GEOLOGICAL SURVEY OF OHIO

WILBER STOUT, State Geologist

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RECENT INFORMATION
ON THE
MAXVILLE LIMESTONE

by

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COLUMBUS
1945
Reprinted 1961

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INTRODUCTION

The Maxville has been an important source of limestone for more than 100 years in southern and east central Ohio where it was first utilized for mortar and for furnace flux. Probably for this reason outcrops of a limestone later shown to be Maxville in age were described by Briggs in 1838 who noted occurrences near Maxville, Perry County; on Three Mile Run near Logan in Hocking County; near Reeds Mills near Wellston, Jackson County; and at the Canter Quarry in Hamilton Township, Jackson County.[1] Further observations of this limestone were made by E. B. Andrews of the Second Geological Survey of Ohio and his report was published in the Report of Progress in 1869. Andrews named the limestone the Maxville for its occurrence near Maxville, Hocking County, noted its patchy distribution on the outcrop, described its stratigraphic position as immediately overlying the Logan sandstones and shales, and declared the limestone to be of sub-Carboniferous (Mississippian) age. Detailed data on the various exposures were lacking, however, until 1910 when W. C. Morse published an account of the Maxville limestone in Ohio as Bulletin 13 of the Geological Survey. He upheld Andrews' interpretation and described the limestone as occurring in a number of small areas disconnected on the outcrop but distributed along the disconformable contact at the base of the Pennsylvanian system from southwestern Muskingum County to southern Scioto County. He also recognized the possibility of disconformable relations existing between the limestone and the underlying sandstones and shales of the Logan formation but lack of exposures rendered that interpretation uncertain.[2] Since 1910 a few feet of badly weathered limestone has been noted on the Maxville horizon at a few localities in northwestern Muskingum County[3] and at scattered places in western Coshocton and in western Holmes counties.[4] North of Holmes County this limestone is not known to occur on the outcrop through Wayne, Medina, Geauga, Portage, Trumbull, and Mahoning counties.

From the field where scattered deposits of Maxville limestone occur on the outcrop, extending in general from the Ohio River in eastern Scioto County north to western Holmes County, the horizon of this formation is carried below drainage in a southeasterly direction by the regional dip of the overlying and underlying strata. Post-Mississippian erosion preceding the deposition of the Pennsylvanian beds removed the Maxville from large areas in northeastern, eastern, and southeastern Ohio. Remnants of this formation remaining before burial beneath Pennsylvanian sediments existed as limestone caps on hills and uplands of the old erosion surface.

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[1] Geol. Survey Ohio, First Ann. Rept., pp. 82-83. 1838; Geol. Survey Ohio, Second Ann. Rept., p. 135. 1838.

[2] Geol. Survey Ohio, Fourth Series, Bull. 13, p. 101. 1910.

[3] Geol. Survey Ohio, Fourth Series, Bull. 21, pp. 34-39. 1921.

[4] Lamb, G. F., Outliers of the Maxville limestone in Ohio north of the Licking River, Ohio Jour. Sci., Vol. XVI, pp. 151-154. 1916.

Knowledge of the location, extent, thickness, and depth of such limestone remnants must necessarily depend upon the accuracy and detail of the records of thousands of wells drilled in the eastern half of Ohio since 1860 for oil and gas. To record the results of a study of well records with respect to depth, distribution, and thickness of the Maxville limestone, now more or less deeply buried beneath the surface in eastern Ohio, as well as to set forth new data on the chemical composition of the stone at a few localities on the outcrop is the purpose of the present paper.

OUTCROPS OF MAXVILLE LIMESTONE

Localities where the Maxville limestone outcrops in sufficient thickness to be of economic value are confined to a few small scattered areas occurring in a belt extending from southwestern Muskingum County to the Ohio River in eastern Scioto County, but the thickest and best known deposits are located in southwestern Muskingum County and in northeastern Perry County. The chief areas of limestone, all of which have been described by Morse,[1] are as follows:

1. Jonathan Creek exposures. Located along Jonathan Creek in Madison Township, Perry County, and Newton Township, Muskingum County; maximum thickness of exposures, about 25 feet.

2. Kent Run exposures. Located along Kent Run in Muskingum County; maximum thickness of exposures, about 13 feet.

3. Rush Creek exposures. A few scattered exposures located along Rush Creek and its tributaries in Rush Creek Township, Perry County; maximum thickness of exposures, about 21 feet.

4. Little Monday Creek exposures. Located along Little Monday Creek and its tributaries at and near Maxville, Monday Creek Township, Perry County; maximum thickness exposed, about 15 feet.

5. Three Mile Run exposures. Located along Three Mile Run near Smith Chapel, Green Township, Hocking County; thickness exposed, about 9 feet.

6. Reeds Mill exposures. Located near Hamden, Clinton Township, Vinton County; thickness exposed, about 18 feet.

7. Canter Quarry exposures. Located in Section 24, Hamilton Township, Jackson County; maximum thickness exposed, about 3 feet.

8. Niner Ridge exposures. Located on Niner Ridge, Harrison Township, Scioto County; maximum thickness exposed, about 3 feet.

The thickest development of the Maxville limestone on the outcrop in Ohio occurs in the Fultonham area in southwestern Muskingum County. Here the greatest depth exposed at any one locality is about 35 feet. South of this at outcrops in southern Perry County and in Hocking, Vinton, Jackson, and Scioto counties, the thickness of the limestone at any one exposure is generally less than 15 feet. Along Kent Run and

[1] Geol. Survey Ohio, Fourth Series, Bull. 13, 1910.

