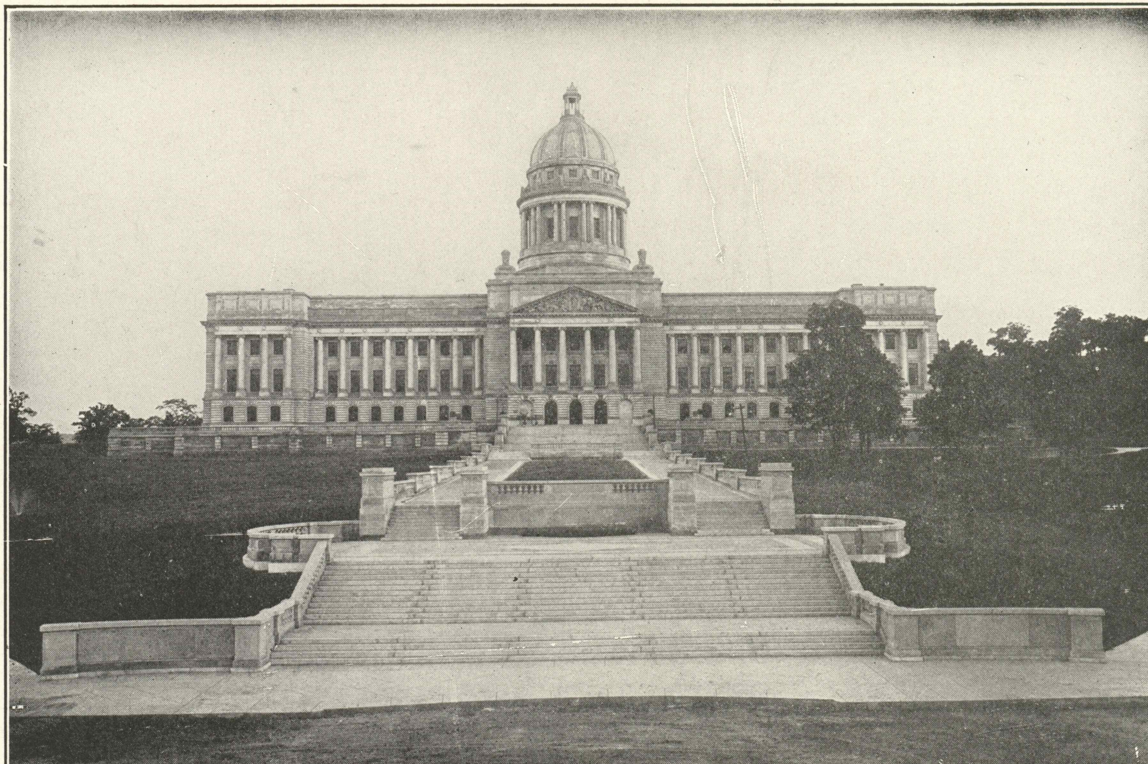


THE NEW STATE CAPITOL.

KENTUCKY

GEOLOGICAL SURVEY

FOURTH SERIES
VOLUME TWO

PART THREE

J. B. HOEING, State Geologist

FRANKFORT, KY.
1914

ADVISORY BOARD.

CONTENTS.

GEOLOGY OF FRANKLIN COUNTY

BY

A. M. MILLER

1914

CONTENTS.

GEOLOGY OF FRANKLIN COUNTY.

HISTORY.

According to Collins' History of Kentucky, Franklin was the 18th county formed in the State, having been organized in 1794 out of parts of Woodford, Mercer and Shelby.

It was subsequently reduced in size by portions being taken to form Gallatin (1798), Owen (1809), and Anderson (1827).

Its area at present has been commonly estimated at 200 square miles. Planimeter measurements on the map indicate that its area is 200.73 square miles.

