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THE ORIGIN OF LATE PLEISTOCENE DEPOSITS AT GARFIELD HEIGHTS, CUYAHOGA COUNTY, OHIO[1, 2]

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ABSTRACT

Illinoian sand and gravel, Sangamonian paleosol, Altonian and Farmdalian loesses, and Woodfordian sediments (laminated sand, silt, clay, and till) occur in superposition at the George Rackle and Sons Gravel Pit, situated in the valley of Mill Creek, Garfield Heights, Ohio. A molluscan fauna consisting of 17 species of terrestrial snails was identified from three studied sections of the Farmdalian loess. Ten species, *Deroceras laeve*, *Discus cronkhitei*, *Gastrocopta armifera*, *Helicodiscus parallelus*, *Nesovitrea electrina*, *Punctum minutissimum*, *Strobilops* sp., *Triodopsis algonquinensis*, *Vertigo elatior*, and *V. gouldi hannai*, are new to the Farmdalian loess of this area. Ten of the loess species do not occur at all of the sampled sections.

These variations in the composition of the molluscan fauna, together with a consideration of the color and the structure of the Farmdalian loess examined at four sections within this pit, suggest that the deposition may have been interrupted by erosion, or a period of non-deposition, or both, and that it is probably steeply time-transgressive. Colluviation toward the end of the Farmdalian Substage is suggested by a contorted two- to six-inch zone containing broken, angular clasts of clay, pebbles, sand, and terrestrial snails, all contained in a silt (loess) matrix, that occurs locally near the top of the Farmdalian loess.

The lower 6 feet of the overlying Woodfordian laminated sequence consists of intercalated layers of sand, silt, and clay, with scattered rock, shell, and plant fragments. This unit contained 12 species of terrestrial snails, all of which also occur in the Farmdalian loess. The terrestrial nature of the fauna, the similarity of the Woodfordian and Farmdalian snail assemblages, the total absence of pollen or of any aquatic organisms, and the presence of scattered clay-blebs, sand-sized quartz grains, and pebbles all suggest that the lower part of the Woodfordian sediments may have been derived locally from older units (Farmdalian loess, Sangamonian paleosol, and Illinoian sand and gravel). These materials were probably transported by some mass-wasting process and redeposited subaerially in topographic lows as slopewash, or as colluvium, or both. Layered modern sediments now accumulating in small, shallow depressions on the floors of abandoned borrow-pits in the area appear to simulate on a small scale the features observed in the basal Woodfordian sediments.

INTRODUCTION

Quaternary deposits locally exposed along the valley of Mill Creek, Garfield Heights, Ohio (fig. 1) are unique for this area of the state. At the George Rackle and Sons Gravel Pit, a sequence of Illinoian, Sangamonian, Altonian, Farmdalian, and Woodfordian sediments occur in superposition (White 1953; 1965; 1968), with some of the units in the sequence being relatively fossiliferous. Fossil molluscs have been reported from the Sangamonian paleosol-colluvium complex and from the overlying Wisconsinan "loesses" (Leonard, 1953). Coope (1968) has described an insect assemblage recovered from a thin organic zone occurring near the base of a sequence of "varved" silt and clay layers which locally overlie the Farm-

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dalian loess in an adjacent gravel pit (fig. 2, unit 5). Wood collected from the same level as the insects has been dated at about 24,000 B.P. (White, 1968).

It was the reported occurrence of fossil molluscs that first brought the senior author to the area in 1964. Numerous collecting trips in subsequent years have provided ample opportunity to examine carefully large areas within this gravel pit where the deposits are best exposed. These studies, which were confined primarily to the Farmalian loess (unit 4) and the Woodfordian sequence of sand, silt, and clay layers (unit 5), provide new data on these molluscan faunas and on details of the stratigraphy. This paper presents these new data and their interpretation.