Jonathan Creek in the Fultonham area "the limestone is divided into a lower and an upper half by a thin zone near the middle of the stratum. This thin zone, the shale-nodular zone of the report, is made up of small nodules or nodular-like layers of limestone which alternate with shales and both of which are very fossiliferous. The lower zone consists of massive, clayey limestone, the bedding planes of which are irregular and very indistinct. In the upper zone the stratification is the conspicuous feature, because the shaly partings found between the thin or medium layers of limestone are commonly weathered away, thus permitting each layer to project apparently independently from the face of the cliff. This zone in many places is fairly fossiliferous, whereas the lower one is generally but sparingly so."[1]

Owing to the limited nature of the exposures and the difference in the amount of pre-Pottsville erosion which has occurred from place to place, the full thickness of the Maxville represented by outcrops in Ohio can not be measured at any one locality. Using the shale nodular zone as a bed of reference, Morse determined that the part of the Maxville above this zone has a maximum exposed thickness of about 25 feet whereas the part below this zone has a maximum thickness of about 22 feet. Exposures south of Perry County are chiefly of the lower part of the formation.

USES OF MAXVILLE LIMESTONE

The several deposits of the Maxville limestone have yielded much stone for economic use since early days. During the operation of the early iron furnaces in southern Ohio stone for fluxing was secured in part from small quarries in the Maxville located along Niner Ridge in Scioto County; in Hamilton Township, Jackson County; and at Maxville, Monday Creek Township, Perry County. Road stone was likewise produced at many of these small quarries, and burned lime for mortar and plaster was an important product at Maxville. Nearly all of these smaller operations have been abandoned. Quarries in the thicker deposits in northern Perry County and in southwestern Muskingum County have yielded much stone for road construction, railroad ballast, concrete, lime, and building stone. In recent years these thicker deposits have been quarried extensively and utilized for road construction and for the production of agricultural lime and Portland cement.

The Columbia Portland Cement Division of the Pittsburgh Plate Glass Company now operates a large quarry in the Maxville limestone near Fultonham. The quarry is located in the southern part of Section 18, Newton Township, where in the summer of 1941 a face about 35 feet in height was being worked. The upper half of the exposure consists of a high calcium limestone whereas the lower part tends to be more dolomitic and more siliceous in composition. Limestone for agricultural purposes and for chemical uses is produced from the upper or purer ledges whereas stone from the entire vertical face, in proportions as normally delivered by the shovel, is utilized for the production of Portland cement. A description of the exposures in the quarry (1941) is as follows:

[1] Geol. Survey Ohio, Fourth Series, Bull. 13, p. 100. 1910.

SECTION OF EXPOSURES IN QUARRY OF THE COLUMBIA PORTLAND CEMENT DIVISION NEAR FULTONHAM

	Ft.	In.
Limestone, gray to light brown tint, dense to finely crystalline. Layers vary from 4 inches to 1 foot in thickness. Sample No. 345	17	9
Limestone, brown, dense texture, flint-like fracture. Sample No. 346	6	5
Limestone, brown, dense texture, tough, somewhat laminated. Sample No. 347	2	0
Shale, dark, carbonaceous	1	3
Sandstone, fine-grained, calcareous. Sample No. 348	2	1
Limestone, dolomitic, buff color, dense texture, laminated. Sample No. 349	5	9
Bottom of quarry	..	..

Five samples of limestone were secured by R. E. Lamborn from the exposures in this quarry. The samples included the entire series exposed with the exception of the 1-foot 3-inch bed of shale occurring about 8 feet from the base of the section. The samples were analyzed by Downs Schaaf, chemist for the Geological Survey of Ohio. Analyses are given below.

CHEMICAL ANALYSES OF FIVE SAMPLES OF MAXVILLE LIMESTONE FROM QUARRY OF THE COLUMBIA PORTLAND CEMENT DIVISION, SECTION 18, NEWTON TOWNSHIP, MUSKINGUM COUNTY

Sample No.	345	346	347	348	349
Silica, SiO_2	1.65	4.82	11.40	73.70	13.82
Alumina, Al_2O_3	.35	1.05	1.95	1.02	3.11
Ferric oxide, Fe_2O_3	.02	.02	.02	.02	.02
Ferrous oxide, FeO	.30	.47	.44	.42	2.45
Iron disulphide, FeS_2	.12	.14	.05	<.01	.05
Magnesium oxide, MgO	.40	.75	1.10	.55	15.82
Calcium oxide, CaO	53.90	50.88	45.75	12.75	24.50
Strontium oxide, SrO	<.01	<.01	<.01	<.01	<.01
Barium oxide, BaO	<.01	<.01	<.01	<.01	<.01
Sodium oxide, Na_2O	.02	.03	.05	<.01	.05
Potassium oxide, K_2O	.07	.14	.29	.02	.28
Water, hydroscopic, H_2O-	.09	.25	.70	.25	.55
Water, combined, H_2O+	.07	.27	.61	.25	.95
Carbon dioxide, CO_2	42.88	40.95	37.17	10.80	37.90
Titanium dioxide, TiO_2	.03	.10	.12	.05	.12
Phosphorus pentoxide, P_2O_5	.06	.05	.16	.09	.07
Sulphur trioxide, SO_3	.03	.05	.10	.02	.15
Manganous oxide, MnO	.07	.05	.06	.05	.12
Carbon, organic, C	.02	.04	.06	.03	.05
Hydrogen, organic, H	....	....	....	....	....
Total	100.08	100.06	100.03	100.02	100.01