Frankfort, the county seat and Capital of the State, situated on the Kentucky River 65 miles from its mouth, was established in 1786. Tradition has it that the name is a corruption of "Frankford," so named because a man by the name of Stephen Frank was killed by Indians at the ford of the Kentucky River which formerly existed opposite the mouth of "Devil's Hollow," just above the mouth of Benson Creek.

An earlier, and for a time, more important settlement in this vicinity was Leestown, situated at the "Lower Ford" just below the mouth of Benson Creek. This is where Lock No. 4 was subsequently located, and is now a part of Frankfort. The reason for the existence of these fords, and hence for the location for the two towns now fused into one, was the great amount of rocky material brought down by Benson Creek and pushed out into the Kentucky River at this point. Much detritus brought down by a tributary stream is apt to narrow a river at the point of junction, forming thereby a rapids or "riffle," some portion of which can often readily be forded at ordinary stages of water. The construction of the lock and dam has obliterated these old shallows.

Franklin county is bounded on the north by Henry and Owen, on the east by Scott and Woodford, on the south by Woodford and Anderson, and on the west by Shelby.

MAPS.

The first complete road and residence location map of the county was made in 1882 by D. J. Lake and Company, of Philadelphia.

This was issued in atlas form as a whole, scale one mile to the inch, and by precincts, scale one mile equals two inches. It was based on accurate surveys as regards location of roads, but the plotting of the stream courses was very inaccurate. Many of the roads have been changed since then, and a number of new ones added. The precinct boundaries have also undergone considerable change as well as the names of the landowners.

The precincts, with their general location as they existed then, were as follows:

Courthouse, Cedar Run and Bridgeport; including the southern part of the county: Forks of Elkhorn, Gas House and Benson; the middle section: and Peaks Mill and Bald Knob the northern portion.

The northern half of the county lies within the Lockport Quadrangle, which was surveyed in 1906 as the result of joint co-operation of the State and Federal governments. The Lockport Quadrangle Sheet was issued in 1908. In addition to showing position of streams, roads and dwellings, it shows topography by means of 20 foot contours.

The above maps have been the basis for the plotting of the geological work of this report, and the map accompanying it is a composite of them.

TOPOGRAPHY AND DRAINAGE.

Most of the county is quite broken. The hilliest portion is in the Bald Knob neighborhood and in that portion of the Peaks Mill precinct lying north and northeast of the village of that name.

The most level and consequently most arable lands are the bottoms along the Kentucky River and its larger

tributaries, among the latter chiefly Elkhorn Creek—both the main stream and the north and south forks. Quite a considerable amount of this bottom land lies in ox-bow bends of older valleys of these streams now running in new and deeper cut channels. There are three of these along the Kentucky River. The uppermost one is above Frankfort. It is now traversed by the lower portion of Vaughn's Creek. The middle one is at Frankfort, extending in a semi-circle from the penitentiary by way of the old fair grounds to the river again a short distance below the lock. Fort Hill, overlooking the town from the north, is an outlier formed by the river when it cut across the neck of this meander bend. The lowermost one is on the west side of the river, where it passes out of the county near Polsgrove.

It was the second one of these which attracted earliest attention. Zadock Cramer, writing in his paper, the Navigator, published at Pittsburg in 1817, describes this old bottom and offers the correct explanation of its formation. He states that the "river at Frankfort has an appearance of having left its old bed which may have been through a pleasant valley or old glen, now a fine meadow between the hill back of Frankfort and that whose point comes to the river just below the town and obliquely opposite hill on the southwest side of the river." Had he stopped here, he would have been in thorough accord in his explanation with the views of modern geographers, but, imbued with the catastrophic notions of his time, he had to go further and invoke a "great convulsion of nature" producing a "fracture" by which the river made its present short cut and left its old bend.

In the Elkhorn Drainage there are three important deserted creek meanders in the county. The first one is on North Elkhorn just above the Forks of Elkhorn. Here it constitutes a wide bottom lying to the west of the Frankfort & Cincinnati R. R.

The second one is on Main Elkhorn west and southwest of Stedmantown, extending westward to the Frankfort and Peaks Mill turnpike.

