

## **Leonard Horner and an enthusiasm for Loess [Leicester Studies in the History of Loess Research part I]**

"For particulars concerning the loess of the Rhine, consult the works of MM. Bronn, Leonhard, Boue, Voltz, Noeggerath, Steininger, Merian, Rozet, Von Meyer, Hibbert and Horner."

Charles Lyell, Principles of Geology 5<sup>th</sup> edition 1837

"Mr. Leonard Horner also took me once to a meeting of the Royal Society of Edinburgh, where I saw Sir Walter Scott in the chair as President.. "

Charles Darwin, Autobiography 1867

### **Abstract**

Leonard Horner (1785-1864) made substantial contributions to the study of loess. He made field trips with J.J.Noeggerath and Charles Lyell and published useful material on the loess near Bonn. He was an unappreciated pioneer- he was the first person to direct attention to loess as a material. He pointed out that loess was intrinsically interesting. He studied the material transported by the Rhine, and the alluvial deposits in Egypt, looking for links to loess, and the problem of loess formation. He was born in Edinburgh in 1785 and directed the thoughts of young Charles Darwin towards science when he came to Edinburgh to study medicine. Circumstances placed him in Bonn in the critical years 1831-1833; in this time Charles Lyell married his eldest daughter Mary; and both Lyell and Horner encountered the loess. Lyell made it well known via vol.3 of the Principles of Geology, Horner became a loess enthusiast. In the summer of 1833 Horner & Lyell were in the crater

of the Roderberg considering the more than 20m of loess deposited there. His major paper was published in 1836 (reporting the Roderberg excursion) and he joined Lyell's list of loess investigators in the 5<sup>th</sup> edition of the Principles published in 1837. He was the last to join that select eleven: Bronn, Leonhard, Boue, Voltz, Steininger, Merian, Rozet, Hibbert, Noeggerath, von Meyer, Horner. Most of these were writing on the geology and landscapes of the Rhine valley, but Horner was drawing attention to the amazing nature of the loess itself, in particular the spectacular disaggregation on contact with water. He also published the first geological map of the Bonn region, including the Roderberg and the Siebengebirge, a region of loess and volcanoes.

Keywords: Leonard Horner, Loess, Bonn, alluvial material, Rhine valley geomorphology

## Introduction

In 1830 Horner was Warden of the new University of London, but he was having problems with recalcitrant professors and in 1831 had to resign because the stress was causing health problems. He moved to Bonn to recuperate and to consider his future. The family was not immediately short of money; his father had died in 1828 and they could live comfortably on his inheritance. So the years in Bonn (1831-1833) could be spent on pursuing his interests in geology.

In 1832, in Bonn, his oldest daughter Mary married the promising young geologist Charles Lyell. Lyell had already published volumes 1 and 2 of the Principles of Geology, and was working on vol.3. Charles and Mary went south into the Rhine valley for their honeymoon, and in Heidelberg Lyell met K.C.von Leonhard and H.G. Bronn and the story of loess began. Von Leonhard (1824) placed loess in the scientific literature and Bronn (1830) gave the first moderately detailed description, but Lyell put loess into vol.3 of the Principles and the widespread distribution of his great book meant that loess became known around

the world. Horner became aware of loess at about the same time as Lyell, and he, it would appear, found it even more fascinating than his famous son-in-law.

### Horner biography

Leonard Horner (1785-1864, fig.1) was born in an elegant house in George Square, in Edinburgh. The family knew James Hutton so there was an early exposure to geological influences. He went to Edinburgh University in August 1799. In 1802 he started to study chemistry with Thomas Hope. There were some lectures on mineralogy. Horner read John Playfair's book 'Illustrations of the Huttonian Theory of the Earth', and he made his first geological excursions on Arthur's Seat.

The Horners moved to London in 1804 and this enabled the geological studies to flourish. Leonard joined the Geological Society of London in 1808, the year after its foundation, and he became a secretary in 1814, and eventually its President in 1846 and 1860. He was elected to the Royal Society of London, and the Royal Society of Edinburgh in 1813. Geology was a lifelong interest but superimposed on this interest was the twenty-six years he spent as an inspector of factories and social reformer (see O'Farrell 2010 for much fuller biographical details.)