Expressed in terms of compounds, the composition of each of samples is essentially as follows:

Sample No.	345	346	347	348	349
Silicates { $(Na.K)_2O.3Al_2O_3.6SiO_2.2H_2O$	.84	1.55	3.07	.17	2.99
Silicates { $Al_2O_3.2SiO_2.2H_2O$	.06	1.13	1.93	2.42	4.94
Silica, SiO_2	1.24	3.58	9.10	72.50	10.16
Hydrated ferric oxide, $2Fe_2O_3.3H_2O$	.02	.02	.02	.02	.02
Ferrous carbonate, $FeO.CO_2$	.48	.76	.71	.68	3.95
Iron disulphide, FeS_2	.12	.14	.05	.00	.05
Titanium dioxide, TiO_2	.03	.10	.12	.05	.12
Calcium phosphate, $3CaO.P_2O_5$	.13	.11	.35	.20	.15
Calcium sulphate, $CaOSO_3$	.05	.09	.17	.03	.26
Calcium carbonate, $CaO.CO_2$	96.04	90.64	81.19	22.54	43.39
Magnesium carbonate, $MgO.CO_2$	.84	1.57	2.30	1.15	33.06
Manganese carbonate, $MnO.CO_2$	.11	.08	.10	.08	.19
Water, hydroscopic, H_2O—	.09	.25	.70	.25	.55
Organic matter	.02	.04	.06	.03	.05
Unbalanced components					
Sum of H_2O, CO_2 residues	+.01	.00	+.16	—.10	+.13
Total	100.08	100.06	100.03	100.02	100.01

In 1941 the Forbes Construction Company of Huntington, West Virginia, was quarrying the Maxville limestone for road construction along Kent Run in the southwestern quarter of Section 15, Hopewell Township, Muskingum County. About 6 feet of the limestone formation is well exposed along the east bank of the stream near the township line. The rock succession is described in the following section.

SECTION OF EXPOSURES AT QUARRY OF THE FORBES CONSTRUCTION COMPANY, SECTION 15, HOPEWELL TOWNSHIP, MUSKINGUM COUNTY

	Ft.	In.
Limestone, light chocolate brown, one layer	..	4
Limestone, light chocolate brown, one layer	..	4
Limestone, light chocolate brown, one layer	1	1
Limestone, light chocolate brown, one layer	..	7
Limestone, light chocolate brown, one layer	..	6
Shale, bluish gray, calcareous	..	1½
Limestone, light chocolate brown, dense texture, one layer	..	8
Shale, calcareous	..	3
Limestone, light chocolate brown, dense texture, one layer	..	8
Limestone, bluish to light chocolate brown, one layer	1	1
Shale, light bluish gray, calcareous, arenaceous	..	6
Shale, bluish gray, argillaceous	1	0
Bottom of exposure	..	..

A sample of the limestone layers as described above was secured by R. E. Lamborn in 1941 and was analyzed by Downs Schaaf for the Geological Survey of Ohio.

CHEMICAL ANALYSIS OF MAXVILLE LIMESTONE FROM QUARRY OF THE FORBES CONSTRUCTION COMPANY, SECTION 15, HOPEWELL TOWNSHIP, MUSKINGUM COUNTY.
SAMPLE No. 354

Silica, SiO_2	5.29
Alumina, Al_2O_3	1.70
Ferric oxide, Fe_2O_3	.02
Ferrous oxide, FeO	.77
Iron disulphide, FeS_2	.10
Magnesium oxide, MgO	2.90
Calcium oxide, CaO	47.18
Strontium oxide, SrO	$<.01$
Barium oxide, BaO	$<.01$
Sodium oxide, Na_2O	.04
Potassium oxide, K_2O	.24
Water, hydroscopic, H_2O-	.24
Water, combined, H_2O+	.49
Carbon dioxide, CO_2	40.55
Titanium dioxide, TiO_2	.07
Phosphorus, pentoxide, P_2O_5	.07
Sulphur trioxide, SO_3	.17
Manganous oxide, MnO	.14
Carbon, organic, C	.03
Hydrogen, organic, H	.....
Total	100.00

Expressed in terms of compounds, the composition of the samples is essentially as follows:

Silicates $(Na.K)_2O.3Al_2O_3.6SiO_2.2H_2O$	2.52
Silicates $Al_2O_3.2SiO_2.2H_2O$	1.83
Silica, SiO_2	3.29
Hydrated ferric oxide, $2Fe_2O_3.3H_2O$	.02
Ferrous carbonate, $FeO.CO_2$	1.24
Iron disulphide, FeS_2	.10
Titanium dioxide, TiO_2	.07
Calcium phosphate, $3CaO.P_2O_5$	.15
Calcium sulphate, $CaO.SO_3$	.29
Calcium carbonate, $CaO.CO_2$	83.85
Magnesium carbonate, $MgO.CO_2$	6.06
Manganese carbonate, $MnO.CO_2$	.23
Water, hydroscopic, H_2O-	.24
Organic matter	.03
Unbalanced components	
Sum of H_2O, CO_2 residues	+.08
Total	100.00

In 1941 Wilber Stout visited the old Howdysell quarry in the Maxville limestone and made a section of the exposures in the quarry and immediate vicinity. The old quarry is located on the east side of Little Monday Creek about three-fourths of a mile south of Maxville, Monday Creek Township, Perry County.

