Illinoian Outwash in Southeastern Pennsylvania

GEOLOGICAL SURVEY BULLETIN 1121-B

Prepared in cooperation with the Pennsylvania Geological Survey, Department of Internal Affairs, Commonwealth of Pennsylvania

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By W. N. LOCKWOOD *and* HAROLD MEISLER

CONTRIBUTIONS TO GENERAL GEOLOGY

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ABSTRACT

The most complete exposed section of Pleistocene sediments in the costal plain of Pennsylvania is in the Turkey Hill gravel pit in southeastern Bucks County. The section consists of highly weathered sand and gravel outwash, containing a red zone in its upper part, and is believed to be of Illinoian age. A lag gravel capping the outwash and containing ventifacts records periglacial conditions. Loess overlies the lag gravel. Relatively unweathered Wisconsin outwash overlies the Illinoian outwash on the flanks of Turkey Hill.

INTRODUCTION

PURPOSE AND SCOPE

This paper describes the most complete exposed section of Pleistocene sediments in the coastal plain of Pennsylvania and suggests its probable age. The section is in a gravel pit in Turkey Hill, southeastern Bucks County, 200 feet north of lat 40°10′ N. and 2,100 feet east of long 74°47′ E. (see fig. 1) and is on the Trenton quadrangle.

Previous workers had not observed more than 20 feet of Pleistocene section at Turkey Hill. During this investigation, however, the authors were fortunate in being able to observe the outcrops when the development of the gravel quarry had exposed the complete section. Further quarrying operations will probably destroy the exposures.

The fieldwork done for this report was part of an investigation of the coastal plain deposits of southeastern Pennsylvania made by personnel of the U.S. Geological Survey in cooperation with the Pennsylvania Geological Survey, Department of Internal Affairs.

PREVIOUS INVESTIGATIONS

Pleistocene sediments of the coastal plain in New Jersey and Pennsylvania consist of gravel, sand, and some clay. They were divided by Salisbury (1898), on the basis of topographic position and degree

