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REPORT OF INVESTIGATIONS—NO. 11

PLEISTOCENE STUDIES:

1. A NOTABLE TYPE PLEISTOCENE SECTION: THE FARM CREEK
EXPOSURE NEAR PEORIA, ILLINOIS

BY MORRIS M. LEIGHTON

2. PRE-ILLINOIAN TILL IN SOUTHERN ILLINOIS

BY PAUL MacCLINTOCK

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A NOTABLE TYPE PLEISTOCENE SECTION: THE FARM
CREEK EXPOSURE NEAR PEORIA, ILLINOIS

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ABSTRACT

In 1920 a detailed examination was made by the writer of the so-called "Farm Creek Exposure" near Peoria, Illinois, from personal interest. It developed, however, that the description previously published of this very important Pleistocene exposure was considerably generalized and was made prior to our present conceptions of such materials as loess and gumbotil. The following discussion gives in detail the various elements in the section and offers an interpretation of them.

INTRODUCTION

The Peorian interglacial stage was named by Leverett¹ on the basis of the relations of a body of loess to the Illinoian and Wisconsin drift sheets in certain exposures east of Peoria, Illinois. One of these was a stream-cut exposure along Farm Creek, $\frac{1}{2}$ miles east of Peoria, and another a railway cut along the Toledo, Peoria & Western Railway, about half a mile farther east. Photographs of these cuts, taken by Dr. Calvin in 1897, are shown on Plate XI of Monograph XXXVIII, opposite page 128, and general descriptions are given in the legends and on pages 128 and 187; but, to the writer's knowledge, no detailed description has been published, such as is desirable for type cuts.

In connection with his investigations of the Pleistocene for the *Illinois State Geological Survey*, the writer had occasion to visit these exposures during the field season of 1920. He was accompanied by Messrs. Ben Herzberg and E. W. Ahern, students of the University of Chicago, who aided materially in the examination. The railway cut was too badly slumped and grassed over for study, but the Farm Creek exposure was in exception-

¹ Frank Leverett, "The Illinois Glacial Lobe," *U. S. Geol. Survey, Monograph XXXVIII* (1899), p. 187.

ally good condition for inspection. Because of the exceptional phenomena shown, some of which have not heretofore been noted, a detailed description was made, which will be presented and discussed herewith.

LOCATION

So far as can be determined from the post-office map of Tazewell County, the Farm Creek exposure is located near the south line of the SE. $\frac{1}{4}$, Sec. 30, T. 26 N., R. 3 W., on the south side of the stream and just east of the Toledo, Peoria & Western Railway bridge. The small stream swings

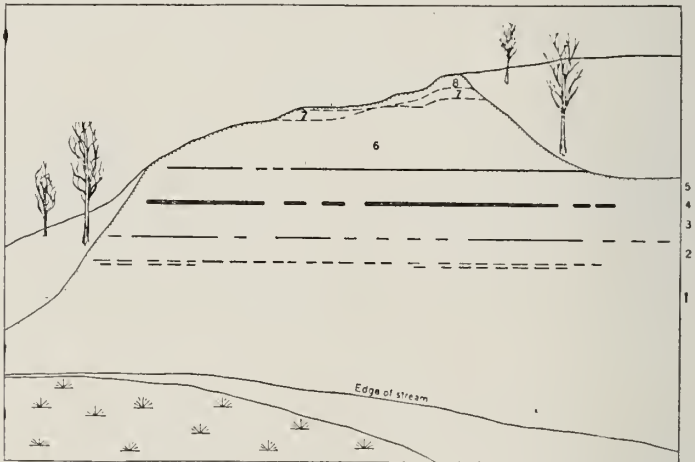


FIG. 1.—Diagram of the stratigraphic successions at the Farm Creek exposures. (1). Illinoian till; (2). Illinoian gum-botil; (3). Sangamon loesslike silt; (4). Old soil (Sangamon); (5). Peorian loess; (6). Shelbyville till; (7). Bloomington gravel; (8). Post-Bloomington loess.

against the south valley wall at this place and undercuts actively enough to keep the face of the exposure fairly clean. At the time of visit the face was somewhat freer of slump than it was when the photograph previously referred to was taken.