SECTION OF EXPOSURES AT HOWDYSELL QUARRY, NEAR MAXVILLE, MONDAY CREEK TOWNSHIP, PERRY COUNTY

	Ft.	In.
Shale	20	..
Coal smut, *Anthony*	..	3
Clay, gray, plastic, sandy, *Sciotoville*	2	1
Shale, dark, fissile	2	2
Shale, dark gray	6	6
Ore, *Harrison*	..	2½
Shale, calcareous	..	6
Limestone, irregular, sandy, reworked	..	6 to 10
Limestone, somewhat irregular, dark, parts sandy	1	6
Limestone, light, hard, shaly	1	3
Limestone, light, hard, conchoidal fracture	..	2
Limestone, pure	..	7
Limestone, pure	..	9
Limestone, pure	..	5¾
Limestone, pure	..	8½
Limestone, pure	..	6½
Limestone, pure	..	3½
Limestone, pure	..	6
Limestone, ferruginous, very irregular, brecciated. Varies from 7 to 16 inches	..	9
Sandstone and shale, *Waverly*	..	..

Mr. Stout sampled the Maxville limestone exposed at this locality for chemical analysis. The bottom and top layers were excluded from the sample. The analysis was determined by Downs Schaaf.

CHEMICAL ANALYSIS OF MAXVILLE LIMESTONE FROM THE HOWDYSELL QUARRY NEAR MAXVILLE, MONDAY CREEK TOWNSHIP, PERRY COUNTY. SAMPLE No. 351

Silica, SiO_2	2.41
Alumina, Al_2O_3	.70
Ferric oxide, Fe_2O_3	.02
Ferrous oxide, FeO	1.11
Iron disulphide, FeS_2	.08
Magnesium oxide, MgO	1.68
Calcium oxide, CaO	50.96
Strontium oxide, SrO	$<$.01
Barium oxide, BaO	$<$.01
Sodium oxide, Na_2O	$<$.01
Potassium oxide, K_2O	.01
Water, hydroscopic, H_2O-	.15
Water, combined, H_2O+	.20
Carbon dioxide, CO_2	42.43
Titanium dioxide, TiO_2	.05
Phosphorus pentoxide, P_2O_5	.06
Sulphur trioxide, SO_3	.06
Manganous oxide, MnO	.08
Carbon, organic, C	.02
Hydrogen, organic, H	....
Total	100.02

Expressed as compounds the composition of the sample is essentially as follows:

Silicates { $(Na.K)_2O.3Al_2O_3.6SiO_2.2H_2O$	.08
Silicates { $Al_2O_3.2SiO_2.2H_2O$	1.69
Silica, SiO_2	1.59
Hydrated ferric oxide, $2Fe_2O_3.3H_2O$	.02
Ferrous carbonate, $FeO.CO_2$	1.79
Iron disulphide, FeS_2	.08
Titanium dioxide, TiO_2	.05
Calcium phosphate, $3CaO.P_2O_5$	.13
Calcium sulphate, $CaO.SO_3$	.06
Calcium carbonate, $CaO.CO_2$	90.82
Magnesium carbonate, $MgO.CO_2$	3.51
Manganese carbonate, $MnO.CO_2$	.13
Water, hydroscopic, H_2O-	.15
Organic matter	.02
Unbalanced components, Sum of H_2O, CO_2 residues	—.10
Total	100.02

The thickest deposit of Maxville limestone exposed on the outcrop in Ohio occurs in the quarries of the Columbia Portland Cement Division near Fultonham where a vertical thickness of about 35 feet is exposed. From analyses of samples from this quarry it is apparent that the purest grade of limestone is found in the upper half of the exposure and that in the lower half the stone becomes in general more argillaceous, more siliceous, and more magnesian downward.

THE MAXVILLE LIMESTONE BELOW DRAINAGE

From its line of outcrop the general regional inclination of the strata carries the horizon of the Maxville limestone below drainage in a southeastern direction. East of the crop line the horizon of this limestone occurs at varying distances below the surface. This distance tends to increase toward the east and southeast, and in general is greatest in Ohio in eastern Monroe County and in eastern Washington County. To determine the presence or absence of the limestone, its depth from the surface, thickness, etc. it is necessary to resort to a study of the records of wells drilled for oil and gas. A study of such well records leads one to the conclusion that the Maxville limestone is not present below drainage north of an east-west line extending along the northern boundary of Harrison County, and that it is apparently wanting over large areas south of that line. In northeastern Ohio pre-Pottsville erosion bit deeply into the Mississippian sediments removing all traces of the Maxville limestone and cutting away much of the underlying sandstones and shales of the Waverly group. So extended was this erosion that in parts of Mahoning and Columbiana counties the basal beds of the Pottsville are found less than 200 feet above the Berea sandstone.

South of Harrison County remnants of the Maxville limestone are confined for the most part to two elongated areas, one located in the southeastern and the other in the south central parts of the State. These areas are separated by a broad expanse where the Maxville, known to the driller as the Big Lime or Jinglerock, is not generally reported in well records. The eastern area extends from northeastern Belmont County to the Ohio River in eastern Washington County and includes much of eastern and southern Belmont, eastern Noble, central and western Monroe, and eastern Washington counties. The present stage of drilling indicates a large central area of occurrence extending from southeastern Washington County to southwestern Belmont County flanked on the north and west by a number of smaller disconnected areas. Future drilling may extend the boundaries of these areas especially to the east where the presence of the limestone is expected but where evidence from well records is at present lacking.