His interest in loess must have started during his time in Bonn. He met and befriended the geological community there and seems to have developed quite a close relationship with Professor J.J.Noeggerath (1788-1877, fig.2) who was professor of geology at the University of Bonn, and a great authority on the geology of the Bonn region (see Noeggerath 1828). Noeggerath and Horner made field excursions together and we speculate that it was on these field trips that Horner saw and became interested in the loess, which was, at that time, hardly in the front rank of study and investigation. In fact the loess landscape was an adjunct to the volcanic landscape; there was a great deal of geological interest in the Bonn region because of the presence of various Tertiary volcanoes.

Horner arrived in Bonn in 1831 and would not have had much time for geologizing before Charles Lyell turned up in July 1832 to marry daughter Mary (see Smalley et al 2010). 1832 was such a critical loess year; on 24 July Horner wrote to Mary:

“How very extraordinary that loess is? It has not been half attended to. I saw it today in great abundance.. “  
(see Lyell K.M. 1890 p.271).

## Loess

The brisk definition of loess (after Pye 1987 p199) is ‘a terrestrial windblown silt deposit..’ This is the material first described and defined in an adequate manner by Karl Caesar von Leonhard (1824), and first studied and investigated in the Rhine valley in the first half of the nineteenth century (Jovanovic et al 2013). There have been surges of interest in the loess and periodic bursts of publication.

For the nineteenth century the loess problem concerned the nature of the deposition process. From about the middle of the twentieth century it was realised that the thick loess deposits contained a good record of Quaternary events; stratigraphical and palaeoclimatological investigations increased- and the advances in Quaternary stratigraphy made via loess investigation were considerable (see for example Markovic et al. 2015, 2016). In the twenty-first century it has proved possible to investigate individual loess particles and produce detailed information about particle origins and histories (Stevens et al 2010). To some extent these recent studies bring the field of loess investigation back to a position adopted by Horner- an interest in loess for its own sake, an interesting geological material is investigated. (for data on loess literature see Smalley 1975, 1980. Smalley et al 2014)

## Geology of the Bonn region: Horner (1836)

On 13 March 1833 Horner delivered his paper on the geology of Bonn and region to the Geological Society of London (Horner 1833, 1834a). At the time there was a considerable hiatus in the publication of the Transactions of the Society so the full text of the paper was not published until 1836. It was this delay in publication that caused the related loess paper by Lyell and the Rhine material paper by Horner to be published in Edinburgh (Lyell 1834, Horner 1834b). The delay was fortunate for Horner because it enabled him to add a substantial amount of additional material, a large part of which concerned loess. Also in 1835 Carl Thomae published a useful account of the Roderberg volcano and Horner was able to record his loessic observations. In the 1836 paper is the first clear presentation of a research programme for loess scholars:

“To give a history of the loess in the valley of the Rhine, by a careful examination of its composition, organic remains, its form of deposition and levels, and to trace it, if possible, to its source, would be a most interesting subject of enquiry, and could not fail to prove a valuable contribution to geological science.” Horner (1836 p.470)

A beautifully defined programme of research which is still being pursued today; there are still many aspects to discuss, see, for example Smalley et al (1973). It seems likely that the 1836 paper also had appended the first geological map of the Bonn region, including the Siebengebirge and the Roderberg. (see Schwarz 2014 p.167: “Horner fertigte die erste Karte des Siebengebirges..”). A reduced, but coloured, version was reproduced by Schwarz (2014 p.167).

