

1992

The Mystery of the Paha: Constructive Landforms of Northeast Iowa

Georgia Quirk
University of Northern Iowa

Follow this and additional works at: <https://scholarworks.uni.edu/istj>



Part of the [Science and Mathematics Education Commons](#)

Recommended Citation

Quirk, Georgia (1992) "The Mystery of the Paha: Constructive Landforms of Northeast Iowa," *Iowa Science Teachers Journal*: Vol. 29 : No. 1 , Article 3.

Available at: <https://scholarworks.uni.edu/istj/vol29/iss1/3>

This Article is brought to you for free and open access by UNI ScholarWorks. It has been accepted for inclusion in Iowa Science Teachers Journal by an authorized editor of UNI ScholarWorks. For more information, please contact scholarworks@uni.edu.

THE MYSTERY OF THE PAHA: CONSTRUCTIVE LANDFORMS OF NORTHEAST IOWA

Georgia Quirk
Instructor/Reference Librarian
Donald O. Rod Library
University of Northern Iowa
Cedar Falls, Iowa 50614-3675

Paha are distinctive landforms of Iowa which could provide the focus for a fascinating earth science instructional unit and even a field trip opportunity for teachers in the northeast part of Iowa. Slides, transparencies and text for a 15-minute introduction are available from the author.

The landform map of Iowa (Figure 1) diagrams the geological areas of the state and indicates some of the *paha* that have been identified. They are found on the Iowan Erosion Surface (often shortened to the Iowan Surface), which covers most of northeastern Iowa. One of the characteristics and mysteries of the *paha* is the way in which they rise abruptly from the surrounding plain in a northwest-to-southeast orientation, which shifts to west-to-east in the eastern portions of the state. (Shimek 1908). From a bird's eye view, *paha* are elliptical. When the entire forms can be seen in profile, they resemble an upside-down canoe.

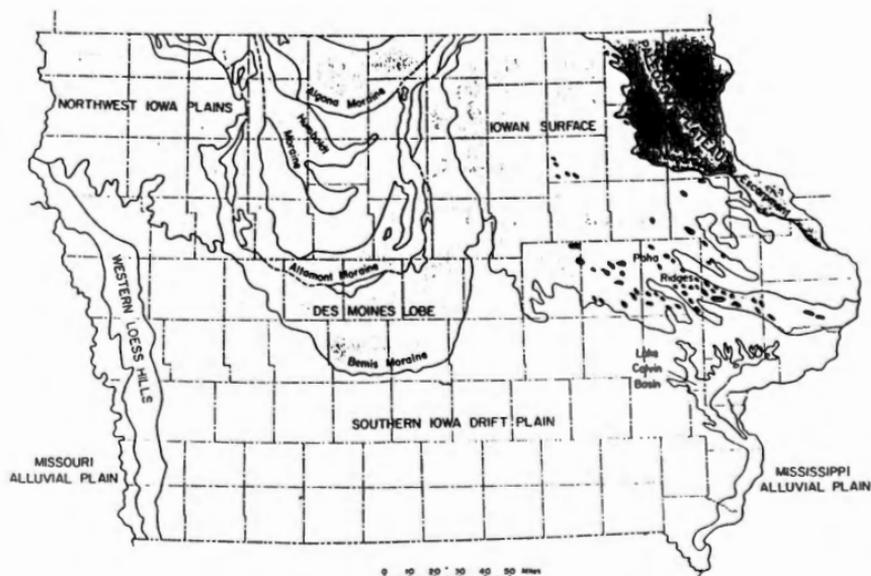


Figure 1. Landform regions of Iowa (Iowa Geological Survey 1976).

A History of Paha

An early geologist, W. J. McGee, established the use of the Dakota Indian name "paha" to designate these unique hills (McGee 1890). He identified paha in many parts of northeast Iowa, including Fayette, Clayton, Delaware and Dubuque counties, which are adjacent to the Paleozoic Plateau of extreme northeast Iowa (part of this area is also called the Driftless Area); and in Jackson, Clinton, Jones, Cedar and Linn counties (located near the southern border of the Iowan Surface). McGee named this border area the "ridged drift area" and designated it "the land of the paha" (McGee 1890). By 1955, over 160 paha had been identified and mapped, the greatest concentration of them being found in Benton, Linn and Jones counties (Scholtes 1955).

What are the paha?

Each paha contains a core of pre-Illinoian glacial till with a developed paleosol that is buried by a thick cap of loess. In contrast, the surrounding Iowan Surface contains a stone line instead of paleosol and a thinner loess cap (Figure 2). The loess cap was an eolian deposit during the Wisconsin glacial stage, and it is usually found to be thicker on the lee (southeast) side of the paha (Scholtes 1955). The loess, like that of Iowa's Western Loess Hills, is a mixture of sand, silt, calcareous materials and other mineral products. It is fine-grained and friable, but able to hold moisture.