The second belt of occurrence extends from central Muskingum County to southern Lawrence County. It consists of a series of disconnected areas located in southeastern Muskingum, northwestern Morgan, and eastern Perry counties; in northeastern Vinton County; in southern Athens County; in eastern Meigs County; in northeastern Gallia County; and in southern Lawrence County. The largest of these areas is found in southwestern Muskingum County and in adjacent areas to the south where the limestone is apparently a continuation under cover of the deposits which outcrop at Fultonham. The distribution of the known deposits of Maxville limestone occurring below drainage in Ohio as determined by a study of well records is shown on the map.

Between the east and the west belts of occurrence of the Maxville limestone there is a broad area in which the presence of the limestone is not generally noted in the records of wells which in depth have passed its horizon. Over this area the basal beds of the Pennsylvanian system are conceived to rest disconformably on the sandstones and shales of the Waverly. Pre-Pottsville erosion has entirely removed the Maxville limestone except in a few small places as in western Washington County where thin deposits of limestone occur on this horizon over limited areas. The maximum thickness of the known deposits of Maxville limestone under cover in Ohio is approximately 200 feet. The variations in thickness of this limestone in a single section may reach 100 feet or slightly more but it is usually much less than 100 feet. The surface upon which the basal beds of the Pennsylvanian rest, which is represented by the upper surface of the Maxville where that limestone is present, is conceived therefore to be somewhat rough and rugged. The local average relief of the erosion surface is generally less than 100 feet, whereas the maximum relief is in excess of 200 feet, which is the maximum known thickness of the limestone in Ohio. The table shows the variation in thickness, average thickness, and the variation in depth of the Maxville limestone from the surface in known areas in eastern Ohio as determined by a comparative study of well records.[1]

[1] In the preparation of the table it was necessary to examine several thousand well records in the files of the Geological Survey of Ohio and of the Division of Mines. To the latter the writer acknowledges his indebtedness and expresses his appreciation.

TABLE SHOWING VARIATIONS IN THICKNESS, AVERAGE THICKNESS, AND DEPTH FROM THE SURFACE IN FEET OF THE MAXVILLE LIMESTONE IN KNOWN AREAS OF OCCURRENCE IN EASTERN OHIO