DIMENSIONS AND FORM

The cut is about 100 feet high, 225 feet long in an east-west direction, and, with the exception of minor details, it still has about the same form as shown in Dr. Calvin's photograph. The general form and sequence of materials is sketched in the accompanying diagram (Fig. 1).

STRATIGRAPHIC SECTION

The following stratigraphic section is shown:

Post-Bloomington:

	Feet
8c. Soil, light gray, loessial.....	1- 1½
8b. Leached loess, brown, jointed by roots and surface weathering, thickness about	3½
8a. Calcareous loess, yellow, no shells found, thickness.....	0- 2½

Wisconsin gravel and till:

7. Bloomington gravel, discontinuous, brown, limestone pebbles present beneath calcareous loess, absent for a few inches directly beneath leached loess, thickness.....	0- 4
6. Shelbyville till, typical pebbly clay till with lens of gravel 8-10 feet thick on east side and about 10 feet below the top, the gravel contains till balls; till oxidized yellow in upper 2-6 feet with very faint maroon or orange tinge, bluish-gray below where damp, light-gray on dry surface, with slight maroon tinge, calcareous, thickness.....	32

Peorian:

5. Loess, grayish yellow, with rusty streaks and spots, fossiliferous, shells fragile and larger ones crushed and difficult to extricate, cleavage planes through the loess made by the pressure which crushed the shells, calcareous throughout, humus streak 2 inches thick about 10 inches below the Wisconsin till, contact with Wisconsin till sharp, thickness.....	6
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Sangamon:

4. Old soil, dark with flakes of carbon, some fragments of old wood in east part of cut, loessial in texture, non-calcareous.....	1- 1½
3. Loesslike silt; on east side brownish in upper 1-1½ feet, grading below into grayish-yellow, 2-2½ feet, and again into brownish with carbon specks, 3-4 feet, the lower 2 feet showing slight trace of effervescence with acid; no effervescence in upper 5½ feet; no bedding or stratification. On west side this loesslike silt is bluish-gray with greenish cast below the old soil, the soil and about 6 inches of the greenish loess is leached; calcareous below, very compact, no bedding or stratification, scattered small pebbles in lower 3 feet; thickness same on both sides of cut.....	7- 8

Illinoian:

2. Gumbotil, chocolate brown, with reddish specks on east side, brownish to brick red at top with bluish-green spots on west side, tenacious, hackly fracture, siliceous pebbles, mostly under ¾ inch, non-calcareous, shear zones on west side, thickness about.....	4
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Grades into:

1. Very calcareous till, few small lime concretions at top, limestone pebbles prevalent, grayish, mostly covered with wash and slump to base of cut.....	41
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INTERPRETATIONS

Several important points are to be noted in the interpretation of this section.

1. There can be scarcely any doubt that the lower till is Illinoian in age. The typical Illinoian till occurs but a few miles to the south and southwest, with its surface at essentially the same elevation as it is here and with similar relations to the overlying loess.

South of the Wisconsin drift boundary, gumbotil has been found at the top of the Illinoian, and it is impressive to find it here. As pointed out by Kay and Pearce,² this peculiar tenacious, leached, and siliceous pebbly clay appears to be the product of a long interval of chemical weathering of the till before the deposition of the overlying deposit.

2. The overlying loesslike silt, horizon 3 of the section, seems best interpreted as a weathered loess. The color and weathered character of the Illinoian gumbotil below, and the thickness and calcareous content of the loesslike silt above, exclude the interpretation that the latter is the product of extreme weathering of the gumbotil. The occurrence of rare pebbles in the lower part is not unusual to the basal portion of any loess deposit which rests on a pebbly formation from which pebbles could be introduced secondarily by organic agencies. The calcareousness of the lower part of this deposit, although not notable, indicates that it was deposited subsequent to the weathering of the gumbotil. The upper leached zone of $5\frac{1}{2}$ feet, the brownish color on the east side of the cut, and the overlying old soil shows that this loesslike silt was subjected to subaerial agencies of weathering and plant growth for a considerable period before the deposition of the overlying fossiliferous loess.

The presence of this soil zone and the loesslike clay beneath the fossiliferous loess has not been hitherto noted in this exposure. In the legend of the photograph of the Farm Creek section in Monograph XXXVIII, Plate XI, Leverett includes all of the deposits between the Illinoian till and the Wisconsin till as "Iowan loess."