In 1833, soon after the reading of the Horner loess paper volume 3 of the Principles of Geology was published (Lyell 1833). This contained a section on loess, essentially

confined to loess in the Rhine valley. Horner may have launched loess into the small confined world of London science but Lyell offered knowledge of loess around the world; wherever *Principles* was sold the idea of loess was implanted. Horner gave some quite detailed descriptions of loess locations:

“A very extensive deposit of it may be seen at the Bruckersberg, near Rhondorf, immediately south of the Drachenfels, where it forms an irregular mass from three to twenty five feet thick, and covers trachyte and grauwacke, as represented in the wood-cut, p.440 (*fig. 3*) It is found at Quegstein in the valley of Konigswinter, covering trachyte tuff, and near Paffroth and Ober Dollendorf, on the slope of the Petersberg, covering grauwacke. Between Ober Dollendorf and Haisterbach it lies upon grauwacke, covering the summit of a ridge over which the road passes, in the side of the valley leading to the Stenselberg, and at Roth Kreuz, covering trachyte tuff. It is found in the narrow valley which opens at Ober Cassel, and covering basalt at a considerable elevation on the Rabenlei. It occurs also, to the depth of fourteen feet, near Utweiler, covering basalt.

These are the places where I have seen it on the right bank of the Rhine (*east bank*); but it is met with, no doubt, in many others. On the left bank a narrow ridge of it runs in a south-east direction from Bonn for about three miles; and it is seen in the high bank of the river, covering the gravel of the Rhine plain, the surface of which is deeply channelled, the loess filling up the furrows. It is seen on the north-western slope of the Kreuzberg; in the valley between the Kreuzberg and Venusberg; in a valley behind Godesberg, near Marienforst; to a considerable extent near Lannesdorf, where very deep clefts are cut in it; and it skirts the northern and eastern sides of the volcano of the Roderberg. Above Rolandseck there is a quarry of grauwacke, and upon the ends of the elevated strata of that rock lies gravel covered by loess. The basaltic columns in the quarry opposite to Unkel are

covered by it at a very great height above the river, and where it is nearest to the basalt it contains rounded fragments of that rock. It is here, as elsewhere, an unstratified mass, which seems to have filled up deep furrows and irregularities of the preexisting surface. The absence of all signs of stratification is universal in this district. At Unkel it contains a considerable quantity of calcareous concretions." (Horner 1836 p.471).

The location of Unkel is shown on fig.4 from Lyell (1833); also shown by Thomae (1835)- his was the study of the Roderberg which Horner cited to good effect in 1836. He quoted some Thomae observations on loess geomorphology:

"On the east side of the Roderberg there are five round-back ridges, covered with vegetation, which seem to radiate from the lower part of the hill towards its base. These are composed of loess; and, at their inferior extremity, are in some places laid open, exhibiting a vertical section from twenty to thirty-five feet in height, resting upon a mass of gravel, identical in composition with that forming the present bed of the Rhine, and from four to eight feet in thickness." (Horner 1836 p.479, Thomae 1835 p29).

More significant than the Thomae geomorphology were some observations on the properties of loess material:

"The loess absorbs water with great avidity, and where exposed to the action of water is often carried away in great masses. It affords a very fertile soil; but the husbandman is sometimes doomed to see his hopes blasted by a violent storm of rain washing away the whole soil from his field, laying the roots of his vines bare to the sun." (Horner 1836 p.479, Thomae 1835 p.26).

This could have been the first observation of the interesting propensity of loess to disaggregate when exposed to water. This is one of the defining properties of

loess, in addition to the restricted particle size distribution, the very open soil structure, the specific mineralogy and the 'draping' of the deposits over the landscape.

This 1833/1836 paper was Horner's major contribution to the study of loess. It could have been his major contribution to geological science although perhaps it should share this position with the pioneering mapping in the Rhine valley. Horner published studies on the material suspended in the Rhine river waters (Horner 1834a) and on the alluvial deposits in Egypt (1858), and these support his studies on loess. They point to the importance of fine alluvial material in the making of landscapes and of the intrinsic interest in silt (for 'silt' see Assallay et al 1998). The 1836 paper is very much a paper of two parts; there is the 1833 text, and then the additions made in 1836. Horner's vision of the mechanism of loess deposit formation changes somewhat over the three years of delay.