The third is west of the Frankfort and Peaks Mill pike, its upper end joining the lower end of number two. Both number two and number three inclose outlier hills.

All these deserted meanders above described now constitute very fine farming country. Since their formation the streams which made them have cut down so far below their old beds that it is only during exceptional high water that any portion of them is now flooded.

The Kentucky River flows almost through the middle of Franklin county from south to north; the distance from southern to northern boundary measured along its meanderings is 26 miles; measured as the crow flies this distance is only 16 miles.

The most important creeks in the county, all tributary to the Kentucky River, are as follows:

Little Benson, forming the southern boundary between Franklin and Anderson; Glenn, entering from the east $5\frac{1}{2}$ miles above Frankfort, but having very little of its course in the county; Vaughn, entering from the east $4\frac{1}{8}$ miles above Frankfort; Cedar, entering from the west $3\frac{1}{4}$ miles above same point; Benson, entering at Frankfort from the west; Stony, entering from the west 6 miles below the mouth of Benson at Frankfort; Elkhorn, entering from the east $14\frac{3}{4}$ miles below same point at Frankfort; Flat, entering from the west at the Owen-Franklin line, $18\frac{1}{4}$ miles below same point at Frankfort. Another stream, Cedar Creek, drains the extreme northeastern part of the county and enters the Kentucky River in Owen county.

Sand Ripple Creek, which enters the Kentucky River in Henry county, drains a little of the extreme northern portion of Franklin, west of Flat Creek.

Benson Creek has two nearly equal forks, South Benson and Main Benson. The former drains the Bridgeport precinct and Main Benson, with its north fork and north fork of north fork, drains mainly the Benson precinct.

Elkhorn Creek, rising in its two forks, North Elkhorn and South Elkhorn, in Fayette County, flows from there, the one across Scott County, and the other along the boundaries of Woodford and Scott to Franklin and thence to their union in Franklin at the "Forks of Elkhorn" in the precinct of the same name. Forming a considerable sized stream here, it pursues a very meandering course to its mouth, draining mainly the Peaks Mill precinct.

Both the very winding courses of the Kentucky River and its main tributaries and the widespread distribution of old river sands and gravels over the present uplands, bear testimony to the former base leveled condition and subsequent rejuvenation by uplift of the country of which Franklin county forms a part. During their period of rejuvenation the streams trenched their channels deep into the underlying strata along the winding paths they had previously sketched out. There is some evidence pointing to the middle or late Tertiary as the time when the base leveled condition was reached, and the early Pleistocene as the period of elevation and stream rejuvenation.

The highest points in the country are on the ridge road along the watershed between the waters of Cedar Creek and those of Elkhorn. Here between Union Church and the Owen-Franklin line elevations of 920 feet above sea level are reached. The lowest point is, of course, where the Kentucky River passes out of the county to the north. Here low water stage in the river is about 450 feet above sea level. This gives for the whole county an altitude range of 470 feet.

HISTORY OF GEOLOGICAL INVESTIGATIONS IN THE COUNTY.

The first report we have on the geology of Franklin county was that made in 1857 by David Dale Owen, the first State Geologist of Kentucky. Though Owen's survey at the time was of necessity in the nature of a reconnaissance and the report brief, it is remarkable how clearly the latter sets forth the essential features of the geology. He recognized a division of the Lexington Limestone (Trenton) which only recently we have again differentiated and given the name "Brannon." He called attention to the presence at this horizon of an interesting fossil sponge, which he described fairly well and named "Scyphia digitata." He gave as the locality where this fossil was found as the "Riffle near Brights

Mill on Benson Creek." This mill has long since disappeared, but it appears to have been near the mouth of Sheep Pen Branch in the Benson precinct.

He noted the stratigraphic position of this sponge as being above that of "Chaetites lycoperdon" (now known as Prasopora simulatrix), the most characteristic fossil of the Wilmore Bed, and by means of this succession established the presence of the same sponge horizon near the top of the "Arsenal Hill" at Frankfort, though no specimens were found there.

