# MILEAGE GUIDE TO FIELD TRIP OF SECOND CONFERENCE ON CLAY AND CLAY MINERALS, OCTOBER 14, 1953

*By*

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MILES

00.00 Leave Greyhound Bus Station, 10th & Locust St., Columbia, Mo., at 7:00 A. M.

1.2 Junction U. S. 40 and 63 north. Turn east on U. S. 40.

1.5 Columbia Municipal Water and Light Plant. Water from artesian wells, 1100'-1400' deep, bottomed in Paleozoic (Cambrian-Ordovician) sandstones and dolomites.

1.8 Wabash overpass.

2.7 Hinkson Creek. Burlington (Mississippian Age) limestone in creek bed.

2.8 South side of road, fire clay, coal, and shale, in ascending order, overlain by glacial till and loess (wind blown). The clay and shale are used by the Columbia Brick and Tile Company in their plant about 1 mile south, to make building brick and tile. The fire clay is locally gypsiferous here, and is used by the Columbia Brick and Tile Co. to make buff and gray brick.

The Burlington limestone underlies the clay, being separated from the latter by a sandy chert conglomerate. The fire clay, coal, and shale are Pennsylvanian in age. The fire clay is regularly referred to the Cheltenham seam or formation.

Most of the highways traveled on this trip lie close vertically to the unconformity between the Cheltenham fire clay and underlying Mississippian and Ordovician limestones.

The generalized stratigraphic sections to be observed are:

North of the Missouri River, morning trip,

Loess (Pleistocene and continuing Recent)
Glacial Drift (Kansan of Pleistocene)
Shale and lime
Cheltenham fire clay } Pennsylvanian
Sandy, cherty conglomerate
Limestone, Burlington formation; Mississippian.

South of the Missouri River, afternoon trip,

Loess (Pleistocene and continuing Recent)
Gravel (Tertiary ? ? ?)
Limestone and shale, only at Bueker pit
Flint, burley, diaspore, boehmite fire clay, } Pennsylvanian
Cheltenham,
Sandstone, variegated clayey sand,
Dolomite, Jefferson City formation, Ordovician

10.4 Cedar Creek bridge. Enter Callaway County.

Old coal strip mines. Produced from Bevier Coal, equivalent to Illinois No. IV coal.

No clay was produced here.



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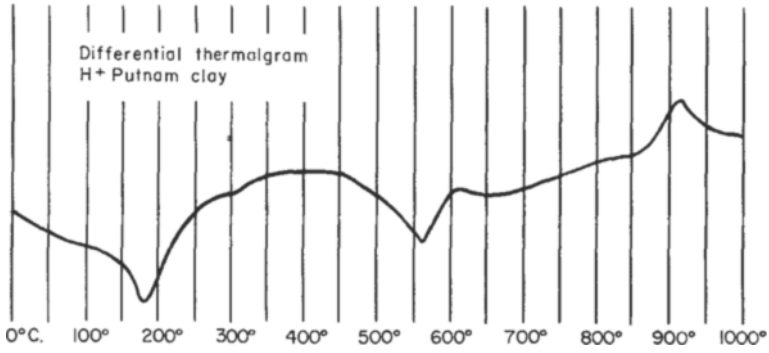
14.4 Flat land in the southern part of the northeast Missouri prairie. Putnam soil.

16.7 Eastville.

18.8 Stop 1. Putnam soil which has produced the Putnam colloidal clay on which the time-honored work of Bradfield, Baver, Jenny, and others has received wide attention. Virgin soil occurs here under 160 acres. Data on the Putnam colloid are as follows:




The Putnam silt loam is an extensive soil type that occurs on the level prairie land of northeastern Missouri. Much of the route — especially between Mexico and New Florence — traversed on the field tour, will be on this soil type. The soil is derived from loess, and has acquired a characteristic profile due to genetic processes. The surface soil is a dark gray silt loam, that grades at 10 to 12 inches into a lighter gray silty material. The distinct and sharply defined subsoil (claypan) at a depth of 18 inches, is a dense, moderately plastic gray-brown clay. It contains from 50 to 60 per cent colloidal clay, mostly beidellite. Because of its high base-exchange properties, the separated colloidal clay has been extensively used in greenhouse soil fertility studies. A detailed profile study of this soil is given in Univ. of Missouri, Agr. Expt. Sta. Research Bulletin 386.