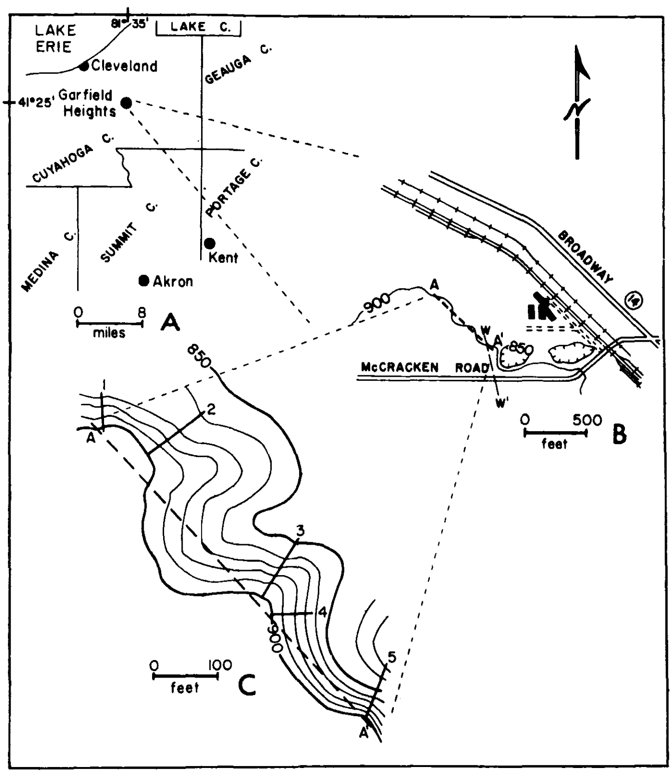

FIGURE 1. Locality Maps. (A) Location of Garfield Heights, Cuyahoga County, Ohio. (B) Location of George Rackle and Sons Gravel Pit in Garfield Heights. Lines A'–A and W'–W show the relative positions of Figure 1C (lower left) and of Figure 2. (C) Southwest wall of pit showing positions of five sections illustrated in Figure 3.

DESCRIPTION OF DEPOSITS

As a part of this investigation, 10 stratigraphic sections along the southwest wall of the George Rackle and Sons Gravel Pit were studied (fig. 1). Of these, five representative sections are illustrated in Figure 3. The elevations at the tops of these sections were established by alidade and the wall of the pit was contoured in 10-foot intervals to provide an accurate base map.

The following is a composite description of the stratigraphic sequence revealed in these sections (thickness listed for each unit is the maximum thickness recorded for that unit in any of the sections).

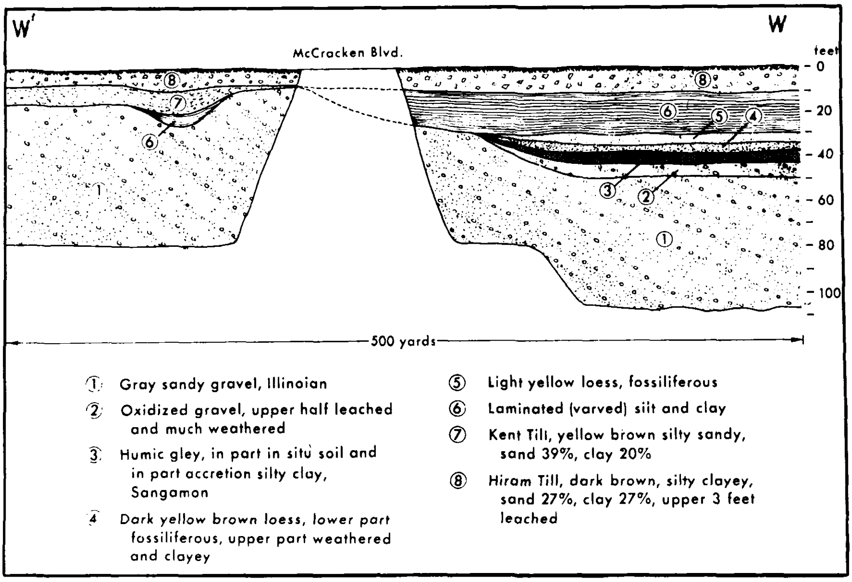

FIGURE 2. Diagramatic sketch of deposits exposed along line W'–W in Figure 1B (from White, 1968, p. 751).