He appears also to have identified the "ostracod horizon," which we now know as the Salvisa Bed of the Perryville. The conspicuous and characteristic ostracod, known as Isochilina jonesi, occurring here, he provisionally identified as "Cytherina baltica," and referred to it as occurring in a limestone quarried on the "Crutcher farm."

Doubtless this refers to the old Crutcher neighborhood south of Jones Station.

In addition to this description of the geology, Owen touched upon the soil and timber resources of the county. One observation on tree distribution is as true today as when he made it. It is, namely, that the prevalence of beech timber increases as one passes southwestward toward the Shelby county line.

At this time Owen collected, or had collected, a number of samples of rock and soil from the county, which were analyzed by Dr. Robert Peter. These rock and soil analyses, with the names of the present owners of the farms from which they came, appear in another part of this report.

Prof. N. S. Shaler, the State Geologist, who, after an interim, succeeded Owen, in Vol. III, New Series, 1877, page 22, compares the section at Frankfort with that at Cincinnati and inclines to the view that the former belongs lower down in the series than the latter.

He attempts to give the fossil succession at the two places, but this is very general, and on account of the doubtful specific determinations, cannot be considered a very valuable contribution to the subject. He, however, agreed with Owen in recognizing the presence of the "Scyphia digitata" sponge horizon near the top of the Arsenal or Cemetery Hill. He goes further and correctly correlates it with the horizon of another sponge-yielding locality—that affording the "artichoke" sponge in Fayette county. We recognize this sponge from its appelation as "Strobilospongia aurita," and fix the locality of its occurrence in Fayette county as in the Russell Cave neighborhood, this being the only part of the county where we have found it abundantly.

Later on, W. M. Linney began work on the geology of Franklin county with a view to issuing a map and a report. This was during the Procter Survey. It was never completed.

During the time of the Shaler and Procter Surveys, Frankfort was the center of geologic interest in the State, and the attention of not a few was turned toward fossil collecting in the splendid exposures afforded by the hills about the city.

Very prominent among these was Mr. E. C. Went. His collection of Trenton and lower Cincinnatian fossils, later purchased by the Department of Geology, Kentucky State University, was very complete.

Through sale and exchange the fossils obtained by these collectors found their way into the various geological museums of the world, so that "Frankfort, Ky.," is seen on many labels therein, and the paleontology of the Trenton of Kentucky is chiefly known through the labors of these collectors.

Mr. E. O. Ulrich and Prof. August Foerste have also in recent years devoted considerable attention to the geology at Frankfort and vicinity and worked out the detailed section so admirably exposed in the river hills there.

The author of this report first began his work in Franklin county for the State Geological Survey in 1904. He was ably assisted in this work by W. F. Pate, then superintendent of the public schools of Versailles, Ky. A geological map was prepared, but the director of the survey, Prof. C. J. Norwood, having changed his plans about the issuance of county reports, the map and report were never issued.

Since the completion of the Lockport contour map, which included the northern half of Franklin county, and the development of phosphate deposits in Woodford county, which deposits seemed likely to extend into Franklin, the time appeared opportune for a re-survey of the latter county on a more detailed scale than hitherto attempted.

STRATIGRAPHIC AND AREAL GEOLOGY.

Franklin county is situated on the western limb of the great Cincinnati Arch or Anticline. As the axis of the anticline is in this portion of its course plunging to the north, a northwest dip is given to the rocks.

The stratigraphic series exposed in the county is included in the Mohawkian and Cincinnatian divisions of the Ordovician, with an erosion interval from strata of the mid Ordovician to river deposits of the late Pliocene or early Pleistocene.

The Ordovician column begins about 60 feet below the top of the Tyrone member of the High Bridge or Stones River series, and ends a short distance up in the Maysville member of the Cincinnatian.

