. By chance, they represent 12 different countries. They provide additional detail for the study of the history of loess investigation. An additional 12 proposed are: Rozycki, Vekhich, Bondarchuk, Zeuner, Pavlov, Denisov, Pewe, Brunacker, Virlet d’Aoust, Keilhack, Cegla and Shimok. Comments and nominations are invited, the first, long-term biobibliographical project will consider 60 loess investigators, but with the longer term aim of eventually reaching 100. The fundamental purpose of the biobibliographical project is to record the development of loess science via a study of the participants, and their special contributions.

Keywords: Loess, loess investigations, biographies, biobibliographical studies, history of the study of loess.

Introduction
A way into the intricacies of the history of loess research and scholarship may be via a study of the key people involved: a history of loess investigators. This approach was initiated at the great 1999 LoessFest, held at Heidelberg and Bonn, to celebrate the naming and discovery of ‘loess’ by Karl Caesar von Leonhard early in the nineteenth century (Smalley et al 2001). This built on the assemblage of material for the ‘Loess Benchmark’ collection some years earlier (Smalley 1975) and the attempts at universal bibliography (Smalley 1980).

The initial study was supposed to identify the 12 key contributors to loess science and a notable set of investigators was, in fact, listed, but it was obviously a subjective and possibly biased choice. A way past subjectivity is to continue the process, and select additional significant people; and if enough people are chosen all(most) significant formative research will be included.

The first 12 people listed were: Leonhard (who named the loess), Lyell (who popularised the concept), Richthofen (who promoted the idea of aeolian deposition), Hardcastle (who suggested the climatic link and invented loess stratigraphy), Tutkovskii (who explored the link between loess and glaciation), Obручев (inventor of the concept of desert loess, and supporter of aeolian processes), Berg (promoter of in-situ/ pedological versions of loess formation), Grahmann (mapper of the European loess), Russell (applier of in-situ ideas to the USA loess), Fink (founder of the INQUA Loess Commission and promoter of co-operative research, and champion of Danubian loess), Liu Tung-sheng (founder of modern loess stratigraphy, and doyen of Chinese loess studies) and Kukla (stratigrapher/ climatologist, linker of loess and ocean records).
The 12 listed here, in this current discussion, are the 'more' loess people; then will come 'additional' loess people, and possibly 'further' loess people; and maybe 'last' people; 60 will provide a good basis for a biobibliographical study of loess, and begin to eradicate any subjective factors in the collection.

More loess people
The following listing is in alphabetical order. The choice is between alphabetical and chronological. The original list (Smalley et al 2001) was chronological because the emphasis was very much on the history of loess and a sequence of developments and the time span was large (>150 years). In the current list there is considerable chronological overlap so it seemed more sensible to attempt an alphabetical presentation. In this list of twelve loess investigators twelve countries are represented: this was largely accidental and displays the worldwide interest in loess and the universality of loess investigation.

B.E. Butler (Australia)
Butler was a pedologist who worked for CSIRO. His claim to loessic fame is in his naming of the 'parna' deposits in S.E. Australia. His studies on parna (Butler 1956) were very relevant to the study of 'desert' loess. In fact it was his statement that desert loess probably did not exist that provoked more activity in the investigation of desert loess. His position was that, in a desert continent like Australia, he could find no traditional loess. If the great deserts of Australia could not generate any loess material how could desert loess exist? His position was largely justified because it has turned out that the great deserts that deliver loess material are only acting as storage regions and the actual material is produced in adjacent mountains (c.f. Central Asia and North China). The desert loess debate continues because there is still much confusion about the fine granular material produced in desert environments. Most particulate material produced in deserts comes from dried up lake beds and consists of fine silt sized material which itself consists of clay mineral agglomerates. There are small deposits of loess associated with deserts but these are often loess of an unusual variety (e.g. the Libyan loess). If the definition of loess is widened and re-cast slightly considerable deposits in
Australia may cross the definition boundary and be seen as loess. The desert
loess debate is one of the continuing debates in the loess world; Butler made
a considerable contribution, and it moves into view again (Haberiah 2007).