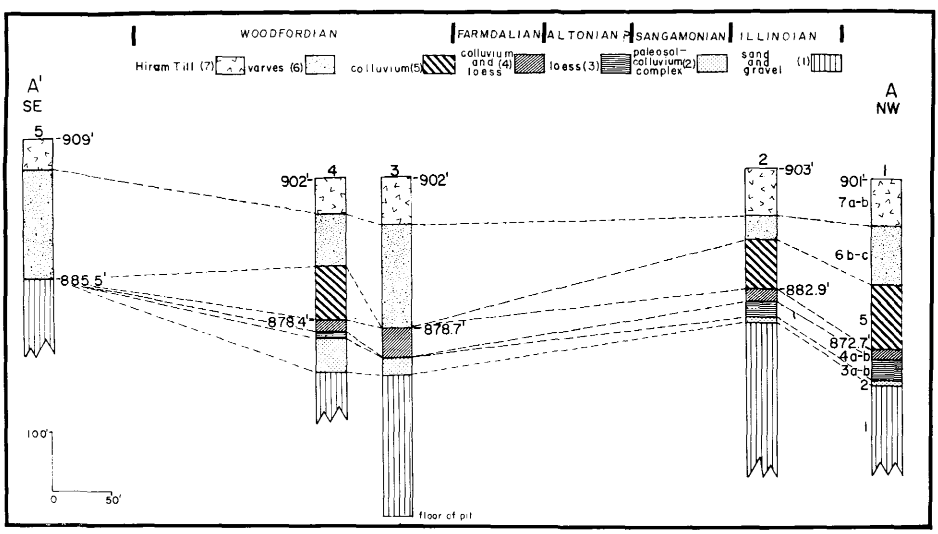

FIGURE 3. Diagramatic presentation of five sections exposed along line A'–A in Figure 1C, the southwest wall of the George Rackle and Sons Gravel Pit. The unit numbers in the legend are explained in the text.

COMPOSITE SECTION OF PLEISTOCENE UNITS IN GEORGE RACKLE AND SONS GRAVEL PIT, GARFIELD HEIGHTS, OHIO

		THICKNESS feet	inches
WISCONSINAN			
WOODFORDIAN			
	Hiram Till		
7b.	Soil		7
7a.	Till, composed of sand 31 percent, silt 32 percent, and clay 35 percent; orange-brown; depth of oxidation and leaching 21 inches; lower 54 inches calcareous and oxidized; black shale fragments common towards base (till description from section 1)	6	3
	"Varves"		
6c.	Silt, composed of silt 83 percent and clay 16 percent; yellow-brown (at section 2); with carbon flecks; layered, thickness of layers ranging from 6 inches to several feet; total thickness of unit ranging from 6 inches (section 2) to 7 feet (section 5)	7	
6b.	Silt, composed of silt 80 percent and clay 20 percent; alternating gray to grayish-brown (at section 2); calcareous; laminations apparent on weathered faces, appearing massive when fresh, laminae of alternating clay and silty clay up to 1 inch thick; thickness of unit ranges from 10 inches (section 2) to 14 feet (section 3)	14	
6a.	Silt, composed of silt 83 percent and clay 16 percent; yellow-brown; calcareous; only present at section 2	1	3
	Colluvium		
5.	Colluvium, composed of sand, silt, and clay; alternating gray and brown towards the top (at section 2); calcareous; laminations in the basal several feet tending to be thinner (½-inch thick) than those above, laminations discontinuous laterally, and containing interbeds of fine to medium sand; basal 6 feet containing terrestrial snails, insects (Coope, 1968), and comminuted wood and plant fragments; contact with underlying unit sharp	8	2
FARMDALIAN			
	Colluvium		
4b.	Colluvium, composed of silt 53 percent, clay 25 percent, sand 7 percent, and gravel 10 percent; reddish-brown, oxidized, calcareous; with broken and bent clay clasts, pebbles (to 2 inches in diameter), wood fragments, and terrestrial snails; contact with underlying unit gradational		6
	"Upper Loess"		
4a.	Loess composed of silt 83 percent and clay 16 percent; light-yellow-brown to gray-brown; calcareous; with carbon streaks; terrestrial snails extremely abundant (=levels 3 and 4 of Fig. 1 in Leonard, 1953)	1	10
ALTONIAN			
	"Lower Loess"		
3b.	Loess composed of silt 57 percent, clay 21 percent, and sand 21 percent; dark-yellow-brown; non-calcareous; with carbon streaks; irregular and wavy banding caused by iron oxide	1	3
3a.	Loess composed of silt 75 percent and clay 23 percent; light to medium yellow-brown; non-calcareous; with shell fragments and etched specimens of terrestrial snails (=level 2 of Fig. 1 in Leonard, 1953)	1	4
SANGAMONIAN			
	Paleosol		
2b.	Composed of silt 45 percent, clay 42 percent, and sand 12 percent, (at section 4); dark-gray, non-calcareous; carbonaceous (=level 1 of Fig. 1 in Leonard, 1953)	10	
2a.	Composed of silt 22 percent, clay 15 percent, sand 47 percent, gravel 16 percent (at section 2); yellow-brown; pebbles weathered; only top 6 inches exposed		6
ILLINOIAN			
1.	Sand and gravel; partly covered	15+	