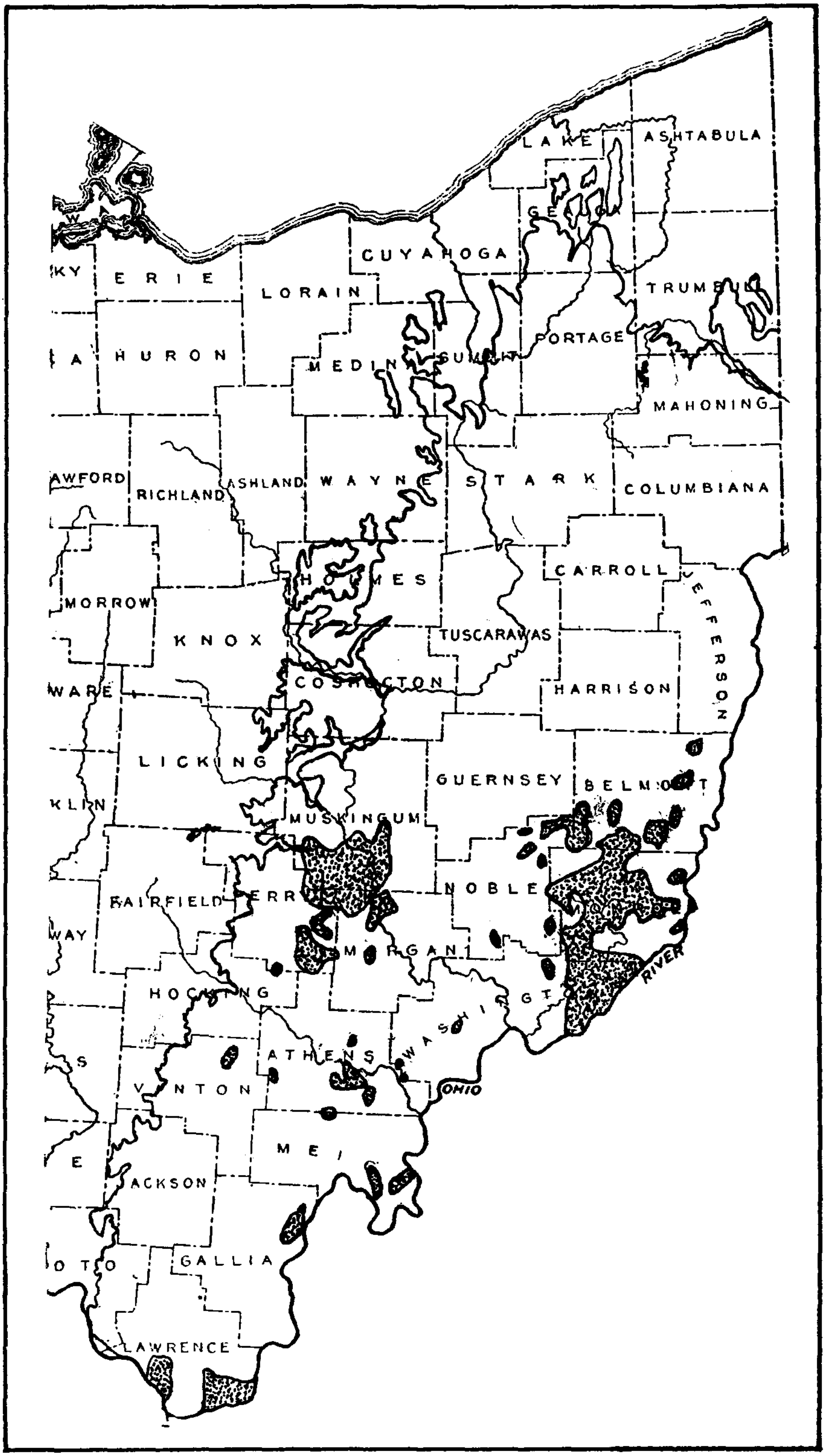
County	Township	Variations in depth to limestone	Variations in thickness of limestone	Average thickness of limestone
Muskingum	Newton	0 to 350	15 to 60	32
"	Wayne	190 to 500	15 to 58	40
"	Salt Creek	330 to 510	20 to 65	50
"	Blue Rock	310 to 710	10 to 80	45
"	Harrison	250 to 620	15 to 70	48
"	Brush Creek	300 to 620	25 to 80	50
Morgan	York	400 to 685	20 to 70	50
"	Deerfield	525 to 750	40 to 56	45
"	Bloom	400 to 750	12 to 75	50
"	Malta	450 to 750	18 to 35	25
Perry	Harrison	110 to 400	6 to 50	40
"	Bearfield	290 to 520	15 to 81	45
"	Pleasant	310 to 450	30 to 41	35
"	Monroe	300 to 320	5 to 50	20
"	Coal	200 to 500	30 to 40	35
Vinton	Brown	150 to 360	30 to 55	40
Athens	Waterloo	440 to 550	20 to 70	40
"	Ames	650 to 915	20 to 28	24
"	Canaan	700 to 1000	8 to 55	35
"	Lodi (S.W.)	980 to 1125	15 to 62	40
"	Lodi (N.)	940 to 1285	5 to 90	30
"	Carthage	1080 to 1200	16 to 59	45
Meigs	Lebanon	1280 to 1540	30 to 133	65
"	Sutton	1170 to 1570	15 to 85	55
Gallia	Cheshire	850 to 1150	50 to 185	75
"	Addison	755 to 1035	90 to 125	110
Lawrence	Upper	420 to 755	38 to 97	85
"	Perry	500 to 700	28 to 85	80
"	Union	975 to 1375	25 to 183	150
"	Rome	1080 to 1410	129 to 195	170
Washington	Decatur (S.W.)	1200 to 1300	15 to 40	27
"	Decatur (W.)	1200 to 1300	6 to 54	25
"	Barlow	1320 to 1645	20 to 41	30
"	Liberty (W.)	1125 to 1450	5 to 90	50
"	Liberty (E.)	1200 to 1500	10 to 120	60
"	Newport	1175 to 1375	26 to 77	71
"	Independence	1100 to 1700	14 to 105	62
"	Grandview	1200 to 1700	10 to 135	60
"	Ludlow	1025 to 1550	5 to 140	90
Noble	Elk	1000 to 1215	20 to 92	54
"	Jackson	800 to 1130	6 to 79	46
"	Stock	975 to 1270	25 to 49	33
"	Marion	850 to 1150	7 to 70	26
"	Seneca	850 to 1070	15 to 35	28
"	Wayne (E.)	700 to 1020	12 to 60	27
"	Wayne (C.)	720 to 920	6 to 25	20
"	Beaver	750 to 1175	5 to 143	38
Monroe	Bethel	1051 to 1400	19 to 126	90
"	Washington	1100 to 1400	35 to 120	95
"	Benton (S.)	1400 to 1600	32 to 127	69
"	Benton (N.)	1400 to 1750	60 to 70	65

County	Township	Variations in depth to limestone	Variations in thickness of limestone	Average thickness of limestone
Monroe	Perry (S.)	1375 to 1650	60 to 80	65
"	Perry (N.W.)	1100 to 1500	70 to 119	95
"	Franklin	1000 to 1300	7 to 49	30
"	Wayne	1000 to 1450	50 to 90	36
"	Summit	1200 to 1500	6 to 110	50
"	Center	1160 to 1650	11 to 122	53
"	Green	1300 to 1700	43 to 124	83
"	Adams	1200 to 1700	50 to 125	70
"	Ohio (S.E.)	1400 to 1800	46 to 90	59
"	Ohio (N.E.)	1350 to 1900	70 to 95	80
"	Salem (S.E.)	1300 to 1800	53 to 80	65
"	Salem (S.W.)	1675 to 1850	35 to 58	48
"	Salem (N.E.)	1200 to 1800	20 to 60	38
"	Sunbury	1200 to 1625	10 to 83	51
"	Malaga	1200 to 1490	5 to 90	56
Belmont	Washington	1100 to 1400	15 to 78	62
"	Wayne	1000 to 1350	5 to 95	51
"	Somerset (S.E.)	1160 to 1300	15 to 60	45
"	Warren (S.W.)	1000 to 1350	60 to 65	62
"	Somerset (W.)	820 to 1300	24 to 116	73
"	Goshen	1000 to 1330	12 to 65	43
"	Mead	1030 to 1575	12 to 95	62
"	Richland	1000 to 1425	34 to 79	54
"	Colerain	1040 to 1440	13 to 68	37

From the table and map, it is apparent that the Maxville limestone occurs in several areas in southeastern Ohio, where it has an average thickness equal to or greater than the maximum known thickness of about 50 feet on the outcrop. Such areas occur in southern Muskingum, northwestern Morgan, and northeastern Perry counties; in southern Lawrence County; in eastern Gallia County; in eastern Meigs County; and over an elongated area including much of eastern Washington, Monroe, and southern Belmont counties. The greatest known thickness is found in southern Lawrence County and in eastern Gallia County where a maximum of 195 feet of Maxville limestone has been penetrated in wells drilled for oil and gas and where a thickness of 100 feet or more is of common occurrence over an area embracing several square miles. The depth of such deposits of Maxville limestone in eastern and southern Ohio varies from a maximum of about 620 feet in southern Muskingum County to a maximum of a little less than 2,000 feet in eastern Washington County and in eastern Monroe County.