In the railway cut, one-half mile to the east, Leverett reports and illustrates by photograph the occurrence of a peat bed 3-5 feet thick, below the so-called "Iowan loess," and a 2- to 5-foot bed of silt between the peat bed and the underlying Illinoian till.³ Of the silt Leverett states that it "bears some resemblance to the overlying Iowan loess in texture, but is not so calcareous and is of a deeper brown color. Whether it is similar in origin to the loess can scarcely be decided." Parenthetically, it may be stated that

² G. F. Kay and J. Newton Pearce, "The Origin of Gumbotil," *Jour. Geol.*, Vol. XXVIII (1920), pp. 89-125.

³ Frank Leverett, "The Illinois Glacial Lobe," *U. S. Geol. Survey, Monograph XXXVIII* (1899), p. 128; Pl. XI b.

this monograph was written when the theory of the origin of the loess was swinging from the aqueous hypothesis to the eolian hypothesis, and the discussion carries the spirit of compromise rather than the present general view that the loess is dominantly eolian in origin.

The peat of the railway cut occupies the same horizon as the old soil in the Farm Creek exposure. The peat here, as Leverett points out, records poor drainage conditions after the weathering of the underlying till. It may well have been a local marsh, such as might result if there were relatively slight irregularities in the deposition of the loess on a previous flat surface. The Farm Creek exposure emphasizes the local transition that existed within short distances from subsurface drainage of an oxidizing character to nearly stagnant drainage of either unoxidizing or deoxidizing character. The brown to grayish-yellow color of the old loesslike silt in the east part of the cut is believed to represent the former condition, and the bluish-gray loesslike silt with greenish cast in the west part represents the latter. The difference in color of this loesslike silt and the normal loess is, therefore, not significant of a difference in mode of origin.

The overlying soil was formed subsequent to the deposition of the underlying loesslike silt, and before the deposition of the overlying loess. Whether its development represents the full period of time involved in the weathering of the underlying loesslike silt cannot be denied or affirmed. It represents at least the latter part of this period, and plausibly coincides with the Sangamon soils known elsewhere which are reported to contain boreal vegetable remains. Such vegetation probably lived during the transition from the Sangamon interglacial epoch to the Iowan glacial epoch, or even during the Iowan glacial epoch. There is, indeed, reason for thinking that the vegetable content of this soil and peat horizon represents the tundra conditions marginal to the Iowan ice sheet. The loesslike silt is referred to the latter part of the Sangamon, and the silt of Leverett's railroad section is correlated with it.

3. Horizon 5 is typical fossiliferous loess. A collection of shells was made and these have been identified by Curator F. C. Baker, of the Museum of Natural History of the University of Illinois, as *Helicina occulta* (Say), *Succinea ovales* (Say), and *Orcohelix iowensis*. The shells of the latter are crushed but identifiable. All three are common to the Peorian loess and the first two have been found in Recent loess. *Orcohelix iowensis*, according to Curator Baker, is not known in Recent loess. It is to be noted that the deposit is calcareous to the top, but the oxidized state, in contrast to the unoxidized basal portion of the Wisconsin drift, is in harmony with the evidence at other places that an interval of weathering occurred between the deposition of the loess and the overlying Shelbyville till. The Shelby-

ville ice may have removed the leached zone, as the contact of the loess with the Shelbyville till is sharp.

The 2-inch layer of humus which occurs 10 inches below the top of the loess records a cessation of wind deposition. Inasmuch as the writer does not recall any other exposure of Peorian loess—among the hundreds which he has seen—which shows a definite soil zone within the loess, he is inclined to the view that the soil represents the latter part of the Peorian epoch, and that the overlying 10 inches of loess was deposited during the oncoming of the Shelbyville ice. The alternative view is that this soil occurs within the body of the Peorian loess, recording two subepochs of loess deposition in the Peorian epoch, in which case there is the possibility that if there were a leached zone of the loess before the invasion of the early Wisconsin ice, that this zone and a part of the calcareous zone were removed by the ice. In a recent report on "The Iowan Drift—a Review of the Evidences of the Iowan Stage of Glaciation," Alden and Leighton present the view that the great body of loess associated with the Iowan drift was deposited almost immediately following the recession of the Iowan ice sheet, but under sufficiently favorable climatic conditions to destroy the glacier and to permit the growth of vegetation and the existence of herbivorous snails;⁴ in other words, the time of the loess deposition was referred to the early Peorian epoch.

