SOIL AND PALEOSOL OF THE WARNOCK TERRACE

HEBER D. LESSIG
U. S. Department of Agriculture, Lisbon, Ohio

Soils developed on terrace remnants at the 960 to 1020 ft level are being studied at several places in the upper Ohio drainage basin with a view of determining some of the early Pleistocene history of the region. The high level alluvium, covering the terrace in the Ohio Valley proper, is of sand and gravel, containing pebbles of crystalline rocks and is presumed to be of glacial outwash (Leverett, 1903, pp. 88–98; Hubbard, 1954, pp. 365–370). Some of this alluvium is found as high as 1060 ft elevation in Section 9, Wells Township, Jefferson County, Ohio, near Salt Run and Rush Run. The high level terrace, covered with alluvium from weathering of local rocks, occurs along tributary streams, from basins not known to be glaciated, and joins with the Ohio River terrace throughout the upper Ohio Valley.

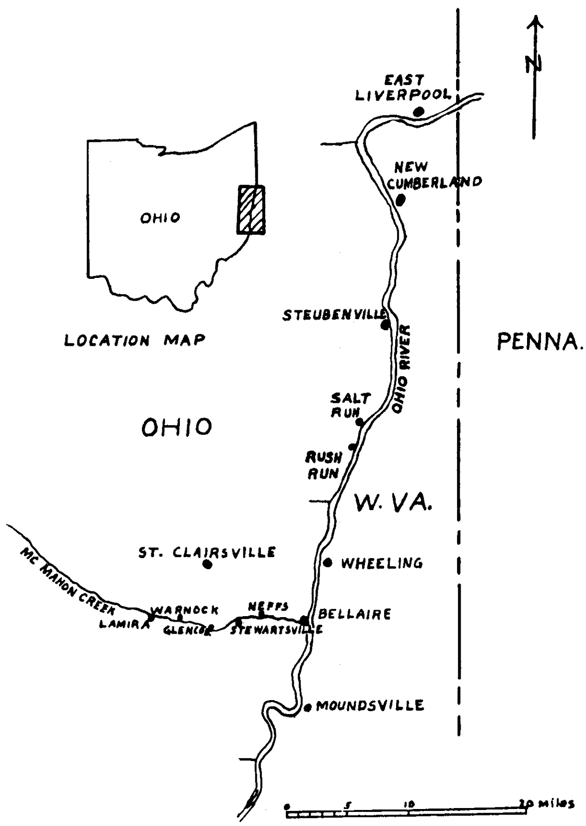

FIGURE 1. Map of region of Warnock Terrace.

During soil survey work, the author found a soil of the tributary high level terrace formed on top of another soil, a buried paleosol, in an excavation ¼ mi northeast of Warnock along the road to Glencoe, Smith Township, Belmont

County, Ohio (St. Clairsville Ohio Quadrangle Map, U. S. Geological Survey), at an evelvation of 1040 to 1080 ft. This may be useful evidence in determining some of the early Pleistocene history of the region, as geologic events which took place in the Upper Ohio Valley may also have affected deposits in the tributary valleys as well.

The soil and buried paleosol of the terrace near Warnock have apparently been formed from alluvium from weathering of local rocks. The buried paleosol was formed on a terrace level apparently older than and buried by the high level terrace. Since the later is the highest terrace of glacial origin or formed as a result of glaciation, it is probably of early Pleistocene age. The evidence indicates that the terrace on which the buried paleosol developed was there before the region was invaded by outwash from glaciers.

This report will refer to the high level terrace remnant near Warnock as the Warnock Terrace. It is part of a terrace that is found along McMahon Creek near Neffs, Stewartsville, Glencoe, Warnock and Lamira.

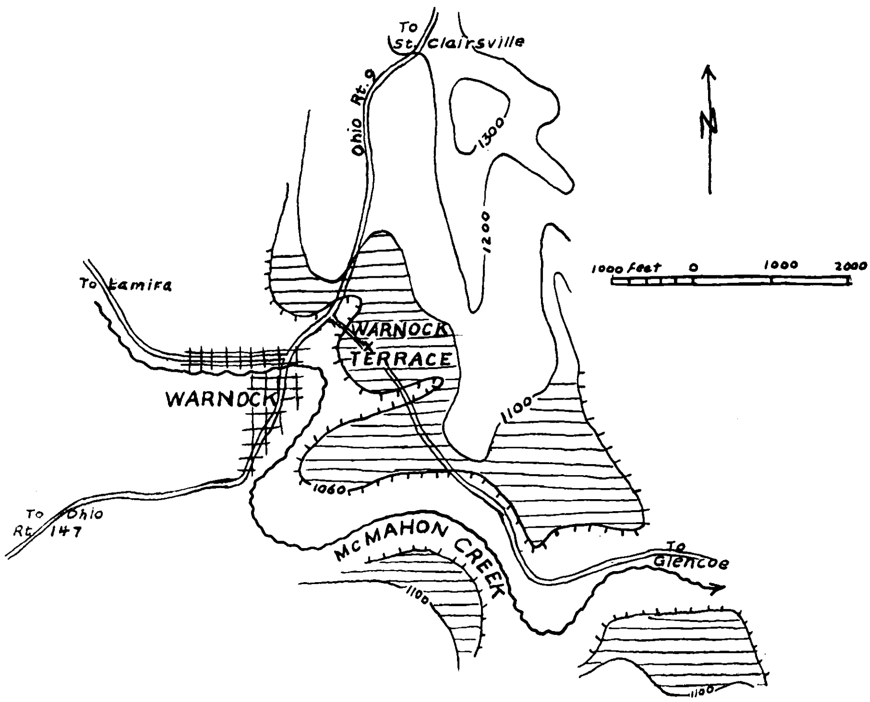

FIGURE 2. Map of the Warnock Terrace.