J.C.Frye (USA)
Frye was associated with the Illinois State Geological Survey and was
involved in many investigations in the Midwestern part of the USA (see Frye &
Fent 1947, Frye et al 1968). He was part of the response to Russell. When
Russell (1944) came up with his radical in-situ approach to the loess in the
lower Mississippi valley there was a considerable response in the American
loess community and the aeolian supporters published many refutations (see
Swineford & Frye 1945). Frye was active in the organisation of the 7th INQUA
Congress in the USA in 1965 and was co-editor of the volume of loess papers
(Schultz & Frye 1968). This volume of loess papers is particularly useful as it
gives a snapshot of the state of loess studies in the mid-1960s. Fink
organised a report section to which members of the Loess Commission
contributed.

J.von Haast (New Zealand)
Haast(fig.1) appears to have been the first person to specifically identify loess
in New Zealand (see Haast 1878, 1879, Smalley & Davin 1980). He was a
citizen of the Austro-Hungarian empire but also an indefatigable worker on the
geology of New Zealand. He brought his European eye to New Zealand and
was able to instantly identify the loess in the South Island, in which a few
years later Hardcastle was to recognize the climatic linkages.

N.I.Kriger (Russia)
Kriger was a great writer; he wrote hundreds of papers on loess. He was
nominally working in the applied field and concentrating on foundation
problems but his vision was wider than that; he had great interests in the
relation of climate to loess. Not so much in the field of palaeopedology as in
the area of loess formation being a process associated with aridity. For the
1965 INQUA Congress in the USA he produced a book (Kriger 1965) relating
loess and geography. This can be seen as a major, pivotal work in loess
literature, although only 1350 copies were printed. It contained a magnificent
bibliography and opened the door to loess literature in Russian. It formed the
basis of bibliographical studies in Smalley(1980). Kriger also made major
contributions to the study of hydroconsolidation and subsidence (see Kriger
1986) which is a topic of particular concern in the Russian loess community.
There is a vast literature on hydroconsolidation in Russian (see Trofimov 2001
who has 6 Kriger citations).
There was a move by the INQUA Loess Commission to have Kriger elected
as an honorary member of INQUA, and submissions were prepared. But
nothing came of this move and it is suspected that he did not find favour in
official Soviet circles, which is hard to explain since his views were not
particularly controversial.

V.I.Krokos (Ukraine)
Undoubtedly a major Ukrainian loess scholar and pioneer. He was a
stratigrapher and produced early definitive studies of loess stratigraphy in
Ukraine. Krokos had eight entries in the Kriger(1965) bibliography- showing
his status as a major loess investigator. He had a surprising 13 entries in the
Berg(1964) bibliography (he was second only to Berg himself). The strange
thing about the Berg entries is that Krokos is perceived as being somewhat
antagonistic to the Berg wold view of loess. Smalley (1980) has four Krokos
entries.
This is Vekhlich (1982) on Krokos: "V.I.Krokos, the student and follower of
A.I.Nabokikh, on the basis of a large new collection of factual data, which he
personally assembled (more than 500 sections) subdivided the loess series
of Ukraine into separate stratigraphic units and proposed the correlation
between loess and fluvisial deposits of the Ukraine region. He distinguished six
loess units (the Sula, Tyligul, Orel, Dnepr, Uday and Bug) and five soil units ."
Krokos was the first person to prove that the loess units of Ukraine are
correlated with the glacial stages of northern Europe, and the fossil soils with
the interglacials (see Krokos 1932).

J.S.Lee (China)
A pioneer of loess study in China; opening the door and laying the foundations for the wonders of the Liu Tung sheng era. Lee's book on the geology of China (1930) set the scene for loess appreciation in China, it truly was the underpinning for the Liu Tung-sheng years (see Liu 1988, Smalley 2006).

Liu (1988) wrote: “Before participating in the 6th INQUA Congress held in Poland in 1961, under the guidance of the late Prof. Li Siguang (J.S.Lee), the former vice-president of Academia Sinica, we had divided the loess series of China into Malan Loess (still using the old name), Lishi Loess and Wucheng Loess. Combined loess stratigraphic and biostratigraphic subdivision and nomination have been gradually adopted by geological circles in this country. The definition of loess deposits in China, consequently, has been expanded and includes sedimentary regions less than 20m thick to over 200m thick. The geological age of loess in China is from Late Pleistocene to the entire Quaternary. From the point of view of engineering geology, Malan loess belongs to collapsible loess, while Lishi Loess and Wucheng Loess are basically non-collapsible. This is of significance for construction in the Loess Plateau. Meanwhile, the recognition of older loess in China is of worldwide palaeoclimatic significance. In recent years, scholars in Europe and America have begun to pay increased attention to old loess strata. (Liu 1988 p.xvi).