Little is known concerning the physical aspects or chemical composition of the Maxville limestone over a large part of the field of occurrence below drainage in Ohio. Detailed information of this nature involves core drilling the formation and determining the physical character and chemical composition of the cores. Such procedure was resorted to near Ironton, Lawrence County, prior to 1914, when the Ironton Portland Cement Company completed two shafts to the Maxville, each 514 feet in depth.[1] The

[1] Geol. Survey Ohio, Fourth Series, Bull. 20, p. 285. 1916.



Map of the eastern part of Ohio showing the line of outcrop of the Mississippian–Pennsylvanian contact and areas of occurrence of the Maxville limestone below drainage.

bottom of the two shafts is approximately 55 feet below the top of the limestone which in this locality has been determined by core drill tests to have a thickness of about 97 feet. Limestone having a thickness of about 40 feet was being quarried in 1943. Wilber Stout, who visited this mine shortly after its inception, describes the limestone as follows.[1]

"In this mine the deposit is made up of rather regularly bedded layers of limestone with thin layers of calcareous shales intervening. Vertically the limestone beds are broken every few inches by irregular bedding planes. The limestone is dense and only sparingly fossiliferous."

No detailed chemical analyses of recent date are available for the Maxville limestone near Ironton. However, the continued and successful use of limestone from this formation since 1914 for the production of Portland cement argues for consistently low magnesia and iron content.

In the records of wells drilled through the Maxville that formation is generally described as a single bed of limestone called the Big Lime or Jinglerock by the driller. Locally "breaks" are recorded in the formation. Thus in southern Lawrence County where the Maxville is a thick deposit, a thin shale bed or "break," called the Pencil Cave, having a thickness of 2 to 10 feet, is in places recorded as occurring from 10 to 30 feet below the top of the limestone. In such localities the upper thinner limestone is termed the Little Lime to distinguish it from the lower thicker bed known as the Big Lime. Sandstone deposits are likewise associated with the Maxville in parts of Belmont, Monroe, Noble, and Washington counties, where it is known as the Lime sand and where it is locally productive of oil and gas.

ROCK SUCCESSION ABOVE THE MAXVILLE LIMESTONE

The rock succession which overlies the Maxville limestone in the eastern half of Ohio varies in thickness from zero at the outcrop to a maximum approaching 2,000 feet in eastern Monroe County and in eastern Belmont County. Near the outcrop the overlying beds are entirely of Pottsville age but as the depth below the surface becomes greater to the eastward, the overlying series increases in thickness by the appearance in order above the Pottsville of the Allegheny, Conemaugh, and Monongahela series of the Pennsylvanian system and finally by beds of the Permian system. The series above the limestone consists in large part of alternating beds of shale and sandstone many of which are water bearing, with many thin zones of coal, clay, and limestone. Many of the sandstones lack horizontal continuity but in general there is a tendency for the basal sandstones of the Pennsylvanian to become thicker and more pronounced to the eastward. The nature of the rock succession, which overlies the Maxville and which must be penetrated by all wells drilled or shafts sunk to the limestone, is illustrated by the following record prepared by R. E. Lamborn from samples of drill cuttings from the Louisa Kerr No. 1 well drilled in 1943 to the Oriskany sand in Section 6, Center Township, Monroe County, by the South Penn Natural Gas Company.

[1] Geol. Survey Ohio, Fourth Series, Bull. 20, p. 285. 1916.

RECORD THROUGH MAXVILLE LIMESTONE OF LOUISA KERR No. 1 WELL LOCATED IN SECTION 6, CENTER TOWNSHIP, MONROE COUNTY

Permian-Pennsylvanian Systems	Top	Bottom
Soil	0	5
Shale, red	5	19
Shale, red, brown, and gray	19	35
Sandstone, micaceous, and bluish gray shale	35	52
Limestone, gray, dense	52	60
Shale, gray, soft	60	66
Shale, sandy, micaceous, and sand shell	66	79
Coal, black shale, and clay	79	83
Limestone, much pyrite, a little shale	83	90
Shale, micaceous, sandy, and fine-grained sandstone	90	102
Shale, bluish gray	102	112
Same, more arenaceous	112	120
Sandstone, gray, micaceous	120	148
Shale, red	148	165
Shale, reddish brown, and a small amount of limestone	165	175
Shale, reddish brown	175	182
Shale, gray, soft	182	193
Shale, gray, and light bluish gray	193	202
Shale, reddish brown	202	220
Shale, soft, gray	220	228
Shale, gray, and bluish gray	228	272
Shale, reddish brown	272	279
Shale, bluish gray, argillaceous	279	305
Shale, soft; some gray limestone	305	310
Limestone, gray to drab, dense, *Benwood-Arnoldsburg*	310	351
Shale, gray, and light greenish gray, soft	351	385
Shale, brown black, *Meigs Creek* coal horizon	385	405
Shale, bluish gray; a few pieces of limestone	405	416
Shale, brown black, gray black, and gray	416	449
Sandstone, very fine-grained, gray, shaly, *Pomeroy*	449	455
Shale, gray, soft	455	460
Shale, micaceous, sandy	460	489
Shale; some pieces of coal, *Pittsburgh* coal horizon	489	496
Shale, gray to drab	496	511
Shale, red	511	516
Shale, soft, gray and gray brown	516	532
Shale, pink, and reddish brown	532	562
Sandstone	562	570
Shale, reddish brown	570	587
Shale, reddish brown, with a few fragments of limestone	587	608
Sandstone, fine-grained	608	644
Shale, red, argillaceous	644	664
Shale, gray to greenish gray	664	681
Sandstone, fine-grained	681	693
Shale, arenaceous, and fine-grained sandstone	693	704
Shale, dark gray to drab	704	713
Shale, pink to brown, variegated, *Round Knob*	713	755
Shale, drab	755	768
Shale, reddish brown	768	773
Shale, greenish gray and bluish gray	773	822
Same with a few pieces of coal, *Anderson* coal horizon	822	828
Shale with a few fragments of gray limestone } *Cambridge*	828	833
Limestone and a little soft shale } *Cambridge*	833	838
Shale, argillaceous	838	850
Shale, red, brown, and greenish gray	850	865