The exposed maximum thickness of the strata included within these limits is about 650 feet. The actual range in altitude of the county we have found to be 470 feet. The seeming discrepancy in these figures is explained by the dip of the rocks, and also to some extent by faulting.

A well drilled to a depth of 1,300 feet at Frankfort throws some light on the underlying stratigraphy of the county and the Blue Grass Region generally. This well, beginning in the Tyrone limestone, reached the top of a magnesian limestone at a depth of 82 feet. This limestone, which is here about 15 feet thick, is undoubtedly the Oregon bed. Below this, to a depth of about 575 feet, relatively pure limestones were penetrated which may all be assigned to the Camp Nelson, making the total thickness of that formation about 480 feet. At this depth (575 feet) the limestones again become magnesian and continue so to a depth of 615 feet. These 40 feet of magnesian limestones are succeeded by a white sandstone, with a calcareous cement (calciferous sandrock), the top of this being at 615. This formation has generally been correlated with the Calciferous, or, as it is now called, the Beekmantown. The drill stopped in this formation at a depth of 1,300 feet, giving 685 feet of this formation penetrated without the base of it being reached. This 1,300 feet of strata drilled through here failed to exhaust the Ordovician column. Added to the section above the surface it gives for the Ordovician section as explored in Franklin county a thickness of about 1,900 feet and for the whole Ordovician section in Central Kentucky a thickness of not less than 2,250 feet.

An outline of the bed rock stratigraphy of the county is given in the following table:

Table of Geological Formations—Franklin County.

System	Series	Formation	Member	Bed	Maximum Thickness Feet
Ordovician	Cincinnatian	Cincinnati	Maysville	Fairmount	
				Mt. Hope	50
			Eden	Garrard	20
				Million	180
			Cynthiana	Pt. Pleasant	Wanting
				Greendale	60
	Mohawkian	Lexington (Trenton)	Perryville	Cornishville	Wanting
				Salvisa	15
				Faulconer	10
			Flanagan	Woodburn	30
				Brannon	15
			Bigby		75
			Wilmore		80
			Hermitage		45
			Cardsville		10
		High Bridge (Stones River)	Tyrone		60
				Total.......	650

The most nearly complete geological section in a continuous steep exposure in the county is that afforded along a neighborhood road ascending the hill from Glenns Creek on the north side at the Old Crow Distillery.

This section drawn to scale is reproduced from the Report on the Georgetown Quadrangle. It differs from the more generalized section given in the preceding table of formations in the thickness assigned to some of the sub-divisions. (See opposite page.)

THE TYRONE LIMESTONE.

Maximum thickness exposed in the county about 60 feet. Area exposed in the county 5.68 square miles.