V. Lozek (Czechoslovakia)

Snails: the great loess malacologist; contemporary of Kukla- but one who stayed in old Europe while Kukla headed for the New World. Lozek was part of the original Fink Loess Commission and has played a key role in Central Europe.

“At present (Lozek 1965), the view is generally adopted that loess does not originate only by the accumulation of wind-borne dust, but also by a particular soil-forming process (loessification), that impresses to dust-accumulations typical features of loess, especially the structure, calcareousness, and colour. Loessification affects the entire area of suitable regions, but requires special environmental conditions, which are not available in present-day Europe. This hypothesis is fully supported by the loess molluscan fauna showing a peculiar composition and including several species and races confined to loess deposits. Therefore, we are justified in speaking about loess assemblages in the ecologic sense and about loess environment, distinguished by specific climatic, sedimentation and soil conditions, as well as by a characteristic fauna and flora. The period of loessification, which could be called a loess phase, differs sharply from other sections of the Quaternary climatic cycle”. (Lozek 1965 p.61).

G.A. Mavlyanov (Uzbekistan)

Mavlyanov (1958) is the key work on loess in Uzbekistan. Mavlyanov, like Kriger worked on the engineering geology of loess, but also like Kriger he was interested in the wider loess world. He was a proponent of the loess ideas of A.P Pavlov who proposed the concepts of 'proluvial' and 'deluvial' loess. Mavlyanov has 17 citations on the Kriger 1965 list, he was identified by Kriger as a major loess contributor. On our list he represents Central Asian loess; his work was considered recently by Smalley et al. (2006b) in their attempt to reconcile the Pavlov based views of the Tashkent loess with current ‘western’ ideas. The Central Asian loess is relatively neglected; the loess on the eastern side of High Asia, in China, is comprehensively investigated, but the loess to the west requires more study. There are moves into the region (see Madalet al. 2006) and there has been a growing realisation that the Central Asian loess has great potential for further investigations in loess stratigraphy.

M. Minkov (Bulgaria)

Minkov was part of the team assembled by Julius Fink for his ambitious project to map the loess of Europe. Minkov was part of the small Bulgarian sub-group which worked on the Danubian deposits defining the north of Bulgaria. Minkov (1968) is still the definitive book on loess in Bulgaria. He was involved in the project to build a nuclear waste repository near to the nuclear power plant at Kozloduy; in fact it was the Minkov design which first placed the repository in the L2 layer, nicely protected by palaeosoils above and below.

M. Pecsi (Hungary)
Pecsi took over from Fink as the President of the INQUA Loess Commission in 1977 at the 10th INQUA Congress in Birmingham UK. He expanded the basis of the work of the Loess Commission and pushed out from the European heartland to worldwide deposits. He also introduced an ‘applied’ aspect and encouraged research into engineering geology and related topics. His time as President of the Loess Commission represents the apogee of its achievements, he was in office from 1977 until 1991 and during that time Loess Commission activity spread all over the World. He handed over to An Zhi-sheng in Beijing in 1991. An’s job was to reconcile the activities of the Commission with the vast opportunities offered by the loess in China. The last Loess Commission president was Ian Smalley, arriving at the bottom of the ninth to tie things up and collect together the bibliographical necessities (1999-2003)- and to make sure that the doings of the Commission were recorded and possibly appreciated.

Pecsi was positioned at an interesting pivot point between east and west, and required to reconcile some widely divergent points of view. There is still wide divergence of opinion in the loess world but the different viewpoints are being understood and intellectual progress is being made. At the base of one of the great divergences was the ‘eastern’ view of loess as a soil, and the ‘western’ view of loess as a sediment. The appreciation of the critical role that palaeosols play in modern loess science has meant that the worlds of sedimentology and pedology have been pushed closer together. Pecsi maintained a largely pedological position with an emphasis on ‘loessification’ to give to the ground that final essence which made it loess (see Pecsi 1990). For a further discussion of loessification see Smalley et al (2006a).

W.Soergel (Germany)

Soergel (fig. 2) seems to us an absolutely critical figure. If we acknowledge that the great advance in loess science in the 20th Century was the realisation that the loess deposits contain an accessible record of past climates and environments, then Soergel was a key player in the loess drama. Hardcastle had made the connection between loess and climate; but that was a Mendel-moment- nobody noticed and nobody realised the vast significance of the connection. Soergel, as much as anyone, deserves the credit for bringing the
loess-climate connection to the eyes of the world (Soergel 1919). His 1919 book set the scene for a century of investigations.