In 1833 he wrote (p.469):

"It is difficult to conceive how it should have been produced, except by some vast flood, which, if no elevations or subsidences of the land have since taken place, must have been of a depth of at least six hundred feet, and several miles in breadth."

By 1836 (possibly after conversations with Lyell) he accepts the importance of vertical movements of the land and writes a cautious sentence:

"Sweden has afforded the most unequivocal proofs that upward and downward movements of the land may take place in countries where no ordinary volcanic action is to be seen; and that so gradually as to be imperceptible to all who are not watching the phenomenon: and, as there are so many indications of volcanic action in early times, on both sides of the Rhine valley, it does not seem to me to be stretching theory beyond the limits of just philosophical reasoning, to suppose that such oscillations

may have taken place in this district, during the gradual accumulation of the loess, and subsequently to its deposition." (p.481).

He was obviously not entirely happy with this approach; there are qualifications in his endorsement of Lyellian earth movements. His final word on the loess formation problem (at the end of the 1836 paper) was suitably measured:

"Its origin remains as uncertain as before; but it is very evident that it came from above Schaffhausen."

He was happier with observation rather than theory.

### Horner & Lyell on the Roderberg

In vol. 3 of *The Principles of Geology* Lyell wrote:

"One of the most interesting volcanos on the left bank of the Rhine is called the Roderberg (*fig.5*). It forms a circular crater nearly a quarter of a mile in diameter, and one hundred feet deep, now covered with fields of corn. The highly inclined greywacke strata rise even to the rim of one side of the crater, but they are overspread by quartzose gravel, and this again is covered by volcanic scoriae and tufaceous sand. The opposite wall of the crater is a scoriaceous rock, like that at the summit of Vesuvius. It is quite evident that the eruption in this case burst through the greywacke and alluvium which immediately overlies it; and I observed some of the quartz pebbles mixed with scoriae on the flanks of the mountain, so placed as if they had been cast up into the air, and had fallen again with the volcanic ashes. On the opposite or right bank of the Rhine, are the Siebengebirge, a group of mountains wherein analogous phenomena are exhibited." (Lyell 1833 p.198)

In July 1833 Lyell and Horner were in the crater of the Roderberg looking at the loess. They each reported the excursion, and their observations (Lyell 1834, Horner 1836). There is some current activity in the Roderberg

crater; a consortium of German universities and institutions has been drilling through the loess accumulations. The Rodderberg (*sic*) project is called 'The late Quaternary climate history of the Rodderberg volcano ([www.liag-hannover.de](http://www.liag-hannover.de)) and is a joint operation by the Universities of Bonn, Bayreuth, Braunschweig, Bremen and Cologne, and the Leibnitz Institute of Applied Geophysics in Hannover (Zoeller et al 2010).

## The Siebengebirge

The Schwarz (2010) study gives geological details of the Siebengebirge. The hills themselves can be placed in context by the opening of the Horner (1836) paper:

"The district about to be described lies on the Rhine, from the mouth of the Sieg (*see fig. 4*), below Bonn, to the town of Linz, a distance of about eighteen English miles, and extends nearly five miles inland, on both sides of the river.

A short way above Bonn the Rhine leaves the mountainous land, through which it has flowed with little interruption from its source, and enters a vast plain that extends to the North Sea, the nearest short of which is about a hundred and thirty miles distant.

The Siebengebirge, or Seven Mountains, are a grand feature in the district, and constitute a group of hills, of very graceful forms, on the right bank of the river. Looking down from one of their higher summits, one sees a numerous assemblage of conical hills and connecting ridges; but when viewed from a distance, and in certain positions, seven peaks rise conspicuously above the rest, and hence the group has received its name. " (Horner 1836 p. 433, *see map from Thomae 1835* ).

Thomae (1835) was a study of the Roderberg. It was published in time to be carefully studied by Horner and

reported on in the 1836 paper Thomae was a student of Noeggerath- who provided the short foreword: "Der Roderberg, unmittelbar an der grossen Strasse von Bonn nach Coblenz gelegen, ist daher dem Reisenden unter allen andern Vulkanen des Rheingebiets am leichtesten zuganglich. Eine Excursion von Bonn oder Godesborg aus von einem halben Tage genucht schon, um ihm Kenntniss zu nehmen..." Noeggerath (in Thomae 1835).