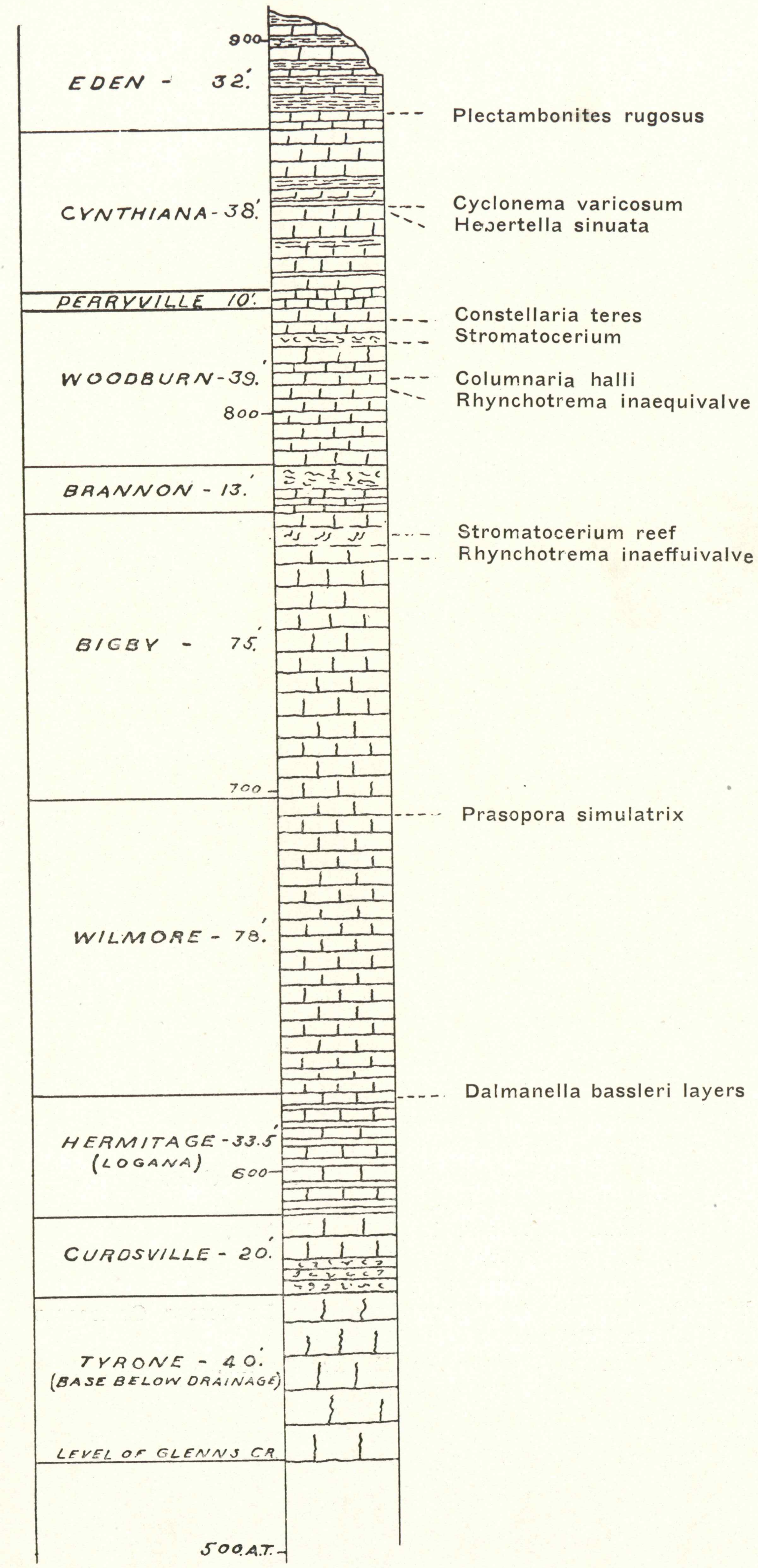
The Tyrone, "Birdseye" of earlier writers on Kentucky geology (Owen to Linney, inclusive), is a compact, light or dove-colored limestone through which is disseminated, often quite regularly, calcitic replacements of some low form of marine life, probably a plant. It is the glistening facets of these calcitic replacements on fresh surfaces of the rock which has given to it the descriptive term, "birdseye."

On account of its firm texture, its light color, and suitability for building purposes, it has also sometimes been called "Kentucky River Marble," though this name was applied by W. M. Linney, who wrote the geology of the Blue Grass counties for the Shaler-Procter surveys, only to the magnesian limestone that next underlies this formation. The chemical analysis of the Tyrone based on an average of two specimens collected outside the limits of this county, is given on a succeeding page of this report. This analysis shows it as a remarkably pure limestone.

As indicated above, it is an excellent building stone, whitening on exposure and exhibiting excellent weathering properties.

The old State House, Capitol Hotel and a number of private dwellings in Frankfort are built of this stone.

The Tyrone is exposed along the Kentucky River and a short distance up its main tributaries from the Anderson-Woodford county line, where its top has a height above the river of about 60 feet, to eleven miles below Frankfort, where one-quarter of a mile above the mouth of Steele Branch it drops below water level with a steep dip.