Rozyczki (1991) has produced an excellent study of the work and significance; he places him as a critical initiator in the progress of loess science: "All the pre-Soergelian theories concerning the origin of loess were in fact merely conceptions developed on the ground of a small number of random observations, and of theorizing about the process involved developed. It was Soergel (1919) who first applied the method of utilizing as fully as possible the results of analysis and coordination of inferences arising from factual evidence. To ascertain facts he used the most detailed data that were methodologically available at a given stage of scientific development. He aimed at a harmonious co-ordination of conclusions reached by different research methods and derived from different fields of science. To this aim he tried to interrelate closely not only the sedimentological and geomorphological data but also the palaeontological, archaeological and pedological information."

Zoller and Semmel (2001) were a bit more muted in their appreciation of Soergel but they put him in a key position in their study of the history of loess research in Germany. "Soergel (1919) summarised the state of the art and discussed the interglacial or glacial origin of loess, a question hotly debated at that time. The relationship of loess to moraines, the mass and constitution of loess, its mineralogical composition, as well as its molluscan and mammalian content, clearly proved it to be a sediment of the glacial periods. As for the age of the loess, three groups were distinguished: older, younger and youngest loesses. The tendency was to attribute the older loess to the Riss or the Mindel glacialls. Within it are three loamy horizons (Lehmzonen) but, because of the lack of exact knowledge about the glacial history, a more precise correlation with glacial advances appeared impossible. The younger loess, which contains a weathering horizon, was attributed to the last glaciation that, after Soergel, included the pre-Wurmian ice advance in sensu Penck. The youngest loess was supposed to be of late Glacial age, partly even post-Glacial. With respect to the Palaeolithic, Soergel correlated the lower part of the younger loess with the late Mousterian, the soil formation period on this loess with the Aurignacian, and the upper part of the younger loess with the Solutrean. The subsequent period of weathering that affected this loess was correlated with the Magdalenian." (Zoller & Semmel 2001, p.21).

J. Tokarski (Poland)
There is a long tradition of loess research in Poland, although the Polish deposits are fairly modest and confined to the southern parts of the country, associated with the rivers Wisia and Odra. Tokarski was a significant Polish loess pioneer. He has 4 citations in Smalley (1980), which identified him as a significant loess scholar. A quotation from Tokarski et al (1961) indicates an interest in loess as a material, a substance with remarkable intrinsic properties: "The problem of the mechanics of loess sedimentation as an aeolian deposit could be solved ultimately only on the basis of analysis of the most precise and various kind performed on the loess matter itself. There is no doubt that each fragment of any rock contains in its mineral and chemical composition and structure the history of its origin. The reading of this history is only a matter of using the correct methods of investigation".

Discussion
The aim of the INQUA Loess Commission Biobibliographical project was to illuminate and document the history of loess investigation by studying the contributions made by sixty investigators. These would be considered in groups of twelve and the total project completed in five publications: the original twelve, followed by more people, then additional people, then further people and finally last people. A study of world-wide loess research presents problems for the biobibliographers, it is difficult to avoid bias, it is difficult to be objective. Every author listed must fall into some of the sub-groupings within the field of loess research; in the simplest of divisions there is a splitting into sedimentology & soil science; and soil mechanics and engineering geology;and stratigraphy and climatology, and obviously many other disciplines are involved. Luckily ‘Quaternary Studies’ covers many of these. And the greatest problem is the linguistic problem; the difficulty of language.
We suggest (tentatively) that the greatest number of loess papers are in Russian, followed by considerable contributions in German, English, French, Polish, Chinese and important contributions in many other languages. So the linguistic aspect has to be factored into a study of importance and influence—and, in theory, all this is accounted for by having the relatively large number of 60 people in the group of investigators investigated. But, in fact, it has become apparent that the sixty investigators listed in table 1, while a remarkable and worthy set of people, only represent a beginning to the biobibliographical endeavours in the field of loess. In table 1 we are looking ahead. We have considered so far, in very modest detail, 24 investigators; there is time to make adjustments to the final listing. Table 1 may contain (or conceal) significant injustices—but there is time to correct them. The division among the nationalities is of passing interest; the ‘national’ division of contributors is—Russia 13, USA 9, Germany 8, Poland 6, Ukraine 4, China 3, New Zealand 3, UK 3, France 2, Czechoslovakia 2, Uzbekistan 2, Hungary 1, Serbia 1, Israel 1, Austria 1. Russia leads the way because in Russia, unlike most other nations (except perhaps Ukraine and Uzbekistan) the loess regions coincide with zones of high population. There are many engineering-geological problems discussed in the Russian language (see Jefferson et al. 2003); the Soviet Union, of course, included many loess regions.