	Top	Bottom
Clay shale, reddish brown	865	869
Shale, greenish gray	869	884
Shale, dark bluish gray, sandy	884	901
Shale, bluish gray, with a few pieces of coal, *Brush Creek* coal horizon	901	912
Sandstone, gray, shaly	912	930
Shale, bluish gray, soft	930	940
Sandstone, bluish gray, micaceous	940	958
Shale, gray and greenish gray, soft, micaceous	958	978
Sandstone, white to gray	978	989
Shale, bluish gray, sandy, micaceous	989	1000
No samples	1000	1035
Sandstone, medium to fine-grained, white, grain free	1035	1055
Sandstone, stained yellow brown	1055	1075
Shale, bluish gray	1075	1090
Shale and clay, with 5 per cent coal fragments, *Middle Kittanning* coal horizon	1090	1100
Shale, gray, with much iron carbonate	1100	1105
Shale, dark bluish gray	1105	1120
Shale, bluish gray, soft, with a few pieces of coal, *Lower Kittanning* coal horizon	1120	1129
Shale, soft, bluish gray	1129	1135
Sandstone, gray to bluish gray	1135	1141
Shale, bluish gray, sandy	1141	1165
Sandstone, gray	1165	1210
Sandstone, stained yellow brown	1210	1219
Sandstone, gray	1219	1236
Sandstone and shale	1236	1258
Sandstone, gray and dark	1258	1266
Shale, dark bluish gray, arenaceous	1266	1312
Shale and sandstone shells	1312	1319
Sandstone, gray to white, generally fine-grained	1319	1369
Sandstone, gray to white, generally fine-grained, grain free	1369	1378
Sandstone, gray to white, coarse-grained, pebbly	1378	1394
Sandstone chips, fine-grained	1394	1418
Shale, dark bluish gray, with 15 per cent sandstone	1418	1425
Shale, dark bluish gray	1425	1440
Mississippian system		
Limestone, gray, and some dark bluish gray shale (*Maxville*)	1440	1448
Limestone, gray, dense, with some gray shale (*Maxville*)	1448	1458
Limestone, gray to brownish gray, dense (*Maxville*)	1458	1471
Limestone, gray, and light brownish gray, arenaceous (*Maxville*)	1471	1516
Shale, bluish to greenish gray, arenaceous	1516	1535
Sandstone, bluish gray, fine-grained, micaceous (*Keener sand*)	1535	1543
Sandstone, white, grain free (*Keener sand*)	1543	1548½
Sandstone, gray, fine-grained, micaceous (*Keener sand*)	1548½	1559
Sandstone, bluish gray, micaceous (*Keener sand*)	1559	1563
Sandstone, shaly, bluish gray (*Keener sand*)	1563	1582

SUMMARY

The Maxville limestone is one of the few sources for thick deposits of high calcium limestone in the eastern half of Ohio. Outcrops of this formation are not continuous but are confined to small areas where limestone remnants of pre-Pottsville erosion are exposed at the surface. The best known deposits occur over a belt extending from southwestern Muskingum County to southeastern Scioto County, but present operations in this limestone are confined almost entirely to southwestern Muskingum County and northeastern Perry County. The thickest exposures occur near Fultonham where 18 feet of high calcium limestone is underlain by an equal thickness of stone which is more argillaceous, more siliceous, and more magnesian.

The Maxville limestone is present below drainage in several areas in the eastern half of Ohio where it has a thickness equal to or greater than on the outcrop. Most prominent of these areas include southern Muskingum County, northwestern Morgan County, northeastern Perry County, southern Lawrence County, western Gallia County, eastern Meigs County, and an elongated area including much of eastern Washington, Monroe, and southern Belmont counties.

Little is known concerning the character of the Maxville limestone below drainage in Ohio. Southern Muskingum County and adjacent areas to the south constitute a large tract where the Maxville is equal to or greater in thickness than at Fultonham and where it can be reached at depths of 700 feet or less. Near Ironton, Lawrence County, the upper part of a remnant of Maxville limestone close to 100 feet in thickness has been worked in a shaft mine for 30 years for the production of Portland cement. Other deposits having a thickness equal to or greater than at Ironton are known to occur in southern Lawrence County and in eastern Gallia County. Such limestone deposits constitute a possible resource an estimate of the value of which must await further investigation by the drill and by the laboratory.