## Discussion

Horner had a lifelong interest in geology, his commitment to geology was considerable, and for the few years from 1831 to 1833 he was able to be a geologist. Before that period he was concerned with the problems of the nascent University of London and after then he took on the responsibility of improving the conditions for child labourers and the working populace in general. For two years he was free to pursue the interest of geology, and good fortune placed him in Bonn where he had quick access to a fascinating volcanic terrain, and was able to observe the wonders of the loess, and walk daily on the Roderberg and the Siebengebirge, and make a real contribution to local geology.

The list of significant scholars who had studied the Siebengebirge, compiled by Schwarz (2014), lists Nose, Wurzer, Noeggerath and then Horner.. " Er was der erste, der erkannte, dass das bis dato als Trachytkonglomerat angesprochene Gestein in Wahrheit Trachyttuff ist. Er erstellte die erste Karte des Siebengebirges." The list goes on to include von Dechen, E.Cloos and H.Cloos and others. Horner stands in an impressive list. Not only does he have Noeggerath for company (and instruction) but Lyell appears in 1832 and intensifies the geological activity. The doings of Lyell at around this time have been discussed (Smalley et al 2016) and it seems likely that there was much conversation about loess. Lyell may have observed loess on his short expedition to the

Eifel in 1831 but it is possible that the visit to Bonn included the first sightings.

On 28 August 1832 Horner wrote to Lyell:

"We slept at Konigswinter, and the next day I spent entirely in the Sieben Gebirge, meeting my fellow travellers at the foot of the Oehlberg, returning to Konigswinter in the afternoon. Yesterday I spent in that part North East of the Konigswinter Thal... I have seen much that was new to me, and much that interested me greatly. The loess covers the basalt columns of Unkel, at an elevation of at least three hundred feet above the Rhine, and here it contains large calcareous concretions-compact limestone, with the land shells enclosed. I found loess again at Orsbeg, on the right bank of the Rhine, exactly opposite to Unkel, covering the brown coal beds, in which the frogs were found at an elevation of not less than five hundred feet...

I have seen basalt dykes traversing the trachyte tuff in five different places, also traversing the trachyte itself. I have seen the grauwacke covering trachyte, and loess over both, a most capital section." (see K.M.Lyell 1890 p.273).

Unkel is a significant place; its location is shown in fig.4. This is a significant figure, it comes from Lyell (1833) where it is fig.48; Lyell commented on it (Lyell 1833 p.193):

"For the geographical details of this volcanic region, we refer the reader to the annexed map, for which I am indebted to Mr. Leonard Horner, whose residence in the country has enabled him to verify the maps of MM. (*sic*) Noeggerath and Von Oyenhausen (*he means Oeynhaus*en), from which that now given has been principally compiled."

This shows clearly the location of Bonn, south of the River Sieg, and also the volcanic district of the Eifel, and Unkel, which features in Horner's loess writings.

## Conclusions

Horner made a significant contribution to the study of loess. His paper, presented to the Geological Society of London in 1833, must have been the first public discussion of loess in Britain. He pointed out that loess was an interesting and significant geological material. He made the first geological map of the Bonn region and is recognized as a pioneer in studies of the geology of the Rhine Valley. He made a modest contribution to Lyell's 'Principles of Geology' the foremost geological text of the age. His observation (after Thomae 1835) of the disaggregation of loess in contact with water was the first time that this very characteristic property had been noticed. He saw the importance of alluvial silt material (some of which could become loess) and carried out pioneering investigations into Rhine river suspended material and alluvial deposits in Egypt.

## Postscript

Charles Lyell wrote to Charles Darwin on 26 December 1836; just a couple of months after Darwin had returned from the *Beagle* voyage:

"Will you come up on Monday, January 2, and come and dine with us at half-past five o'clock, or come at five, and I will go over the paper before dinner? No one dines with us but Mr. and Mrs. Horner and one daughter, and Mr. Horner will be glad to renew his acquaintance with you.."