The Farmdalian loess

The Farmdalian loess (unit 4a) occurs at different elevations along the pit wall (fig. 3). At section 5 (and farther to the southeast), units 4a and 4b are missing, and laminated silt and clay (unit 6) rests directly upon Illinoian sand and gravel (unit 1) at an elevation of 885.5 feet. The elevation of the contact between the Farmdalian loess (unit 4) and the overlying laminated sequence (unit 5) at sections 4, 3, and 1 occurs respectively at 878.4, 878.7, and 872.7 feet. The contact between unit 4b and unit 5 at section 2 is at 882.9 feet. Several hundred feet to the northewest of section 1, the contact between units 4a and 5 is at an elevation of about 860 feet.

The composition and color of the Farmdalian loess (unit 4a) are not uniform throughout the pit. At section 4, the upper one foot is gray-brown (Munsell 2.5Y6/4), and consists of an organic-rich zone containing wood, plant fragments, and streaked, sometimes contorted, ⅛- to ¼-inch-thick carbonaceous laminae (fig. 4). The percentages of sand, silt, and clay in the carbonaceous zone are 11, 73, and 14, respectively (hereafter abbreviated to 11–73–14). In contrast, the sand-silt-clay percentages of the loess (unit 4a) at section 4, beneath the organic zone, are 0.1–83–16. At sections 2 and 1, the loess is yellow-brown (2.5Y5/6) with sand-silt-clay percentages of 0.2–83–16 and 4–82–12. Seventeen species of snails were identified from the Farmdalin loess (unit 4a), collected at sections 2, 3, and 4 (Table 1).

Overlying the Farmdalian loess of unit 4a at section 2 is a 2- to 6-inch-thick zone, of colluvium unit 4b, consisting of tongues of contorted and broken reddish-brown (7.5YR7/2) clay clasts (fig. 5), sand, occasional disseminated plant fragments, and pebbles up to 2 inches in diameter (fig. 6) in a silt (loess) matrix. The sand-silt-clay percentages of this unit are 12–53–25.

The Early Woodfordian Colluvium

At sections 1, 2, 3, and 4, about 10 feet of layered sand, silt, and clay (unit 5) occur with erosional disconformity on either the Farmdalian loess (units 4a) or the Farmdalian colluvium (unit 4b). Relief on the disconformity is at least 20 feet (the maximum vertical distance now visible between units 4a and 5 occurs between section 1 and an unnumbered exposure several hundred feet to the northwest of section 1).

Plant fragments and the remains of terrestrial insects have been reported from the basal four inches of this early Woodfordian colluvium (unit 5) (White, 1968; Coope, 1968). Twelve species of terrestrial snails have been identified from the basal six feet of this unit (Table 1) and are reported here for the first time. The snails occur in discontinuous ½- to ¾-inch-thick laminae that commonly pinch out laterally within 6 to 8 feet (fig. 7). The fossiliferous laminae are composed of silt and clay that are gray (10YR7/1) and contain fine-to-medium sized sand in the form of whole and fragmented shells; sandstone, siltstone, and shale clasts; grains of quartz, biotite, and muscovite; plant fragments; and unidentifiable pieces of carbon.

