

Kentucky Geological Survey.

Bulletin No. 7.

**THE SILURIAN, DEVONIAN AND IRVINE FORMATIONS
OF EAST-CENTRAL KENTUCKY.**

1906.



MAP OF NORTH-CENTRAL KENTUCKY AND ADJACENT PARTS OF OHIO AND INDIANA.

Areas underlain by Silurian strata, either exposed or covered by Devonian and later formations, indicated by dots. Areas in which Silurian strata are absent are left blank. Areas in which the Clinton is absent occur between Dupont, Westport and Osgood in Indiana.

Kentucky Geological Survey,

CHARLES J. NORWOOD, Director.

BULLETIN No. 7.

The Silurian, Devonian and Irvine Formations of East-Central Kentucky,

WITH
AN ACCOUNT OF THEIR CLAYS AND LIMESTONES.

Preliminary Report by
AUG. F. FOERSTE.

Office of the Survey: Lexington, Ky.

1906

CONTENTS.

	Page
Table of Paleozoic Formations.....	10
The chief divisions of the Paleozoic rocks of Kentucky.....	11
The minor subdivisions adopted in this report.....	14
Mississippian	14
Devonian	15
Silurian	17
Cincinnatian	18
The Cincinnati geanticline.....	19
Areas of exposure of the Paleozoic rocks of Kentucky.....	22
The Classification of the Silurian rocks of East-Central Kentucky.....	27
Table of formations.....	27
Brassfield limestone.....	27
Fauna of the Brassfield limestone.....	30
Whitfieldella horizon.....	36
Rose Run iron ore.....	38
Plum creek clay.....	44
Oldham limestone.....	47
Lulbegrud clay.....	50
Waco limestone horizon.....	52
Fauna of the Waco limestone horizon.....	55
Estill clay.....	59
Indian Fields formation.....	60
Alger formation.....	61
Crab Orchard division.....	62
Clinton outlier on the axis of the Cincinnati geanticline.....	290
Linney's reports on the Silurian rocks of East-Central Kentucky.....	63
A. Lincoln county.....	63
B. Garrard county.....	68
C. Clark county.....	71
D. Montgomery county.....	75
E. Bath county.....	76
F. Fleming county.....	78
G. Mason county.....	78
Marion county.....	78
The Classification of Devonian rocks.....	79
Devonian limestone.....	79
Fauna of Devonian limestone.....	80
Fossils cited by Linney from Devonian limestones of Eastern Kentucky	87
Variations in thickness of Devonian limestone.....	89
Minor subdivisions of Devonian limestone in East-Central Kentucky	92
Kiddville layer, with fish remains.....	93
Duffin layer.....	97

	Page
Devonian Black Shales.....	102
Variations in thickness of Black Shales.....	102
Base of Black shale section.....	104
Notes by Linney on the Devonian Black shales.....	107
Greenish clays above the middle of the Black shale section.....	109
Phosphatic nodules at base of Waverly section.....	109
Fossils of Devonian Black shales.....	110
The Silurian and Devonian of Southern Kentucky east of the Cincinnati geanticline.....	114
The Silurian-Devonian unconformity.....	116
The Devonian limestone—Black shale unconformity.....	129
The Lexington peneplain.....	130
The Irvine formation.....	133
Derivation of sediments from the waste of the Cincinnati geanticline....	135
Detailed account of sections of Silurian and Devonian rocks of East-Central Kentucky.....	139
A. Sections west of Stanford.....	139
B. Sections between Crab Orchard and Stanford, south of the Louisville and Nashville railroad.....	142
C. Sections between Crab Orchard and Stanford, north of the Louisville and Nashville railroad.....	148
D. Sections east and northeast of Crab Orchard, chiefly in the northwestern corner of the London quadrangle.....	152
E. Sections between Crab Orchard and Berea.....	156
F. Sections between Hammack and Lancaster.....	163
G. Sections between Berea and Whites.....	165
H. Sections between Berea and Brassfield.....	168
I. Sections between Irvine and Brassfield.....	171
J. Sections between Moberly, Waco, and the Kentucky river.....	178
K. Sections between Indian Fields, Vienna, and Lulbegrud creek... 183	183
L. Sections between Rightangle and Merritt.....	189
M. Sections between Indian Fields, Clay City, and Lulbegrud creek..	191
N. Sections west of Indian Fields, along the railroad.....	195
O. Sections between Indian Fields, and Jeffersonville.....	197
P. Sections between Spencer and Olympia.....	203

ECONOMIC GEOLOGY.