This was the famous letter in which Lyell went on to advise Darwin to concentrate on his science and not get involved in wordly matters and the distractions of administration.

"Don't accept any official scientific place, if you can avoid it, and tell no one that I gave you this advice, as they would all cry out against me as the preacher of anti-patriotic principles. I fought against the calamity of being President as long as I could. All has gone on smoothly,

and it has not cost me more time than I anticipated; but my question is, whether the time annihilated by learned bodies ('par les affaires administratives') is balanced by any good they do." (see K.M.Lyell 1881 p.475)

There is a certain irony here; three enthusiastic geologists dining together, but one had been required to forsake a life of geology and take on vast administrative burdens- of enormous benefit to community and nation- while the other two became world-famous scholars. Horner managed two years of real scholarly life; and he made an important contribution to geological science.

## References

Assallay, A.M., Rogers, C.D.F., Smalley, I.J., Jefferson, I.F. 1998. Silt; 2-62  $\mu\text{m}$ , 9-4 $\Phi$ . *Earth Science Reviews* 45, 61-88

Bronn, H.G. 1830. *Gaea Heidelbergensis, oder Mineralogische Beschreibung der Gegend von Heidelberg*. Karl Gross Heidelberg u.Leipzig 220p. (loess section, pp.167-176 reprinted in *Loess Letter* 67, April 2012, see [www.loessletter.msu.edu](http://www.loessletter.msu.edu))

Horner, L. 1833. *Geology of the environs of Bonn*. *Proceedings of the Geological Society of London*. 1, No.31, 467-469.

Horner, L. 1834a. *Ueber die geologischen Verhältnisse der Umgegend von Bonn [Notizen]* *Jahrbucher der Mineralogie, Geologie, Berg- und Huttenkunde* 1, 171-176 (ed.C.Hartmann, pub. J.A.Stein, Nurnberg).

Horner, L. 1834b. *On the quantity of solid matter suspended in the waters of the Rhine*. *Edinburgh New Philosophical Journal* 18, 102-124

Horner, L. 1836. Geology of the environs of Bonn. Transactions of the Geological Society of London 4 (2<sup>nd</sup> series), 433-481.

Horner, L. 1855. An account of some recent researches near Cairo, undertaken with a view of throwing light upon the geological history of the alluvial land of Egypt. Philosophical Transactions of the Royal Society of London 145, 105-138.

Jovanovic, M., Gaudenyi, T., O'Hara-Dhand, K., Smalley, I.J. 2013. Karl Caesar von Leonhard (1779-1862) and the beginnings of loess research in the Rhine valley. Quaternary International 334-5, 4-9.

Leonhard, K.C.von, 1824. Charakteristik der Felsarten; Dritte Abtheilung, Trummer-Gesteine, Lose Gesteine, Kohlen. Joseph Engelmann Heidelberg (Loess section 89, reprinted in Loess Letter 67, April 2012, see [www.loessletter.msu.edu](http://www.loessletter.msu.edu)).

Lyell, C. 1833. Principles of Geology vol.3. John Murray London (facsimile reprint University of Chicago Press)

Lyell, C. 1834. Observations on the loamy deposit called 'loess' of the basin of the Rhine. Edinburgh New Philosophical Journal 17, 110-120 (reprinted in part in Smalley 1975, 13-19).

Lyell, K.M.(ed.) 1881. Life, Letters and Journals of Sir Charles Lyell, John Murray London vol.1, 477p.

Lyell, K.M.(ed.) 1890. Memoir of Leonard Horner FRS FGS. Women's Printing Society Ltd. London v.1, 376p.