The Iowan Surface that surrounds each paha was formed by erosion, and the paha were exposed to the same erosional activities. Several explanations have been advanced for the unequal deposition of loess between the paha and the lower lying plain, including W.J. Vreeken's suggestion that the plain was actually part of a drainage system where erosion could successfully compete with loess deposition (Vreeken 1975). Other hills, however, exhibit characteristics of the paha but lack

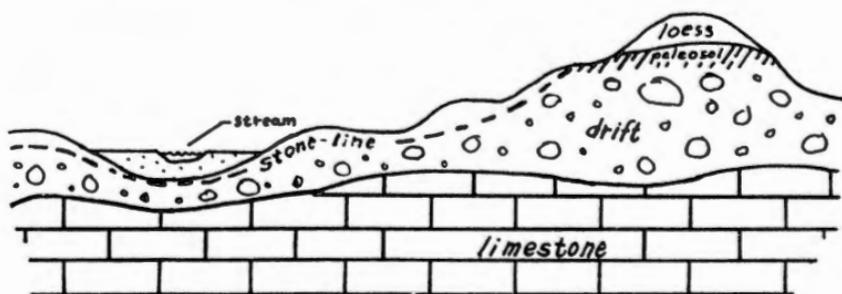


Figure 2. Cross section of a paha (after Prior 1976).

the thick loess cap. On those hills, the depth of the loess covering is comparable to the amount deposited on the rest of the Iowan Surface (Scholtes 1955). Earlier studies have been cited showing that the thickest loess occurs on the boundary edges of the Iowan Surface and that the amount of loess decreases significantly in more northerly locations (Ruhe, Dietz, Fenton and Hall 1968). Thirty to 40 foot deposits are usual near the boundary of the Iowan Surface, and, in fact, it was found that the "border" of this surface was often determined by the thickness of loess (Hallberg, Fenton, Miller and Lutenegegar 1978).

Where are the paha found?

From earliest records, paha locations were associated with the topographic highs of river ridges and interstream divides. In fact, some paha researchers have studied aerial photographs as a method of predicting the presence of paha. A combination of characteristic orientation, shape and relief signal their location. Often, the area in which the paha is found is natural forest rather than prairie, a factor that furthers the identification. Cultivation of the paha most often results in erosion characterized by recognizable gullies worn into the sloping sides (Scholtes 1955).

Conclusive identification of paha, however, requires examination of the subsurface materials. In order to be classified as an "authentic" paha, the loess cap of the hill must be underlaid by a paleosol developed upon pre-Illinoian till over bedrock structure. In addition, the stone line of the Iowan Surface must be absent.

Where did the paha come from?

Why is there no stone line? Why is paleosol present? Robert Ruhe answered those questions and, in the process, deduced the stratigraphy of the area that had long been called the Iowa Drift Plain. In his 1969 book, he explains how the area is actually a product of *erosion* rather than the result of Iowan-age glacial deposition and subsequent drift deposition. Since Ruhe's discovery, the region has been known as the Iowan Erosion Surface, rather than the Iowa Drift Plain.

To prove that the Iowan Surface is an erosion surface, Ruhe studied drill cores at the surface border. With analysis and radiocarbon dating of the samples, he was able to show that, where a paleosol is absent, the Wisconsinan loess sits on pre-Illinoian till. Where a Yarmouth-Sangamon paleosol is present, it lies between the pre-Illinoian till and the Wisconsinan loess. (The latter describes a cross section of a paha.) When

the paleosol is not present, a stone line is commonly found between the till and the loess. These configurations show that nothing was *added* as a result of Wisconsinan-age glaciation. Rather, the paleosol was removed and the stone line formed. These processes would most likely have occurred from erosion rather than glacial activity. In addition, radiocarbon dating shows that this erosion surface formed during the Wisconsinan glacial stage, between 18,300 and 29,000 years ago (Ruhe 1969).

Figure 3 shows the glacial and interglacial stages of the Pleistocene (2 1/2 to 3 million years before the present). Neither the Wisconsinan nor the Illinoian glaciers reached Northeast Iowa. Thus, deposits from the Yarmouth and Sangamon stages sit on the pre-Illinoian till in this area. Study of the pre-Illinoian and its nomenclature is still in process. The names found in Figure 3 (Kansan, Aftonian, and Nebraskan) are found in older references, but they are superseded by the term "pre-Illinoian" in more recent literature.

Quaternary Period	Glacial Stage	Interglacial Stage
Holocene Epoch		Holocene or recent
Pleistocene Epoch	Wisconsinan	
		Sangamon
	Illinoian	
		Yarmouth
	Pre-Illinoian [Kansan]	[Aftonian]
	[Nebraskan]	[Previously unrecognized]

Figure 3. Stages of the Quaternary Period [with former names].

A Century of Studies of Paha Formation

Historically, speculation on the process that allowed the paha to form was closely tied to the presumed Iowan glacier. Some attributed formation of the paha core and cap to direct, glaciofluvial deposition, placing it in the same group as outwash plains and kames (McGee 1890). Others interpreted the Iowan ice as a thin layer that flowed around and between

existing higher cores composed of rock or Kansan drift. These researchers speculated that the loess deposits somehow came from the Iowan till and created a covering on the paha cores (Calvin 1899).