Chemical characteristics of the Ordovician rocks of Kentucky.....	211
Chemical characteristics of the Silurian rocks of Kentucky east of the Cincinnati geanticline.....	217
A. Silurian limestones.....	217
B. The ferruginous, phosphatic, and magnesian content of the Silurian limestones.....	220
C. Silurian clays.....	226
1. Chemical analyses.....	226
2. Possible uses of Silurian clays for the manufacture of clay products	231

	Page
3. The mineral waters and salts of the Crab Orchard clays.....	236
4. Silurian limestones above the Crab Orchard horizon.....	242
Chemical characteristics of the Devonian rocks of Kentucky east of the Cincinnati geanticline.....	244
A. Devonian limestones.....	244
1. Chemical analyses.....	244
2. Availability for the manufacture of natural cements.....	252
B. Devonian black shales.....	254
1. The mineral waters of the black shales.....	254
Chemical characteristics of the Lower Waverly strata.....	262
A. Linietta or Bedford clay shales.....	262
B. Upper layers of the Waverly series.....	266
Chemical composition of the Irvine clays.....	267
Clay industries of Madison county.....	276
Berea College brick company.....	283
Water horizons.....	285
Oil horizons.....	288
Clinton outlier on the axis of the Cincinnati geanticline.....	290

PALEONTOLOGY.

Characteristic Silurian fossils from East-Central Kentucky.....	297
Explanations of plates.....	331

ILLUSTRATIONS.

Fig. 1. Brassfield or Clinton bed, between Brassfield and Panola, on the Louisville and Atlantic railroad. Near the eastern end of the type section, opposite.....	26
Fig. 2. Brassfield limestone, Plum creek clay, Oldham limestone. A mile and a quarter northwest of Indian Fields, along the Lexington and Eastern railroad, in Clark county, opposite....	44
Fig. 3. Plum creek clay shale overlaid by Oldham limestone. West side of Plum creek, directly east of home of George McIntosh. South end of type section, opposite.....	46
Fig. 4. Oldham limestone, east of Brassfield, along the Louisville and Atlantic railroad. View of farther end of cut shown in Fig. 5, following.....	48
Fig. 5. Oldham limestone, east of Brassfield, along the Louisville and Atlantic railroad, following.....	48
Fig. 6. Top of Lulbegrud clay. Roadside gulley one mile southeast of Indian Fields, north of Lulbegrud creek, along the road pass- ing northward across the railroad toward Kiddville, opposite.	50
Fig. 7. Waco bed; a part of the Alger formation. A quarter of a mile north of the Estill Springs hotel; north of Irvine, Estill county, on the eastern side of the pike, opposite.....	52
Fig. 8. Contact between Estill clay and Devonian limestone. At Brass- field, along the Louisville and Atlantic railroad, opposite....	120

	Page
Fig. 9. Devonian limestone, opposite the home of Green McDowell, west of Clay City, on the Lexington and Eastern railroad, Powell county, opposite.....	122
Fig. 10. Knobs and hills rising above the Lexington peneplain. View looking from the road east of Brassfield southward across the peneplain. Estill and Madison counties, opposite.....	132

MAPS.

Map of North-Central Kentucky and adjacent parts of Ohio and Indiana	Opposite Title Page
Diagram indicating relative position of road maps accompanying this bulletin	138
1. Map of area between Stanford, Crab Orchard, and Lancaster.....	140
2. Map of area between Crab Orchard, Hammack, Berea, and Paint Lick.	155
3. Map of area between Berea and Brassfield.....	167
4. Map of area between Brassfield, Irvine, College Hill, and Red river....	173
5. Map of area between Red River, Indian Fields, and Winchester.....	185
6. Map of area between Indian Fields, Clay City, and Jeffersonville.....	193
7. Map of area between Jeffersonville, Preston, and Olympia.....	202

PLATES OF SECTIONS OF SILURIAN AND DEVONIAN STRATA.