TOPOGRAPHY OF THE WARNOCK TERRACE

The region near the Warnock Terrace has an upland surface which is a dissected part of the Unglaciated Allegheny Plateau. The ridgetop remnants of this surface have a general elevation of 1200 to 1360 ft. The preglacial drainage level stood at 1080 to 1040 ft in upper parts of tributary streams and descended to about 960 ft in the main valley at East Liverpool, Ohio. It drained northward towards Lake Erie.

The rock terraces of this system are mentioned by Leverett (1903, pp. 88–98, 121–125). During Pleistocene time this drainage level was entrenched and present stream levels are at 920 ft at Warnock and at 610 ft at Wheeling.

The upland soils are formed from interbedded sandstone, shale and limestone. Most of these soils, upstream from Warnock, are deep, medium to fine textured soils and most of them are formed partly from limestone.

SOIL AND BURIED PALEOSOL OF THE WARNOCK TERRACE

The soil of the Warnock Terrace has been identified by the author as Monongahela Silt Loam and the buried paleosol as a paleo-Humic-Gley soil. Both the soil and the paleosol are developed from alluvium from weathering of local, residual, sandstone, shale and some interbedded limestone rocks.

Location: NW ¼ Section 18, Smith Township, Belmont County, Ohio, along paved road from Warnock to Glencoe, ¼ mi northeast of Warnock and about 500 ft east of intersection with Ohio Route 9.

Slope: 3%, concave, 200 ft from base of steep slope.

Elevation: 1060 ft. Relief: ridgetops at 1320 ft, stream at 920 ft.

Drainage: moderately well drained tending towards imperfectly drained class.

Collectors: John Dunlavy and H. D. Lessig.

(The soil descriptive terminology used below follows usage of the Soil Survey Manual by the Soil Survey Staff, 1951, U. S. Dept. of Agriculture, Handbook 18, Washington, D. C.)

Depth and Horizon	Profile Description (moist colors in Munsel notations, pH determined colorimetrically in field).
0–8 in. A_p	Dark grayish brown (10YR 4/2) silt loam; weak very fine crumb structure; friable when moist; no pebbles; very strongly acid, pH 4.8; boundary abrupt.
8–14 in. B_1	Brown (10YR 5/3) silt loam to silty clay loam with few faint reddish brown mottles; moderate fine subangular blocky structure; friable when moist; no pebbles; very strongly acid, pH 4.6; boundary abrupt, smooth.
14–20 in. B_{21g}	Yellowish brown (10YR 5/6) silty clay loam to silt loam with many medium prominent gray and reddish brown mottles; light yellowish brown (10YR 6/4) silty coatings on ped faces; weak medium prismatic structure breaking to moderate medium subangular blocky peds; friable when moist; small pebbles weathered to silt; strongly acid, pH 5.2; boundary clear, smooth.
20–45 in. B_{22g}	Strong brown (7.5YR 5/6) silty clay loam with many coarse prominent gray and reddish brown mottles and black Mn stains; light brownish gray (10YR 6/2) silty clay coatings on prism faces 4 mm thick; moderate very coarse prismatic structure breaking to very coarse angular blocky peds; firm when moist; no pebbles; strongly acid, pH 5.2; boundary gradual.
45–60 in. B_{23g}	Strong brown (7.5YR 5/6) silty clay with many coarse prominent gray and reddish brown mottles and black Mn stains; light brownish gray (10YR 6/2) clay coatings on prism faces 4 mm thick; moderate very coarse prismatic structure breaking to strong very coarse angular blocky peds; firm when moist, sticky when wet; no pebbles; very strongly acid, pH 5.0; boundary clear irregular extending in narrow pockets into underlying horizon.
60–65 in. A_{1b}	Very dark brown (10YR 2/2) coarse clay with many coarse faint dark gray (10YR 4/1) mottles; gray (10YR 5/1) fine clay coatings on prism faces 4 mm thick; weak coarse prismatic structure breaking to strong medium subangular blocky peds; firm when moist, plastic when wet; medium acid, pH 5.6; buried surface soil of paleo-Humic-Gley soil which has become part of solum of overlying soil.
65–120 in. B_{2b1}	Yellowish brown (10YR 5/6) silty clay loam with many fine distinct gray and brown mottles and black Mn stains; gray clay coatings on prism faces; moderate coarse prismatic structure breaking to fine subangular blocky peds; firm when moist; medium acid, pH 5.8; part of B horizon of paleo-Humic-Gley soil.