Geological section exposed at the Old Crow Distillery from level of Glenns Creek to top of hill on North Side of the creek, taken along steep road intersecting the pike at the distillery.

At Frankfort the top of the Tyrone may be plainly seen about half way up the side of the tunnel at the eastern portal. This, according to Owen, is 54 feet above what at that time (1857) was low water mark in the Kentucky River. The line of contact between the Tyrone and the overlying Curdsville here as elsewhere in Kentucky is very sharp.

There is every indication of a hiatus in the record here, due either to lack of deposition of sediments or subsequent removal of them by erosion. If the latter is the explanation, base level conditions must have ensued, as the contact section is everywhere that of an even plane. Both the community of fossils and the remarkable lithological resemblance in the "birdseye" character of the rock, point to the identification of the Tyrone with the Lowville of New York and Canada and makes it therefore of Black River age.

The same resemblances correlate it with a portion of the Stones River of Tennessee.

There is not in New York and Canada, however, that abrupt passage from Black River to Trenton which is evidenced in Kentucky.

Fossils are not abundant in the Tyrone, the most abundant and characteristic are:

Bryozoa, Phyllodictya frondosa, Ulrich.
Brachiopoda, Strophomena incurvata, Shepard.
Orthis subaequata, Conrad.
Orthis namburgensis. Walcott.
Orthis tricenaria, Conrad.
Orthis deflecta, Conrad.
Rafinesquina minnesotensis, H. H. Winchell.
Hallina saffordi, W. and S.
Lamellibranchiata, Cyrtodonata huronense, Billings.
Gastropoda, Hormotoma augustata, Hall.
Helicotoma verticalis, Ulrich.
Cephalopoda, Species belonging to the genera, Endoceras, Ormoceras and Orthoceras.
Crustacea, The ostracod, Leperditia fabulites, Conrad.

LOWER AND MIDDLE TRENTON.

Thickness 210 feet. Areal outcrop 30.256 square miles.

This portion of the Mohawkian, including the Curdsville, Hermitage, Wilmore and Bigby members of the Lexington limestone, outcrops in the county on the steep slopes of the hills bordering the Kentucky River and its tributaries, and for this reason it has not been found practicable to map the separate members. The boundaries between these different divisions are not sharply defined lithologically and it is not always possible to satisfy oneself as to just where the lines of demarkation should be drawn in the different sections.

An examination of the Devil's Hollow section near Frankfort, in company with Mr. E. O. Ulrich, has led to the following as a revision of the thicknesses of these members:

Curdsville, 10; Hermitage, 45; Wilmore, 80; Bigby, 75. Total, 210 feet.

THE CURDSVILLE is a massive cherty crystalline limestone, containing as its most characteristic fossil the brachiopod Dinorthis pectinella, Billings. Other fossils are the brachiopods Orthis tricenaria, Conrad; Rhynchotrema subtrigonale, S. A. Miller; Plectambonites sericeus, Sowerby; the lamellibranchs; Vanuxemia dixonensis, M. and W., and Cyrtodonta subovata, Ulrich; fragments of stems and heads of crinoids, mostly cystids belonging to the genera Hybocystites, Amygdalocystites and Edrioaster; the horn coral, Streptelasma profundum, Hall.

This assemblage of fossils indicates lowest Trenton.

THE HERMITAGE, named by the author of this report "Logana" before it was proven to be the equivalent of the formation previously called "Hermitage" in Tennessee, consists largely of argillaceous limestones and shales. Heterorthis clytie, Hall, a brachiopod, occurs near the base. Near the top occur the fossils, Modiolodon oviformis, Ulrich; a lamellibranch, and the gastropods, Protowarthia obesa, Ulrich; Protowarthia pervoluta, Ulrich; Liospira micula, Hall; and Lophospira obliqua, Ulrich. These mollusca frequently make up nearly the whole mass of the layers. The brachiopod, Dalmanella bassleri, Foerste, is also very abundant, some layers being composed exclusively of their shells jumbled together very confusedly and indicating, therefore, wave or current action.