THE FARMDALIAN-WOODFORDIAN SNAIL FAUNA

Approximately 200-, 20-, and 50-pound samples of Farmdalian loess (unit 4a) were collected from sections 2, 3, and 4, respectively. Molluscs were extracted from this material using a washing and screening technique described by Hibbard (1949).

A list of all molluscs identified from the Farmdalian loess is given in table 1. Only one of the 11 species reported from this unit by Leonard (1953), *Vertigo pygmaea*, was not identified in our collections. Ten species, *Deroceras laeve, Discus cronkhitei, Gastrocopta armifera, Helicodiscus parallelus, Nesovitrea electrina, Punctum minutissimum, Strobilops* sp., *Triodopsis algonquinensis, Vertigo elatior,*

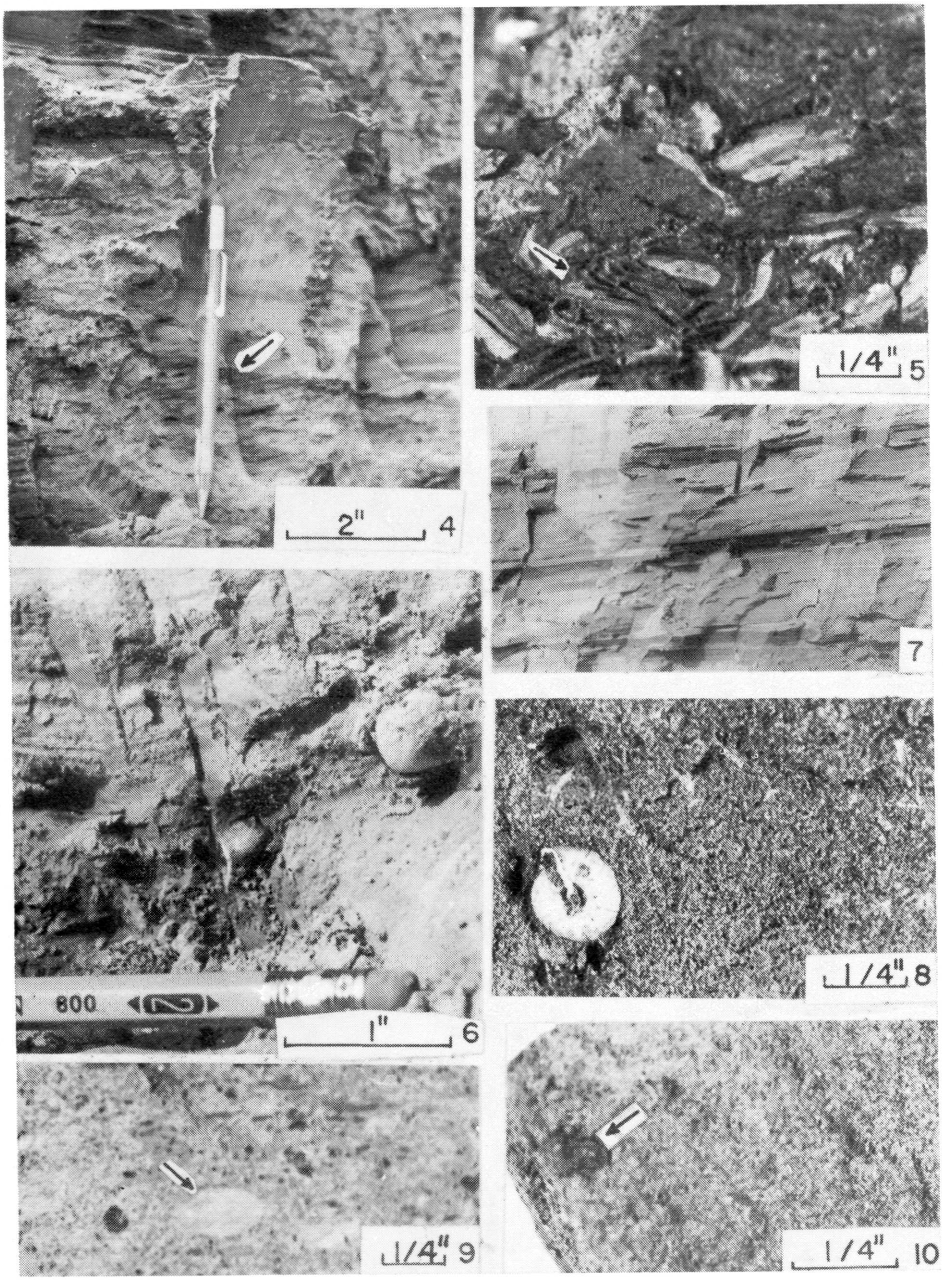

FIGURE 4. Contorted carbonaceous laminae (arrow in unit 4a at section 4).
FIGURES 5 and 6. Contorted and broken clay clasts (arrow) (Figure 5), and pebbles (Figure 6) from unit 4B at section 2.
FIGURE 7. Unit 5 at section 2, showing the discontinuous nature of the laminae.
FIGURE 8. *Stenotrema leai*, a terrestrial snail, from unit 5, section 2.
FIGURE 9. Clay bleb (arrow), unit 5, section 2.
FIGURE 10. Pebble (arrow), unit 5, section 2.

and *V. gouldi hannai*, were not listed by Leonard (1953) and are reported herein for the first time from the Farmdalian loess (unit 4a). The occurrence of *T. alonquinensis* at all three of our collecting localities, together with its absence from Leonard's faunal list, is perhaps of greatest significance, because it is highly unlikely that this large snail would have been overlooked by so experienced a worker if it had been present at or near the site from which he collected.

Ten of the 17 species of snails identified in the present study did not occur at all of the sampled sections (Table 1). The disjunct distribution of these species does not appear to be entirely related to sampling error or to differences in the local habitat conditions present at the collection