Chemical analysis and formula from *Minerals of the Montmorillonite Group,* Ross and Hendricks No. 70, U. S. Geol. Survey, Prof. Paper 205-B.

| | |
|---|---|
| $SiO_2$ | 49.50 |
| $Al_2O_3$ | 21.74 |
| $Fe_2O_3$ | 8.81 |
| FeO | 0.42 |
| MnO | 0.02 |
| MgO | 1.99 |
| CaO | 0.28 |
| $K_2O$ | 0.94 |
| $Na_2O$ | 0.44 |
| $TiO_2$ | 0.70 |
| $P_2O_5$ | 2.16 |
| $H_2O$ | 13.05 |
| | 100.05 |

Tetrahedral $Si^{4+}_{3.55}$ $Al^{3+}_{.45}$

Octahedral $Al^{3+}_{1.40}$ $Fe^{3+}_{.48}$ $Fe^{2+}_{.03}$ $Mg^{2+}_{.21}$ $\Sigma 2.12$

External Ions 0.19

Cation Exchange Capacity 60-70 meq per 100 grains.

21.5 Kingdom City. Turn left (north) on U. S. 54. Glacial till exposed behind Roland's Cafeteria, N. E. of intersection.

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The name Kingdom City perpetuates the "Kingdom of Callaway (County)." In 1861, the "invasion" of Callaway County, a Confederate stronghold, by a Union militia was averted when both sides agreed to disarm or withdraw. They kept their agreements, and consequently the new "Kingdom", now apart from the warring portions, was so known.

22.3 McCredie. Fire clay stock piles. Reserve clay is hauled here from pits in the neighborhood and stocked for shipment, during winter weather, by rail to Mexico, Mo. (our morning destination).

24.3 On left side of road, fire clay, light-gray, semi-plastic, slightly sandy, underlain by darker fire clay which is underlain by a chert conglomerate, resting on the Burlington (Mississippian age) limestone in the creek (Auxvasse Creek). This is the same sequence observed at mileage 2.7-2.8.

25.0 Entrance to Auxvasse limestone rock quarry. The formations exposed are:

| | |
|---|---|
| Burlington (Mississippian) | 40+ feet thick |
| Chouteau (Mississippian) | 25 feet thick |
| Bushberg (Mississippian) | 3-10 inches thick |
| Snyder Creek (Devonian) | 7 feet thick |
| Callaway (Devonian) | 20 feet thick |

26.6 Note saddle horse sign on barn. Entering the country of the "Saddle horse and fire brick capital of the nation".

27.3 City limits of Auxvasse. Name taken from the creek, whose name was derived from the French words *aux* and *vase*, meaning "of mud in the bottom of the river". A party of early settlers, including a subsequent governor, were mired while crossing the creek.

30.7 Enter Audrain County, Missouri, a famous fire brick-producing county.

31.8 Beaver Dam Creek.

33.8 Scattering Fork Creek.

36.6 Mexico, Mo., City limits. "Fire brick capital of the nation". Go north out of Mexico on County Highway J to the plant of the

41.1 Mexico Refractories Co.

Stop 2. Semi-flint fire clay pit. Courtesy of Mexico Refractories Co.

Dark-colored, harder, semi-flint fire clay occurs in the floor and as the lower member of the Cheltenham formation. A lighter colored, softer, slightly more plastic, semi-flint fire clay occurs in the upper part of the Cheltenham (an x-ray powder diffractogram of this upper clay is included in the paper on the Origin of Missouri fire clays, by Keller, Westcott, and Bledsoe). This Cheltenham fire clay is overlain by gray and greenish illitic clay, shale, and nodular limestone of the Loutre formation. Coal may occur in local lenses, not of wide extent. Glacial drift, which is capped by loess, overlies the Loutre here. Beneath the dark, semi-flint clay is a thin, cherty, sandy layer which mantles a hill-and-valley surface which was eroded in the underlying Burlington limestone. The "rolls" or "rises" in the floor of the clay deposit are the hills, and the deep, clay-filled basins are the valleys and depressions in the old, early Pennsylvanian (fire clay deposition) landscape.