A. Sections illustrating the classification of Silurian strata used by W. M. Linney.....	64
B. Diagram illustrating various conditions resulting from the formation of geanticlines.....	123
C. Fig 1. Silurian and Devonian between Stanford and Crab Orchard. Fig. 2. Devonian northeast of Crab Orchard. Fig. 3. Devonian west and east of Crab Orchard. Fig. 4. Devonian two miles west of Crab Orchard. Fig. 5. Devonian south and north of Crab Orchard.....	141
D. Fig 1. Silurian and Devonian between two miles west of Crab Orchard and three miles west of Berea. Fig. 2. Silurian at Hammack. Fig. 3. Between 3.5 miles southeast of Lancaster and Hammack. Fig. 4. Three miles west of Berea. Fig. 5. Silurian and Devonian between Berea and Whites.....	154
E. Fig. 1. Silurian and Devonian between Berea and Irvine. Fig. 2. Devonian between three miles northeast of Berea and Brassfield. Fig. 3. Devonian and Silurian between Elliston and Irvine. Fig. 4. Devonian limestone at Rice.....	166
F. Fig. 1. Three miles south of Indian Fields. Fig. 2. Silurian and Devonian between J. T. Elkins and Clay City. Fig. 3. Near Vienna. Fig. 4. Silurian and Devonian between two miles northwest of Indian Fields and three miles southwest of Clay City	184
G. Sections of Silurian and Devonian strata between Indian Fields and Jeffersonville	192
H. On plate 7. Silurian and Devonian between Spencer and Olympia....	202

Letter of Transmittal.

*To His Excellency, J. C. W. BECKHAM,
Governor of Kentucky.*

SIR: I have the honor to herewith transmit for publication a bulletin, prepared by Professor Aug. F. Foerste, on the Silurian, Devonian and Irvine Formations of East-Central Kentucky, with an account of their clays, limestones, mineral waters and water horizons.

The report is divided into three parts. Part I. deals with the classifications of the several formations, and with the geographic distribution of their subdivisions, in accordance with the better knowledge of them that has been acquired since the earlier work of William M. Linney (deceased). The great excellence of the pioneer work of Mr. Linney on the Kentucky Silurian (then known as Upper Silurian) is heartily conceded by all who are acquainted with the subject; but the urgent necessity for a classification which will accord with more recent knowledge and present terminology is well recognized by all geologists who have worked or who expect to work in Kentucky regions where Silurian or Devonian rocks form the substructure of the ground. The usefulness of a correct classification of our rocks—the bearing it has upon the study of the economic geology of the State—has been discussed in my Report of Progress for 1904-'05. The numerous sections and page maps, showing the distribution of various members of the formations, will prove of much value in connection with the preparation of the soil map of the State. Professor Foerste has taken pains to give full lists of fossils which characterize the more important beds, thus rendering his report of especial service to local investigators.

Part II. deals with the economic values of the formations

under consideration. In this section is discussed, among other subjects, the availability of Devonian and Silurian clays and limestones for the manufacture of cements. A good foundation is here laid for the technological investigations that are to follow in due course.

In Part III. are given descriptions, with plates, of some of the fossils that characterize the principal Silurian beds referred to in the preceding parts of the report. The local worker will find this a very useful feature of the bulletin, since it will enable him to discriminate individual beds of the formation, and teachers in the advanced schools of the State will find it helpful in their work.

Very respectfully,

C. J. NORWOOD,
State Geologist.

Addendum.

This report was prepared for publication in 1905, but various causes have delayed its passage through the press. This has not been altogether unfortunate, since it has enabled Professor Foerste to include notes on some observations made in 1906, the date which the title page now bears.

Letter of Submittal.

PROFESSOR CHARLES J. NORWOOD,

Director, Kentucky Geological Survey.

SIR: I have the honor to submit herewith a report on the Silurian and Devonian formations of East-central Kentucky, with an account of the economic availability of their clays and limestones. To this is added a brief discussion of the Irvine formation, which includes the extensive clay deposits used for the manufacture of pottery at Waco and Bybeetown or Portwood, in Madison county. The report is of necessity merely preliminary to further investigations, since the field work of the last season has left many questions of stratigraphic and economic interest unanswered. In the investigation of the Red river area I was materially assisted by John Goff, a resident at Indian Fields.

Respectfully,

AUG. F. FOERSTE,

Assistant Geologist.

Dayton, Ohio, Nov. 1, 1905.