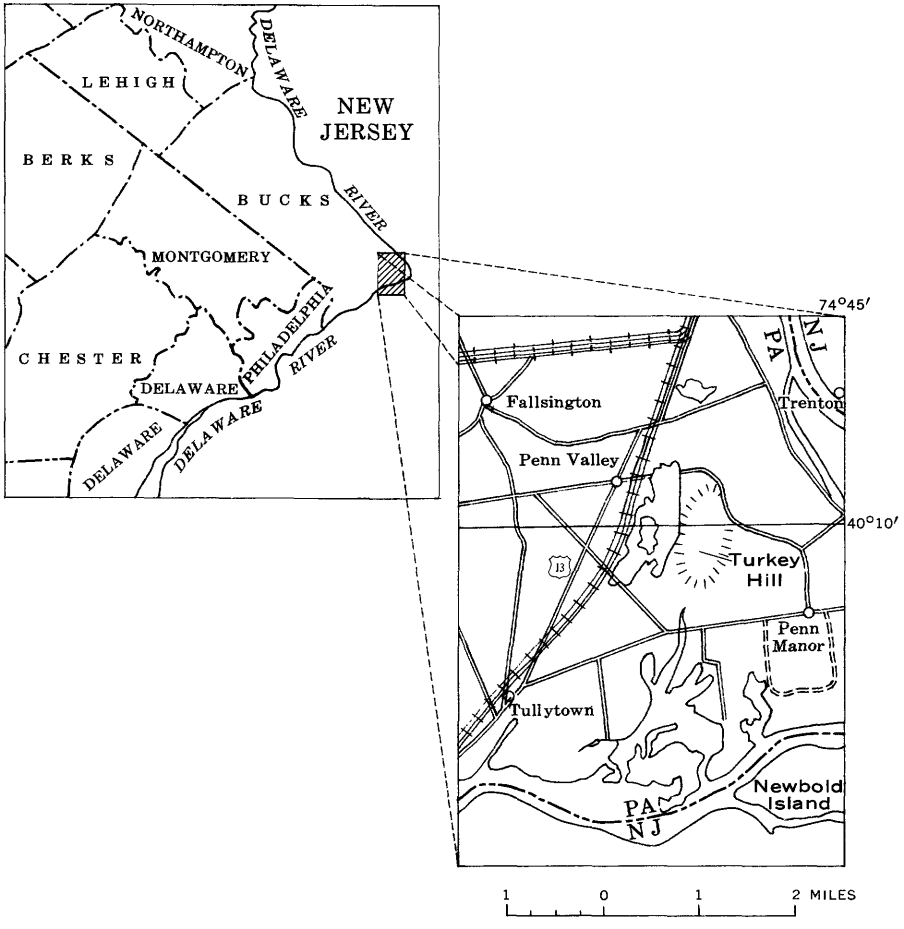

FIGURE 1.—Index map of Turkey Hill area, Pennsylvania.

of weathering, into the Bridgeton, Pensauken, and Cape May formations.

The Bridgeton, the oldest of the three formations, caps the higher hills. It was considered by Salisbury and Knapp (1917) to be of fluvial origin and to be, in part, glacial outwash from the earliest recorded glacial ice sheet of the New Jersey area. Leverett (1934) suggests that the Bridgeton was deposited during a glacial stage but that the drift with which it should be correlated has not been definitely recognized. However, he believes that the formation is older than the Jerseyan drift. The Bridgeton formation occurs only in small patches in the Trenton quadrangle and has not been mapped at all in the Pennsylvania part of the quadrangle (Bascom and others, 1909, areal geology map).

The Pensauken formation, consisting of gravel and sand, unconformably overlies the Bridgeton formation (Salisbury, 1898). Salisbury and Knapp (1917) considered the Pensauken to be a glacial outwash deposit, probably of Jerseyan age. Leverett (1934) believed the formation to be older than Illinoian and possibly of Jerseyan age.

In the Trenton quadrangle, according to Salisbury (*in* Bascom and others, 1909), the Pensauken formation occupies uplands from 40 to 130 feet above sea level and is mixture of glacial material deposited by streams from the north and fluvial sand and gravel derived from Cretaceous and Tertiary formations to the south and east. MacClintock and Richards (1936) believed the twofold division of the older Pleistocene gravels into the Bridgeton and Pensauken formations to be incorrect, and that these deposits are a series of many formations. They believed that these sediments, which contain warm-climate plant remains, were deposited during interglacial time and that they are older than Illinoian—probably even pre-Jerseyan in age. They considered also the possibility that part of the deposits may have been deposited during a glacial stage.

The Cape May formation unconformably overlies the Pensauken formation (Salisbury, 1898) and was correlated with the last (Wisconsin) glaciation by Salisbury and Knapp (1917). It is confined to valleys of the present streams in the Trenton quadrangle.

According to Salisbury (*in* Bascom and others, 1909), the formation contains material of both glacial and nonglacial origin. MacClintock and Richards (1936) believe that the Cape May formation consists of two phases: an interglacial deposit of Sangamon age, and an outwash gravel. They prefer to retain the name "Cape May" for the interglacial phase.

On the geologic map of the Trenton quadrangle (Bascom and others, 1909, areal geology map) Turkey Hill is shown as a deposit of Pensauken surrounded by the Cape May formation.

Deposits previously mapped as Pensauken on the Pennsylvania part of the Trenton quadrangle (Bascom and others, 1909, areal geology map) have been mapped by Peltier (1959) as Illinoian valley train sand and gravel. Evidence for an Illinoian age is the reddish-brown color, the composition, and the altitude at which deposits lie. Peltier, however, mapped Turkey Hill as Pensauken. At the time he mapped Turkey Hill there was 20 feet of section exposed on the south side of the hill. Because of the degree of weathering of the exposed sediments and the lack of a red zone he considered the sediments to be older than any other recognized Wisconsin sediments in the area but younger than Illinoian.

The sediments mapped as Cape May on the geologic map of the Trenton quadrangle (Bascom and others, 1909, areal geology map) were identified by Peltier (1959) as Wisconsin in age and were divided by him, on the basis of terrace level identification, into Olean gravel outwash (the oldest), Binghamton sand outwash, and Valley Heads gravel outwash (the youngest).