If the first view outlined above is correct, the time of the deposition of the loess in the Farm Creek exposure is more closely connected with the Wisconsin glacial epoch than if the second view were found to be true. On the other hand, it is clear that the Peorian loess was deposited a long time after the deposition of the Illinoian drift.

4. The body of till at horizon 6 is unquestionably Early Wisconsin in age, and is clearly Shelbyville, since the Bloomington moraine lies to the north of this locality.

5. The overlying gravel is probably outwash from the Bloomington ice, since it occurs above the till and has an elevation in accord with the Bloomington outwash at Peoria.

6. The loess above the Shelbyville till and the Bloomington gravel is not mentioned in the legend accompanying the photograph in Monograph XXXVIII previously cited. Its thickness is from $4\frac{1}{2}$ to 7 feet. The upper $4\frac{1}{2}$ to 5 feet, including the soil, is non-calcareous, and where the non-calcareous portion rests on gravel, the gravel is partly leached. But where the loess is thicker than 5 feet its base is calcareous and the gravel beneath is unleached. This shows that at least a part, if not all, of the loess was deposited in a calcareous state immediately after the retreat of the ice at a

⁴ *Iowa Geol. Survey*, Vol. XXVI, "Annual Report for 1915," pp. 156-58.

rate in excess of leaching, and that subsequently the deposition of the loess either decreased in rate or ceased, giving opportunity for leaching to take place.

SUMMARY

This cut is remarkable in its display of evidence for two glacial epochs, the Illinoian and Wisconsin, and two interglacial epochs, the Sangamon and Peorian. Most of the varieties of interglacial evidence are present, including ordinary weathering, gumbotil development, loess deposits, and soil formation. Not only is the common Peorian loess present, but also what seems to be loess of Sangamon age and the more-or-less local post-Wisconsin loess. Well deserving is the Farm Creek exposure—7 miles east of Peoria, Illinois—of a place among the type exposures of the Pleistocene of America.

The writer wishes to express his grateful appreciation to Curator F. C. Baker for his study of the fossils. His description of these is to be published soon.

PRE-ILLINOIAN TILL IN SOUTHERN ILLINOIS

PAUL MACCLINTOCK
Illinois Geological Survey

ABSTRACT

In central Randolph County, southwestern Illinois, a 52-foot cut shows, below Illinoian drift, 12 feet of leached gray loess referred to Kansan time. Below this loess is a much-weathered old till, probably of Nebraskan age, which seems best attributed to ice invasion from the Labrador center.

INTRODUCTION

A section of glacial drift, showing undoubtedly pre-Illinoian till, of peculiar interest because of its location farther south than any previously



FIG. 1.—Index map of Illinois showing location of Schuline exposure described pre-Illinoian till, was found in central Randolph County, Illinois, during the first season of Pleistocene studies in southern Illinois. Two

miles west of the village of Schuline, a tributary to Little Plum Creek has undercut its west bank to make the exposure. The cut lies just south of the road in the north center of the NE. ¼, Sec. 24, T. 5 S., R. 7 W., Lat. 38°05' N., and Long. 89°49' W. (Fig. 1).

The topography of the vicinity is that of a monotonously flat till plain dissected by valleys 30-80 feet deep, many of which have small valley flats.



FIG. 2.—Schuline cut

The drainage pattern, typically dendritic, shows the valleys to be mainly post-Illinoian in their origin. The exposure was revisited by the writer in the company of Dr. M. M. Leighton, G. F. Moulton, R. M. Leggette, and W. Goddard, to whom thanks for helpful criticism and suggestion are given.

TOPOGRAPHIC POSITION OF EXPOSURE

In the exposure, made by the stream's undercutting its west bank on the outside of a meander swing, glacial drift is exposed in a bluff 175 feet long and 52 feet high, so steep that footholds had to be cut in order to examine the details of the face (Fig. 2).