Typical data on the fire clay are:

Chemical Analysis

| | |
|---|---|
| $SiO_2$ | 53.41 per cent |
| $Al_2O_3$ | 30.41 |
| $Fe_2O_3$ | 1.61 |
| $TiO_2$ | 1.35 |
| CaO | 0.28 |
| MgO | 0.22 |
| Alkalis | 1.41 |
| Loss in Ignition | 11.22 |
| | 99.91 |

P. C. E. — Cone 31-32

Total shrinkage, Cone 14 — 7.1%

Linear change, Reheating 2910°F — +1.3%

Retrace route to Mexico, and go east on Breckenridge Street to the manufacturing plant of the A. P. Green Fire Brick Company.

46.8 This is the largest fire brick plant *under one roof* in the world.
Trip through the manufacturing plant; courtesy A. P. Green Fire Brick Company. Lunch at Empire Club Grounds (A. P. Green Company), courtesy of the Company.

50.0 Return to traffic light, U. S. 54; turn east on U. S. 54.

62.4 Intersection U. S. 54 and Mo. 19 (Scott's corner). Turn right (south) on Mo. 19. This agricultural area is on Putnam soil.

66.8 Martinsburg.

70.2 Wellsville Fire Brick plant on the left.

70.9 Wellsville city limits.

78.5 Montgomery City limits.

83.4 Underpass, Wabash Railroad.

84.4 New Florence city limits.

85.8 Cross U. S. 40, continue south on Mo. 19.
Travel continues on a high flat ridge for the next 6 miles, after which the road descends into a region dissected by erosion which is spreading from the Missouri River. The ridge flat is about a mile wide here but becomes narrower to the south; its margin is outlined by the erosion of tributaries to the Missouri River. Flint fire clay is exposed along the eroded "breaks" of this ridge. Clay haulage roads entering upon Mo. 19 may be recognized by their gray clay surfaces. This road clay is in part low-fusion, inferior clay, or weathered clay from the tops of the pits.

Although fire clay probably underlies this highway ridge, it is covered too deeply to be mined economically. The location of a workable fire clay deposit is usually a compromise between erosion which has been severe enough to remove most of the overburden, but not enough to remove the clay. Note that erosion which is pre-Pleistocene in age, next erosion by the Pleistocene continental glacier which advanced to about the present position of the Missouri River, the overburden of glacial drift, and now stream erosion of both the glacial drift on the clay and the clay itself, must be reckoned with in prospecting for economical occurrences of fire clay in this region.

91.6 Descending through the regional geological section. Yellow Snyder Creek shale and gray Callaway limestone, both Devonian formations, are exposed in the road cut on the right.

91.9 Joachim (Ordovician) dolomite.

92.1 St. Peter sandstone. A glass sand; an aquifer.

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92.8 Big Springs village.

96.7 Round-topped hills are capped by St. Peter sandstone. Jefferson City dolomite at base of hills.

98.9 Missouri, Kansas and Texas Railroad overpass.

99.7 Loutre River.

100.4 Missouri River. Jefferson City (Ordovician) dolomite in river bluff.

100.8 Hermann, Mo. Hermann was originally settled by Germans who found the location on the river, and the thick, rich loessial soil to their liking. The architecture of the older buildings, and the names on signs and show windows reflect the German heritage. In recent years some of the "fests" and old folk customs are being revived (with notable enthusiasm from outside, after suppression during World War I). Before prohibition, Hermann was famous for its vineyards on the hills, and for a huge winery and wine cellar. The latter is now used to grow mushrooms; buildings over the cellar may be seen on the hillside to the west (on the right), from the south city limits. Interesting folklore abounds in the Hermann region.