ACKNOWLEDGMENTS

Acknowledgment is due Prof. Paul MacClintock of Princeton University for his encouragement and helpful suggestions given on a field trip in May 1958.

PLEISTOCENE STRATIGRAPHY OF TURKEY HILL

The Turkey Hill section includes about 43 feet of Pleistocene outwash gravel and sand overlain by 1 to 3 feet of sandy loess. (See table 1 and fig. 2.) The Pleistocene outwash overlies sand of Cretaceous age. Most of the Pleistocene section is exposed in the walls of a gravel pit. A test hole in the floor of the gravel pit revealed an additional 3.5 feet of gravel of Pleistocene age underlain by sand of Late Cretaceous age.

The outwash deposit consists predominantly of coarse gravel and coarse sand. The pebbles and cobbles are limonite-stained quartzite and deeply weathered crystalline and sedimentary rocks, some of which are readily identified as having been derived from formations of Triassic age. The outwash contains large cobbles, boulders weighing up to several tons (fig. 3), and some glauconite which was probably derived from marine sediments. Some quartzite erratics are smooth except for faint glacial striae. Much of the sand is crossbedded.

The uppermost gravel in the section is immediately below the loess. This gravel is approximately 1 foot thick and consists of tightly compacted faceted pebbles, some of which appear to be ventifacts. (See figs. 4 and 5.) Most of the pebbles are ¼ inch to 3 inches in diameter, and red clay and sand fill the interstices between pebbles. This tightly compacted gravel is considered to be a lag gravel formed from glacial outwash as a result of removal of fine material by strong winds.

The lag gravel and several feet of the underlying gravel and sand have been reddened by weathering. This red zone represents a fossil soil indicative of long exposure to surface weathering and in eastern Pennsylvania is characteristic of Illinoan till that was weathered during the Sangamon interglacial stage (Leverett, 1934, and Peltier, 1949).