Markovich, S.B., Stevens, T., Kukla, G.J., Hambach, U., Fitzsimmons, K.E., Gibbard, P., Buggle, B., Zech, M., Guo, Z., Hao, Q., Wu, H., O'Hara-Dhand, K., Smalley, I.J., Ujvari, G., Sumegi, P., Timor-Gabor, A., Veres, D., Sirocko, F., Vasiljevic, D.A., Jary, Z., Svensson, A., Jovic,

V., Lehmkuhl, F., Kovacs, J., Svircev, Z. 2015. Danube loess stratigraphy- towards a pan-European loess stratigraphic model. *Earth Science Reviews* 148, 22-258, doi: 10.1016/j.earscirev.2015.06.005.

Markovich, S.B., Fitzsimmons, K.E., Sprafke, T., Gavrilov, D., Smalley, I.J., Jovic, V., Svircev, Z., Gavrilov, M.B., Beslin, M. 2016. The history of Danube loess research. *Quaternary International* 399, 86-99.

Noeggerath, J.J. 1822-36. *Das Gebirge in Rheinland-Westphalen nach minerlogische und chemische Bezuge* 4 Bde. Eduard Weber Bonn.

O'Farrell, P.N. 2010. *Leonard Horner: Pioneering Reformer*. Heriot-Watt University Press Edinburgh 378p.

Pye, K. 1987. *Aeolian Dust and Dust Deposits*. Academic Press London 334p.

Schwarz, C. 2014. *Die Geschichte der Geologischen Erforschung des Siebengebirges*. 2<sup>nd</sup>.ed. Bonn 190p. [POD CreateSpace Independent Publishing Platform].

Smalley, I.J.(ed.) 1975. *Loess Lithology and Genesis*. Dowden, Hutchinson and Ross Stroudsburg 429p

Smalley, I.J. 1980. *Loess: A Partial Bibliography*. GeoBooks/Elsevier Norwich 103p.

Smalley, I.J., Krinsley, D.H., Vita-Finzi, C. 1973. Observations on the Kaiserstuhl loess. *Geological Magazine* 110, 29-36.

Smalley, I.J., Markovic, S.B., O'Hara-Dhand, K. 2010. Charles Lyell from 1832 to 1835: marriage, Principles, 2 trips to Heidelberg, snails and loess. *Central European Journal of Geosciences (Open Geosciences)* 2, 15-18.

Smalley, I.J., Smalley, G.J., O'Hara-Dhand, K., Jary, Z. 2013. The loess biobibliographical project, with some emphasis on Polish investigations; in memory of Jerzy Cegla 1935-1984). *Quaternary International* 296, 7-14.

Smalley, I.J., Kels, H., Gaudenyi, T., Jovanovic, M. 2016. Loess encounters of three kinds: Charles Lyell talks about, reads about, and looks at loess. *GeoLogos* 22, 71-77.

Stephens, T., Palk, C., Carter, A., Lu, H., Clift, P.D. 2010. Assessing the provenance of loess and desert sediments in northern China using U-Pb dating and morphology of detrital zircons. *Geological Society of America Bulletin* 122, 1331-1344.

Thomae, C. 1835. *Der Vulkanische Roderberg bei Bonn: geognostische Beschreibung seiner Kraters und seiner Umgebungen.* Henry u. Cohen Bonn 58p.

Zoeller, L., Hambach, U., Blanchard, H., Fischer, S., Kohne, S., Stritzke, R. 2010. *Der Rodderberg-Krater bei Bonn. Eiszeitalter und Gegenwart* 59, 1-2.

## Figures

1. Leonard Horner (1785-1864); crayon drawing by Samuel Lawrence.
2. Johan Jacob Noeggerath (1788-1877); professor of geology at the University of Bonn in the critical Horner time: 1831-1833.
3. The only figure in Horner (1836); it shows trachyte and loess at Bruckersberg (so named by Horner), near Rhondorf. [Bruckersberg = Bruckertsberg(SO-Vorberg Drachenfels)].
4. Sketch map of the Rhine region, from vol.3 of *The Principles of Geology* by Lyell (1833). Shows the location

of Unkel, a significant place in the loess observations of Horner. The map is by Horner, it formed the basis of the more elaborate map of the Bonn region in Horner(1836).

5. The Roderberg; from Thomae(1835)