It may be necessary (desirable?) to extend the chosen 60 to 100. It is immediately apparent, after a fairly casual glance at table 1, that important names are missing. There is a growing realisation of the enormous extent of loess scholarship. Woldstedt (1951, p. 170) wrote “Die Literatur über den Loss ist ungeheuer” The translation of ‘ungeheuer’ offers a few options; a neutral translation could be ‘enormous’ or ‘huge’ but it is just possible to detect in the Woldstedt text the feeling that a better translation might be ‘monstrous’ or ‘overwhelming’. It is certainly a large task to corral and appreciate it. Some truly comprehensive national surveys and bibliographies would be useful, but only one (Smalley & Davin 1980 on New Zealand) has actually appeared. Certain threads can be detected and demarcated within the overall surge of loess research. There will be a continuing interest in stratigraphy and palaeo-climatology—the thread from Hardcastle and Soergel will thicken and grow. There is still some continuing interest in the whole problem of the nature and formation of loess material and loess deposits; there is still reconciliation to be achieved between the views of loess as a sediment, and loess as a soil. The true nature of loess hydroconsolidation and subsidence is still being investigated and significant new advances in this field are being made. The ‘desert’ loess debate still offers areas of dispute. It is only very recently that the absolutely essential role played by rivers in loess deposit formation has been recognised, and current investigations are showing that the nature of loess material is much more complex than was hitherto believed.

It is relatively easy, thanks to Kriger (1965, 1986) and Berg (1964) and Trofimov (2001), to write down a list of 100 significant scholars publishing on loess in Russian. Our task is to pick out the most significant and influential, and repeat the process for all the other loess languages—and to follow all the distinctive and fascinating threads of loess research.

Acknowledgements

Material supplied by N.I. Kriger of PNIIIS Moscow and Alexander Alexiev of the Bulgarian Academy of Sciences has been absolutely vital in the early stages of the Bibliobibliographical project. We thank Eric Robinson of UCL for a very timely contribution. Every loess scholar asked has contributed some opinions and we thank them all. Such a project depends heavily on libraries; We thank in particular the New Zealand Soil Bureau library at Taite, the Paul Galvin Library of the Illinois Institute of Technology in Chicago and the Larkin Library of Leicester University. The Loess Letter Archives provided continuing support. The project was initiated in the closing years of the Loess Commission (before the extensive reorganisation of INQUA in 2003) and will be completed in post-Commission time.

References


Krokos, V.I. 1932. Directions of study of the Quaternary deposits in Ukraine. Chetvertynny period 3, 17-55. (in Ukrainian)


Figure captions
1. Julius von Haast. He moved from the Austro-Hungarian empire to New Zealand and introduced the idea of loess to that country. He named the Franz Josef glacier- a small relic of the Empire in New Zealand. He illustrates the value of applying ideas and concepts across the world. Thanks to persistent lobbying he became an FRS and also 'Sir Julius'. (for more detail see Te Ara the N.Z.Govt encyclopedia website www.teara.govt.nz).

2. Wolfgang Soergel. Although we have credited John Hardcastle with actually making the first link between climate and loess deposit it was Soergel, as much as anybody, who promoted the idea of loess stratigraphy and prepared the ground for Liu Tung-sheng and Kukla and the other mid-century investigators. (Picture from Freiburg University website www.geologie.uni-freiburg.de)
Table 1. The first selection of the 60 loess people; the original, more, additional, further and last lists. Here the lists have been arranged in more or less chronological order to facilitate cross-linking. The additional, further and last lists are tentative and it is expected that modifications will be made after further consultations have occurred. This is the basis of the INQUA Loess Commission Biobibliographical Project.

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**Head Labyrinth.** Saul Steinberg, ink on paper (1961)... thinking about 🗣️
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.

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