Bohumil Shimek, who had studied loess in other localities, advocated the idea of eolian deposition of the loess on the paha, and he questioned the Iowan glacial stage. He had developed an eolian theory of loess distribution and named three conditions favorable to deposition:

1. a source of material from river sediments or adjacent areas
2. the wind as an agent which can not only *transport*, but also *erode*, causing unequal deposits
3. a receptive surface (possibly covered with vegetation) that could hold the material

Shimek used examples of drifting snow and sand dune behavior to explain varied quantities of deposition on adjacent surfaces. As an additional argument, he pointed out the abundance of mollusk fossils found in the loess of paha. These mollusks would not exist in a cold, glacial environment without vegetation (Shimek 1908).

Subsequent scientists agreed with the eolian hypothesis and also suggested a saltation model of drifting sand and silt (Scholtes and Smith 1950). A later report supported the concepts of those who proposed the idea of a thin and discontinuous Iowan glacier that did not cover the paha. It was concluded that the exposed topographic highs received the eolian deposition of sand and sand-sized silt (Scholtes 1955). A correlation between greater relief and loess thickness was found (Ruhe et al. 1968), and, using carbon dating, scientists showed that the age of the Iowan Surface coincided with the time of loess deposition.

A Challenge from the Past, for the Future

To the student of Iowa geology, paha provide a curious remnant of glacial heritage. Their study started in 1890 and continues today. The recognition in the 1960s that the "Iowan glacial stage" did not exist was quite revealing. The area that is now known as the Iowan Surface has been exposed to erosion as well as eolian deposition in the past. Modern analyses of the paha and their stratigraphy and soils offer the potential of expanding our knowledge.

The paha have been the subject of considerable study and several publications. They are a prevalent geological feature found in northeast Iowa. Their mystery sits as patiently as the paha themselves, waiting to be solved.

References

- Anderson, W. I. 1972. Casey's paha. In *General geology in the vicinity of northern Iowa: Guidebook for the 36th Annual Tri-State Geological Field Conference*, 27-33. Cedar Falls, IA: Univ. of Northern Iowa.
- . 1983. *Geology of Iowa*. Ames, IA: Iowa State Univ. Press.
- . 1989. Iowa geology: The early years. *Journal of the Iowa Academy of Science* 96(3-4):81-91.
- Calvin, S. C. 1899. Iowan drift. *Bulletin of the Geological Society of America* 10:107-120.
- Hallberg, G. R. 1980. *Pleistocene stratigraphy in east-central Iowa*. Technical Information Series, no. 10. Iowa City, IA: Iowa Geological Survey.
- Hallberg, G. R., T. E. Fenton, G. A. Miller, and A. J. Lutenebgar. 1978. The Iowa Erosion Surface: An old story, an important lesson, and some new wrinkles. Part 2 of *Forty-Second Annual Tri-State Geological Field Conference on Geology of East-Central Iowa*, 1-94. Iowa City, IA: Iowa Geological Survey.
- McGee, W. J. 1890. The Pleistocene history of northeastern Iowa. Part 1 of *Eleventh annual report, U. S. Geological Survey 1890*, 189-577. N.p.
- Prior, J. C. 1976. *A regional guide to Iowa landforms*. Iowa Geological Survey Education Series, pub. 3. Iowa City, IA: Iowa Geological Survey.
- Prior, J. C., R. G. Baker, G. R. Hallberg, and H. A. Semken. 1982. Glaciation. In *Iowa's Natural Heritage*, 43-61. Des Moines, IA: Iowa Natural Heritage Foundation; Iowa Academy of Science.
- Ruhe, R. V. 1969. *Quaternary landscapes in Iowa*. Ames, IA: Iowa State Univ. Press.
- Ruhe, R. V., W. P. Dietz, T. E. Fenton, and G. F. Hall. 1968. *Iowan drift problem, Northeastern Iowa*. Report of Investigations, no. 7. Iowa City, IA: Iowa Geological Survey.
- Savage, T. E. 1903. Geology of Tama County. *Iowa Geological Survey Annual Report 1902* 13:185-295.
- Scholtes, W. H. 1955. Properties and classification of the paha loess-derived soils in northeastern Iowa. *Iowa State College Journal of Science* 30(2):163-209.
- Scholtes, W. H., and G. D. Smith. 1950. Some observations of the paha of northeast Iowa. *Proceedings of the Iowa Academy of Science* 57:283-291.

Shimek, B. 1908. The loess of the paha and river-ridge. *Proceedings of the Iowa Academy of Science* 15:117-124.

Vreeken, W. J. 1975. Quaternary evolution in Tama County, Iowa. *Annals of the Association of American Geographers* 65(2):283-296.

Text, slides and transparencies for a 15-minute presentation on the paha, suitable for class or science club program, are available from Georgia Quirk, Donald O. Rod Library, University of Northern Iowa, Cedar Falls, IA 50614-3675, ph. (319) 273-2838.