sites. *Pupilla muscorum*, for example, was a common species (22 specimens) at section 3, but was absent at section 2, only several hundred feet to the northwest. The large sample size (200 pounds of matrix was collected from section 2), together with the close proximity of the sections (fig. 1), diminishes the probability that the species was not present at section 2 because of inadequate sampling or because the samples were taken from slightly different contemporaneous local habitats.

Species present in the early Woodfordian sediments are identified in Table 1 by single stars. No species were found in this unit which had not also been found in the underlying Farmdalian loess.

TABLE 1

Molluscs from the Farmdalian and Early Woodfordian Substages. A Kent State University catalogue number indicates the occurrence of the species at the locality. An X indicates that the species was recorded from the Farmdalian loess by Leonard, (1953).

Species	Section 2	Section 3	Section 4	Leonard 1953
Cionella lubrica (Mueller)*	2243	2201	—	X
Columella alticola (Ingersoll)*	2213	2202	2228	X
Deroceras laeve (Muller)**	2214	—	2229	—
Discus cronkhitei (Newcomb)**	2215	—	2230	—
Discus patulus (Deshayes)	—	2203	—	X
Euconulus fulvus (Muller)*	2216	2204	2231	X
Gastrocopta armifera (Say)* **	2217	—	—	—
Helicodiscus parallelus (Say)* **	2218	2205	2232	—
Hendersonia occulta (Say)*	2219	2206	2233	X
Nesovitrea electrina (Gould)* **	2220	—	—	—
Punctum minutissimum (Lea)* **	2221	—	2234	—
Pupilla muscorum (Linnaeus)	—	2207	2235	X
Stenotrema leai (Binney)*	2222	2208	2236	X
Strobilops sp. **(fragment)	2242	—	—	—
cf. *Succinea* (2 forms)	2223	2209	2237	X
Triodopsis algonquinensis Nason**	2224	2210	2238	—
Vertigo alpestris oughtoni Pilsbry*	2225	2211	2239	X
Vertigo elatior (Strerki)* **	2226	2212	2240	—
Vertigo gouldi hannai (Pilsbry)* **	2227	—	2241	—
Vertigo Pygmaea (Draparnaud)	—	—	—	X

*Species also occurs in the overlying Early Woodfordian sand, silt, and clay (unit 5).