102.4 St. Peter sandstone in road cut. Note that we are climbing up, out of the valley of the Missouri River. Within a few miles we enter upon another high flat, a continuation of the one which was observed north of the Missouri River. This old peneplain has been deeply dissected by the Missouri River. The flat south of the Missouri River is underlain by Jefferson City (Ordovician) dolomite, which was seen in the Missouri River bluff, and is in turn covered by a thin (relatively) blanket of Pennsylvanian variegated sandy clay, sandstone, and occasional deposits or "pits" of flint, diaspore, burley, and rarely plastic clay.

Here, as elsewhere, the fire clay is exposed by erosion of the cover, and unfortunately from the clay producer's viewpoint, much (probably most) of the originally present fire clay was eroded away long ago.

Watch for clay-surfaced roads in a few miles, and for abandoned, worked-out clay pits, which are geologic remnants of fillings of geologically ancient sinkholes and depressions in the Jefferson City dolomite.

110.3 Abandoned, worked-out, clay pit on the left.

110.8 Another old pit.

111.6 Clay stock piles on the left.

112.2 Swiss village. Emigrants of Swiss and German ancestry settled here.

112.4 The Klossner, small, high alumina pit which contained boehmite. The pit has been cited frequently in literature on boehmite. When pit is filled with water, boehmite remnants are inaccessible.

112.7 County Road F to right.

An unmined diaspore "pit" (deposit) lies beneath this highway (Mo. 19) a short distance south of Swiss and County Road F. Can you see any indication of clay; would you prospect here? Prospecting for pits is now done with power auger 4″ drills in geologically favorable terrain.

119.2 Drake store. Join U. S. 50 and continue south on U. S. 50 and Mo. 19.

119.9 Continue on Mo. 19 to right.

123.8 Turn right on gravel road. This is the Goerlich (pronounced Gurley) Ridge road, a prolific clay-producing region.

124.2 Abandoned clay pit on right.

125.0 Take left fork.

125.7 Clay pits of shallow, wide-spread type.

126.4 Stop 4. The Bueker flint and diaspore clay pit. Courtesy of the General Refractories Co. The Bueker pit is unique in that it is the only one showing completely a Paleozoic rock cover over the fire clay. The geologic evidence here is that the flint and diaspore clay were deposited, later oxidized and weathered on their upper surface, and then covered by green shale and Fort Scott (Pennsylvanian) limestone. Subsequent geologic history is that which is common to other clay deposits.

The most significant exhibit of this pit is the convincing evidence that the fire clay was formed prior to its Fort Scott (Pennsylvanian) cover, which establishes a syngenetic (or almost so) origin for the fire clay. This concept revises most of the older theories of origin of Missouri high alumina clay.

Retrace route to U. S. 50.

132.8 Turn left, driving west on U. S. 50.

139.6 Cave Hill. Shows the jumbled mixture of variegated clay, sand, and sandstone which are characteristic of the basal Pennsylvanian sediments, and displays their unconformable contact with the unevenly eroded, upper surface of the oxidized, underlying Jefferson City dolomite.

143.7 Mt. Sterling and Gasconade River.

146.7 Useful. Store and community.

153.1 Intersection Mo. 89. Optional side trip to Ochesky pit which contains boehmite. Will not be visited if weather is good.

156.3 Linn, Mo.

163.1 Loose Creek, Mo.

165.8 Maries River.

166.6 Intersection U. S. 50 and U. S. 63. Continue straight ahead.

167.0 Osage River.

173.4 Moreau River.

176.0 Jefferson City city limits. Missouri State Capitol.

178.8 Missouri River bridge. Type section of the Jefferson City formation.

179.6 Junction U. S. 63 and U. S. 54. Continue left on U. S. 63.

180.7 State prison farm.

182.4 Missouri, Kansas and Texas Railroad overpass.

183.3 Cedar Creek.

186.7 Quarry in Callaway (Devonian) limestone.

193.6 Ashland, Mo.

207. Columbia, Mo.