120–140 in. B_{2b2} Light gray (10YR 6/1) coarse silty clay 80% with light brownish gray (10YR 6/2) silt loam 20% in center of prisms, many coarse black Mn stains; moderate coarse prismatic structure; very firm when moist; medium acid, pH 5.8; part of B horizon of paleo-Humic-Gley soil.

140–160 in. B_{3b} Strong brown (7.5YR 4/6) clay with many medium distinct gray mottles and black Mn stains; moderate coarse prismatic structure; very firm when moist; medium acid, pH 6.0.

160 in.+ D Gray (10YR 5/1) clay with brown stains in vertical cracks and black Mn stains; extremely firm when moist; medium acid, pH 6.0; total thickness undetermined, however bedrock outcrops a short distance away, indicating this horizon is not very thick over bedrock.

TABLE 1

Mechanical analysis of soil and Paleosol of Warnock Terrace*

Depth	Horizon	Sand 2–.05 mm	Silt .05–.002 mm	Total clay <.002 mm	Fine clay <.0002 mm
0–8 in.	A_p	5.3%	73.7%	21.0%	5.2%
8–14	B_1	1.8	70.8	27.4	12.2
14–20	B_{21g}	2.3	69.1	28.6	13.0
20–30	B_{22g}	2.4	73.0	24.6	11.9
30–45	B_{22g}	3.0	61.0	36.0	17.0
45–60	B_{23g}	5.1	49.1	45.8	21.3
60–65	A_{1b}	3.0	23.4	73.6	38.5
65–80	B_{2b1}	10.3	46.4	43.3	19.6
80–100	B_{2b1}	13.0	50.4	36.6	12.2
100–120	B_{2b1}	11.4	47.1	41.5	13.3
120–140	B_{2b2}	10.2	43.7	46.1	16.0
140–160	B_{3b}	6.1	37.1	56.8	27.2
160–170	D	1.2	31.8	67.0	34.1

*Mechanical analysis made by the Ohio Agricultural Experiment Station, at Columbus, Ohio.

DISCUSSION

The soil of the upper 60 in. of solum of the Warnock Terrace is believed to be derived from a more recent material and one laid down under different conditions than the material of the paleosol, below 60 in. depth. The sand content of the upper solum ranges from 1.8 to 5.1 percent while that of the paleosol ranges from 10.2 to 13.0 percent.

Horizon A_{1b} is called the A_1 horizon of the buried paleo-Humic-Gley soil because of its dark color. The sand content of 3.0 percent is low compared to the 10.2 to 13.0 percent sand content of the B_{2b1} and B_{2b2} horizons of the paleosol. However, a Humic-Gley soil normally occurs in depressed positions and is developed under high moisture conditions where clay sediment was probably deposited in quiet water conditions. This could explain the high clay and low sand content.

The author believes the soil of the Warnock Terrace to be alluvium from weathering of local rocks, deposited during the drainage cycle during which the glacial outwash of the 1020 to 960 ft terrace of the Ohio Valley was deposited because both materials occupy the same general level where they join. However, the alluvium of the Warnock Terrace and other tributary terraces, in basins not known to be glaciated, differs from that of the Ohio Valley in that it is medium to fine textured while that of the Ohio Valley is coarse textured and the later contains pebbles of crystalline rocks. The terrace in the Ohio Valley apparently belongs to the outwash of the earliest Pleistocene glaciation of the Allegheny

Plateau because of its 1020 to 960 ft elevation, presence of crystalline pebbles and greater weathering than other, lower level, glacial outwash material. The soil of the Warnock Terrace is believed to be a part of that terrace, though of different material.

Buried paleosols have not been found beneath the 1020 to 960 ft outwash material of the upper Ohio Valley, except at one place about 1½ mi southeast of New Cumberland, W. Va., where the lower part of what is thought to be a paleosol occurs beneath a solum developed in sand and gravel. It is believed that the preglacial alluvial soil of the Ohio Valley was mostly removed by glacial meltwater transgressing and lowering a divide south of Bellaire. Such meltwater was confined, in this vicinity, to the Ohio Valley and the ponded water in the valley of McMahon Creek did not remove the paleosol at Warnock but deposited other alluvium on top of it.

The entire soil profile of the Warnock Terrace is composite because the soil forming processes taking place in the B_2 horizon are extending downward through the A_{1b} horizon of the paleosol. This is evidenced by the coarse prismatic structure of the B_{23g} horizon also occuring in the A_{1b} horizon and by the gray color developing along the prism faces. The very dark brown color in the center of the prisms is the fossil remnant of the color of the former surface soil before it was buried.

CONCLUSIONS

The arrangement of the soil and paleosol of the Warnock Terrace shows that a geological event must have ponded the drainage of McMahon Creek so that alluvium was deposited over a former surface standing at 1055 ft elevation. This ponding is interpreted as caused by glacial blocking of original northward drainage of a larger stream to which McMahon Creek was a tributary. The deposit of the Warnock Terrace is correlated with the highest glacial outwash terrace in the upper Ohio drainage basin. The ponding was caused by the advance of an early ice sheet to the Allegheny Plateau.

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