**First reported occurrence of this species from the Farmdalian loess (unit 4a) at Garfield Heights.

DISCUSSION AND INTERPRETATION

The faunal differences between the collections obtained from sections 2, 3, and 4, and between these collections and that reported by Leonard (1953) can be explained most parsimoniously by assuming that loess deposition in this area was discontinuous and probably took place over a time interval that included most of the Farmdalian Substage. In this interpretation, the faunal differences are considered to be at least in part the result of faunal successions, with new species migrating into this area during a long interval of time. The fauna in each sample is thus believed to be slightly different because they represent collections made from loess of slightly different ages.

Variations in color, organic content, and particle size within unit 4a at sections 2, 3, and 4 also suggest that these sediments might not have been deposited contemporaneously throughout the pit. At section 2, a contorted 2- to 6-inch-thick zone (unit 4b) containing broken angular clay clasts (fig. 5), pebbles, and sand, mixed in a silt (loess) matrix, is gradational with the underlying loess (unit 4a). The convoluted bedding does not appear to be the result of post-depositional differential compaction because the snail shells intermixed in this zone are not crushed. The appearance of the material in unit 4b suggests emplacement by some mass-wasting process which the writers believe was colluviation.

The origin of the laminated silt, clay and sand (unit 5) poses a problem. White (1968, p. 751) interpreted these sediments as varves ". . . deposited in a lake formed by damming of the drainage by the advance of the Kent ice." G. W. White states (written communication of December 24, 1971) that "Coope's beetles came from a 'litter layer' at the base of the 'varved' silt and clay which I interpret as a deposit in the swash zone (upper part?) along the encroaching lake. The abraided wood and small logs in the layer are exactly like the materials along parts of the present Lake Erie shore." This interpretation is difficult to reconcile with the total absence of aquatic species from the insect fauna reported from near the base of this unit by Coope (1968). The present study revealed that unit 5 also contains a terrestrial snail fauna consisting of twelve species (Table 1), all of which also occur in the underlying Farmdalian loess (unit 4a). Samples of unit 5 submitted for pollen analyses produced no identifiable materials.

The discontinuous nature of the ½- to ¾-inch thick layers in unit 5, together with the composition of the scattered, fine to medium sand-sized rock, shell, and plant fragments, suggest that this unit may have been derived from local older units. Unit 5 appears to have been deposted on a surface with at least 20 feet of relief. The depth to which previous erosion had progressed determined which of the older units would be exposed locally on the dissected surface and would thus provide a source for the materials making up unit 5. Contributions from both the Illinoian sand and gravel (unit 1) and the Farmdalian loess (unit 4a) are suggested by the presence of terrestrial snails (fig. 8), clay belbs (fig. 9), pebbles (fig. 10), and quartz grains in zones scattered through the basal 6-feet of unit 5.

These sediments were either deposited subaerially or in a subaqueous environment of ephemeral pools that were dry during most of the year (Coope, 1968). The total absence of pollen and of aquatic insects or snails strongly supports a subaerial origin for these sediments. The layering within unit 5 may be genetically related to the rhythmically stratified slope deposits described by Dylik (1955). Stratified slopewash and colluvium now accumulating in small depressions on the floors of local borrow pits in the area (fig. 11) may represent a modern analog that

FIGURE 11. Modern stratified slopewash accumulating on the floor of a borrow-pit in the Cuyahoga River Valley, near Akron, Ohio.

simulates on a small scale the environmental conditions that prevailed at the time unit 5 was deposited.

AKCNOWLEDGMENTS

The writers wish to express their thanks and appreciation to Mr. George Rackle for granting permission to work on his property, to Mr. Milton Cooper for doing the granulometric analysis, to Mr. George Gardner who provided the figure of modern stratified slopewash depsoits, to the Kent State University Research Council for funding the study, and to our colleagues in the Department of Geology for their helpful suggestions and stimulating discussions on the Garfield Heights deposits.

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