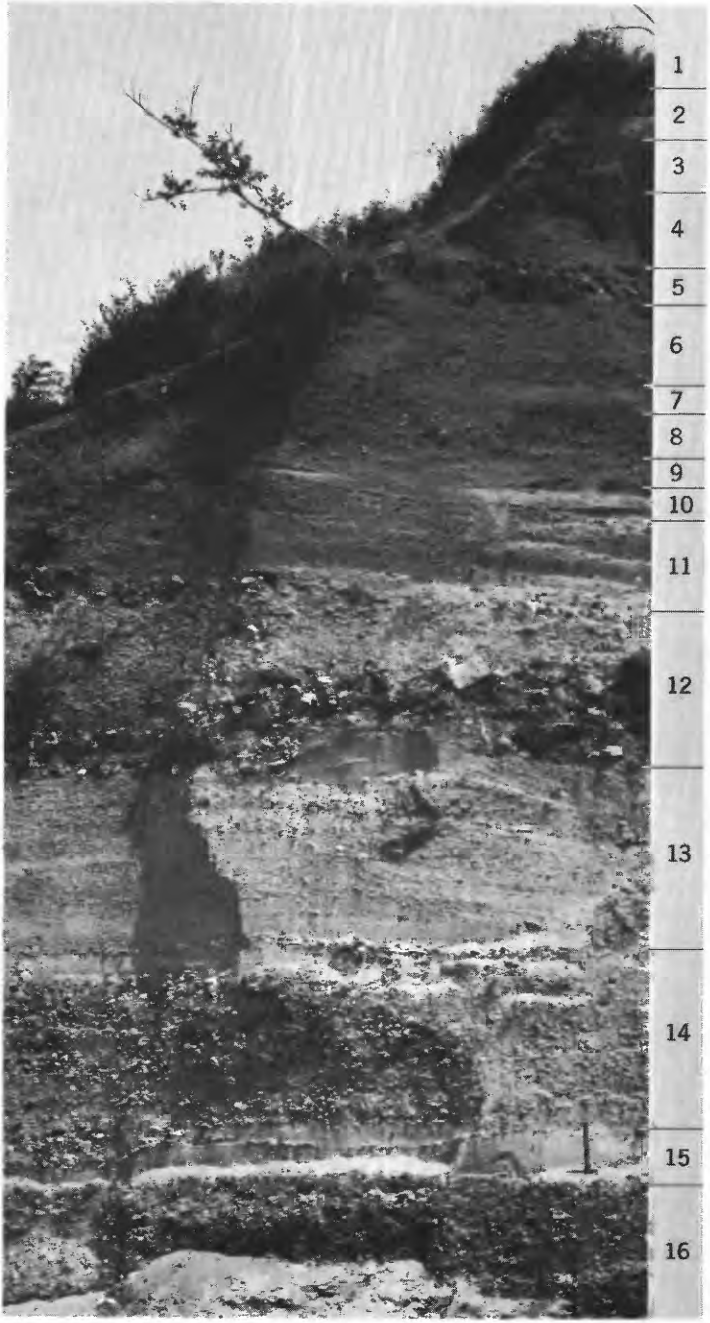

FIGURE 2.—Stratigraphic section at Turkey Hill. Numbers refer to the description of the stratigraphic units.

TABLE 1.—*Turkey Hill section*

	Thickness (feet)
Recent deposits:	
1. Soil	0–1
Pleistocene deposits:	
Wisconsin stage:	
2. Loess, grayish-brown, sandy	1
Illinoian stage:	
3. Lag gravel, red, clayey, poorly sorted, tightly compacted; contains ventifacts; some pebbles show impact fractures	1
4. Sand, red, medium- to coarse-grained: some pebbles show impact fractures	3
5. Gravel, reddish-brow, very coarse grained	1
6. Gravel, reddish-brown, sandy	3
7. Sand, yellowish-brown	1
8. Gravel, reddish-brown, sandy, weathered	2.5
9. Sand, dark-yellowish-brown, pebbly	1
10. Sand, light-grayish-brown, pebbly	2
11. Sand, dark-yellowish-brown, pebbly	4.5
12. Gravel, very coarse grained, poorly sorted; quartzite pebbles and extremely weathered sedimentary- and crystalline-rock pebbles; boulders at base; grades laterally into a finer grained deposit	5
13. Sand, light-yellowish-brown, coarse-grained, well-sorted, crossbedded; angular quartz grains; mica; thin pebble streaks	5.5
14. Gravel, light-yellowish-brown, coarse-grained, sandy, clayey, poorly sorted; subrounded quartzite pebbles and some weathered sedimentary- and crystalline-rock pebbles	3.5
15. Sand, light-grayish-brown, coarse-grained, clayey, fairly well sorted; angular quartz grains; thin pebble streak	1
16. Gravel, dark-yellowish-brown, coarse-grained, clayey, sandy, poorly sorted; subrounded quartzite pebbles; large highly weathered sedimentary- and crystalline-rock pebbles and cobbles	5.5
(Section below seen in cuttings from a test hole)	
17. Gravel, dark-yellowish-brown, clayey, sandy, highly weathered	3.5
Cretaceous deposits:	
18. Sand, pale-yellowish-brown, fine- to coarse-grained	114.5

The grayish-brown sandy loess above the lag gravel ranges from 1 to 3 feet in thickness and is believed to be of Wisconsin age. A Recent soil has developed upon the loess.

The Cape May formation overlies the highly weathered outwash on the flanks of Turkey Hill. This formation consists of relatively unweathered gray sand and gravel ranging from medium-grained sand to boulders weighing several hundred pounds. The pebbles and boulders are composed of hard sandstone, quartzite, red and gray argillite, gray silty limestone, gneiss, and gray granitic-textured

FIGURE 3.—Large glacial erratic.

FIGURE 4.—Lag gravel overlain by loess. (1) Loess, (2) lag gravel.