From the top of the cut, which is in a bit of a spur between the main and a tributary valley, the land surface slopes westward, away from the main valley. This topographic position is noteworthy, for it means that slumping could not have altered the original relations of the material.

TABLE I
DESCRIPTION OF THE MATERIAL (FIG. 3)

	Section 1	Feet	Section 2	Feet
3.	Loess	3-5	
7.	Gumbotil, Illinoian	2	
3.	Till, sand, and gravel leached	12	Till, leached	13
6.		Till, calcareous	3
			sandstone, cg.....	1/3
4.	Loess, dense, leached.....	15	Loess leached	12-14
3.		Gumbotil	3
2.	Till, leached	6-8	Till, leached	6
1.	Till, calcareous	5 1/2	Till, calcareous	5 1/2

DESCRIPTIVE NOTES

8. The post-Illinoian loess is the typical light-buff, fine-textured loess of the southern part of the state.

7. Illinoian gumbotil is the typical dark bluish-gray, sticky, leached, and highly weathered surface of the Illinoian till.

6. The leached Illinoian till is fairly dense, dark yellow-brown, and stony, from which the lime content has been so removed by downward moving water that it does not effervesce with acid. Sand and gravel, also leached, are incorporated as lenses and pockets in the till.

5. In the northern part of the exposure (Sec. 2) the leached till grades almost imperceptibly downward into calcareous till, from which the lime carbonate has not yet been removed. This calcareous till is darker in color and somewhat more dense than the overlying drift. It shows also the fracture and texture of fresh till. At its base in one place 4 inches of sand and small pebbles have been cemented by lime into a fairly well-indurated conglomerate. In the southern part of the exposure (Sec. 1) the Illinoian till with the incorporated sand and gravel is leached to its base.

4. The 12-15-foot layer of dark brownish-gray loessial silt is entirely leached. Uniform in texture and composition from bottom to top, it fractures with characteristic loess faces and columns.

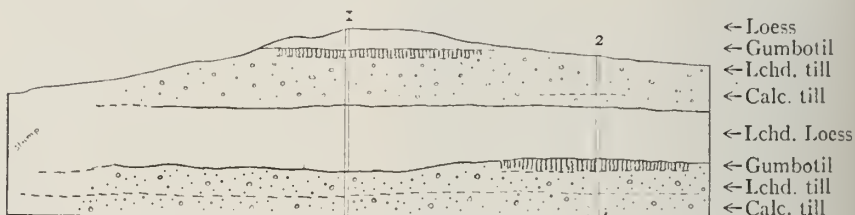


FIG. 3.—Diagram of the Schuline cut
Scale: $\frac{1}{4}$ inch = 10 feet

3. In the northern part of the cut (Sec. 2) the leached loess lies on a 3-foot horizon of brown-mottled, blue-gray dense, sticky gumbotil. While not as well developed as the Illinoian gumbotil in this cut, it is nevertheless a very old soil zone and represents a long interval of weathering. In the southern part of the cut (Sec. 1) the gumbotil was eroded away before the loess (No. 4) was deposited.

2. The leached till is entirely oxidized to a yellow-brown color. It is fairly hard and medium stony. Stones up to 3 inches are not uncommon.

1. The calcareous till at the base of the cut is notable because of its hardness, compactness, and durability. The sharp pick must be driven with considerable force to dig into it. The mass is entirely oxidized to a yellow-brownish color, which is more pronounced along the many joints traversing it (Fig. 4). In the joints themselves, however, gray deoxidized color is seen. Along these joints, also, secondary lime has been deposited to so great an extent that erosion has left the joint filling projecting beyond the general surface (Fig. 4).

The lower till contains not only many small polished and striated limestone pebbles, but also numerous cobbles and a few boulders ranging in diameter up to a foot and a half. Sand and gravel lenses are also present. No purple quartzites were seen. A pebble count gives the percentage of

materials shown in Table II. This shows a total of 13.2 per cent of foreign material.

It is not known definitely how thick the lower till is, but about 200 yards north of the exposure, a well at about the same elevation as the base of the cut penetrated 31 feet before encountering bed rock.

INTERPRETATION

The upper loess, while not fossiliferous in this place, bears such relations to the Illinoian drift that it is believed to be of early Peorian age. The Illinoian drift in its three phases, i.e., gumbotil, leached till, and fresh till, is normal and typical of the area.