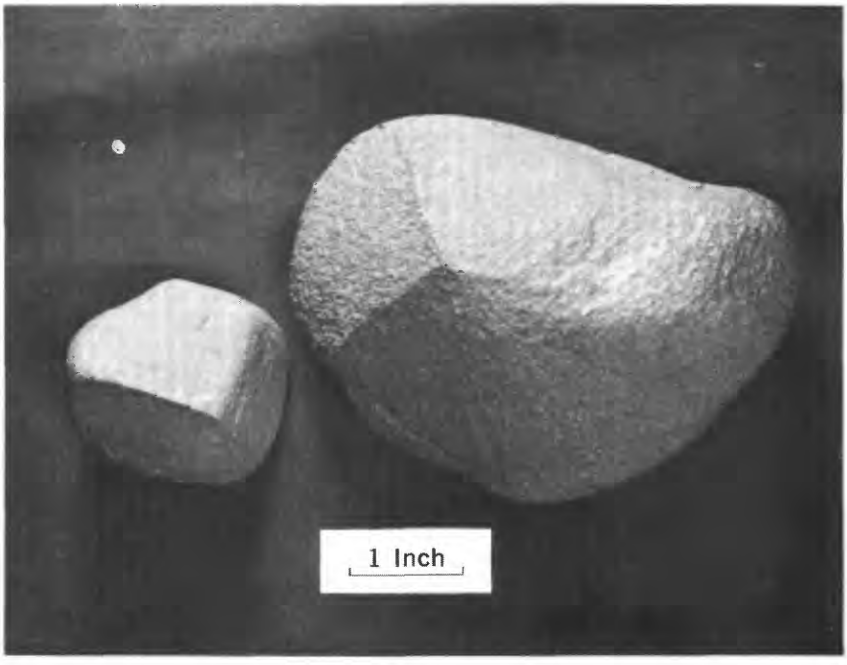

FIGURE 5.—Ventifacts.

rocks. The great contrast between the degree of weathering of the Cape May formation and the outwash in Turkey Hill indicates that the two deposits belong to separate glacial stages.

The writers believe, as do previous workers in the Coastal Plain (Peltier, 1959), that the Cape May formation in southeastern Pennsylvania comprises one or more Wisconsin glacial substages.

The outwash in Turkey Hill is believed to be Illinoian in age because the degree of weathering, especially the red zone, is characteristic of Illinoian till in eastern Pennsylvania. The outwash in Turkey Hill has been mapped by previous workers as Pensauken (Bascom and others, 1909, and Peltier, 1959). As the age and origin of the Pensauken formation has not been established, the authors of this report do not imply a correlation between the outwash deposits of Turkey Hill and the Pensauken formation.

PLEISTOCENE HISTORY

Prior to Pleistocene time Turkey Hill stood as a topographic high composed of sand of Late Cretaceous age.

During Illinoian time glacial outwash was deposited upon the Upper Cretaceous sand by swiftly flowing streams. Large glacial erratics weighing several tons were rafted by floating ice blocks and

incorporated in the outwash. The Illinoian ice sheet approached Turkey Hill and created periglacial conditions—strong wind action, frozen ground, and little vegetation. During this period of periglacial conditions wind removed fine material from the top of the deposit, leaving a concentrated zone of pebbles and cobbles (lag gravel) and producing ventifacts.

After the Illinoian ice front retreated, deep weathering of the exposed Illinoian outwash during the Sangamon interglacial stage resulted in reddening of a zone several feet thick.

During a Wisconsin glacial substage, outwash was deposited on the flanks of Turkey Hill and a thin veneer of loess was deposited on Turkey Hill. A Recent soil has developed on the loess.

SUMMARY AND CONCLUSIONS

The authors believe that the Pleistocene outwash exposed in Turkey Hill is of Illinoian age. The two outstanding facts supporting this belief are (1) the thick red zone which apparently developed during Sangamon time and is overlain by loess and a Recent soil zone and (2) the deep weathering of the crystalline- and sedimentary-rock pebbles and cobbles in the gravel pit—in contrast to the freshness of the outwash of Wisconsin age on the flanks of Turkey Hill.

Periglacial conditions prevailed at Turkey Hill during part of Illinoian time. This statement is supported by the tightly compacted lag gravel and the presence of ventifacts, indicating strong wind action and lack of vegetation.

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