Since the pre-Illinois loess formation was thoroughly leached prior to the invasion of the Illinoian ice, it must be notably older. And since it must



FIG. 4.—Photograph of jointing in lower till

have taken a long time to leach 15 feet of loess, assuming it to have been originally calcareous, a probable assumption in the case of loess, this formation seems to be associated with a pre-Illinoian glacial invasion—quite possibly the Kansan—as the early Peorian and early Wisconsin loesses are associated concomitantly with the late phases of the Iowan and early Wisconsin ice invasions, respectively. It could scarcely be associated in age or origin with the underlying till for it is separated therefrom by the gumbotil, and it is clearly not related to the gumbotil.

The lower till and gumbotil must be either Kansan or Nebraskan. Its relations to the leached gray loess above show that it is vastly older than the loess, for it was deposited, weathered to gumbotil, and much of its upper surface eroded prior to the formation of the loess. It seems best, there-

fore, in the present state of the investigation to refer it to the earliest glaciation (Nebraskan).

Recent studies by Leverett and Schoewe (unpublished data) have shown a drift older and more extensive than the Kansan in Kansas and western Missouri. Pre-Illinoian drift is found in southeastern Missouri from St. Louis County southward to about the head of the gulf embayment. The occurrence of old till in St. Louis County has been discussed by Dru-shell¹ and Fenneman² and more recently noted by Shipton and Hanley, while farther south, erratics on the uplands have been noted by Shaw, M. Weller,

TABLE II

Limestone:	
Dense dark	14.3
Soft (Pennsylvanian)	13.5
Dense, few large crystals.....	2.3
Crystalline	1.2
<hr/>	
Total	31.3
Chert	19.4
Sandstone (Pennsylvanian)	14.3
Ironstone concretions (Pennsylvanian).....	10.0
Igneous rocks:	
Granite	4.0
Greenstone	4.8
Basalt	1.2
<hr/>	
Total	10.0
Lime concretions (Pleistocene).....	8.0
White quartz pebbles (Pennsylvanian).....	3.1
Shale (Pennsylvanian)	2.0
Quartzite (brownish and gray).....	1.6
Quartz (white, crystalline).....	0.4

Sauer, Flint, and Leverett. But in no place could the age of this older drift be definitely determined. In Illinois it has been described from the bluffs northwest of Alton,³ but evidence in this case was not sufficient to determine whether the drift belongs to the Keewatin or the Labrador drift sheet. Leverett has described⁴ pre-Illinoian drift in Monroe County where, west of Rock School (N.E. $\frac{1}{4}$, Sec. 21, T. 3 S., R. 10 W.), he found $\hat{\tau}$ feet of much-indurated, massive till below $\hat{\tau}$ feet of softer Illinoian till. South of Burkesvill station (near the center of Sec. 20), a roadcut descending the hill showed a kaolinized soil zone at the top of the lower till. These exposures, how-

¹ *Jour. Geol.*, Vol. XVI (1908) pp. 493-98.

² "Geology and Mineral Resources of the St. Louis Quadrangle," *U. S. Geol. Survey, Bull.* 438, p. 31.

³ M. M. Leighton, "The Pleistocene Succession near Alton, Illinois," *Jour. Geol.*, Vol. XXIX (1921), pp. 505-14.

⁴ Frank Leverett, personal communication, 1925.

ever, are none too good, and their interpretation is consequently difficult. He is at present disposed to correlate this older drift with that found near Ste. Genevieve, Missouri, and to refer it to the earliest glaciation rather than to the Kansan.

With the evidence at hand of Labradorian pre-Illinoian drift in the La Salle and Hennepin⁵ and Springfield⁶ quadrangles in central Illinois, it is most plausible to include the pre-Illinoian drift near Schuline with that of the eastern ice-cap.

⁵ G. H. Cady, "Geology and Mineral Resources of the La Salle and Hennepin Quadrangles," *Bull. 37, Ill. State Geol. Survey* (1919), p. 71.

⁶ E. W. Shaw and T. E. Savage, "The Tallula-Springfield Quadrangle," *U. S. Geol. Survey, Folio No. 188* (1913), p. 7.

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