On account of the general argillaceous or siliceous character of the rock it is likely that certain layers might be suitable for use in hydraulic cement manufacture.

THE WILMORE consists of purer limestone than the Hermitage. The layers are prevailing thin-bedded, though near the top they sometimes become more massive in character and afford good building stone.

The thickness is about 80 feet for the whole formation. The most characteristic fossils are Prasopora simulatrix, Ulrich; the "chocolate drop bryozoan," and Dalmanella bassleri, Foerste, a brachioped. The latter is not confined to this bed, ranging from the Hermitage below where it is abundant, up into the Bigby above, where it is rare. The concurrence of these two fossils, however, may be taken as indicating that the strata containing them are Wilmore. The Wilmore nowhere in its outcrop reaches to the uplands of the county, and hence is not an important contributor to the formation of soil in place.

THE BIGBY, named from Bigby, Tenn., is 75 feet in thickness It resembles the Wilmore in lithological charasteristics.

It begins with the strata from which disappears Prasopora simulatrix and includes from here to those containing the Stromatocerium reef. This coralline, or hydrocoralline fossil, which is provisionally identified as rugosum, Hall, but may be a distinct species, is usually very abundant at this horizon and represented by very symmetrically formed individuals. When typically developed they are mound or conical in shape and may reach the weight of several hundred pounds. This Stromatocerium reef has been traced in outcrop in absolute continuity from where it passes under cover near the headwaters of North and South Elkhorn Creeks in Fayette county, along the drainage of these two streams through Fayette, Woodford and Scott counties, to where they unite in Franklin, and thence along the drainage of the combined streams to the mouth. Its outcrop has

also been traced in Franklin county along the Kentucky River gorge and up its main tributaries to where it goes under drainage on the latter. It is seldom absent for any great distance from any continued exposure of this horizon. No other Stromatocerium occurs so persistently at a definite horizon in the Ordovician of Kentucky. No Stromatocerium of any description occurs at a lower horizon in the Ordovician in Kentucky, and at any other horizon until the Richmond is reached its presence is only occasional. Thirty-five feet above the top of the Bigby Stromatocerium reef one occasionally finds specimens of what is probably a different species of this same problematic organism. Proximity to the outcrop of this Bigby Stromatocerium reef is generally indicated by presence of this fossil in the rock fences and as cap stones for posts at the entrance to country estates. This latter use is particularly prevalent in the Forks of Elkhorn neighborhood. Associated with Stromatocerium in the upper part of the Bigby are the two brachiopods described from this horizon by Prof. Foerste. These are Strophomena vicina and Dinorthis ulrichi. Also the globular bryozoan, Cyphotrypa frankfortensis, belongs here. Two other characteristic brachiopods of the Bigby are Hebertella frankfortensis, Foerste, and Rhynchotrema inaequivalve, Cast. The latter ranges above the Bigby, but reaches its culmination here. The Bigby mounts to the top of the river hills and, especially east of the river, enters by rocky decay somewhat into the formation of excellent upland soils.

UPPER TRENTON.

Thickness, 70 feet.

THE FLANAGAN.

The maximum thickness of this formation is about 45 feet. The name is derived from Flanagan Station on the L. & N. R. R., 5 miles south of Winchester, in Clark county, and was first applied to the uppermost part of the Lexington Limestone by Marius Campbell in his account of the geology of the Richmond Quadrangle in Folio No. 46, U. S. G. S. It was there referred to as the "Flanagan Chert," though we know that only the lower portion of the formation—that represented by a siliceous limestone—weathers into a chert.

In our account of the geology of the Georgetown Quadrangle we named this siliceous portion the "Brannon Bed," and the remainder, which is highly phosphatic, the "Woodburn Bed." The former name is derived from Brannon Station in Jessamine county, and the latter from the Woodburn estate, near Spring Station in Woodford county. The Brannon is a very persistent bed in the upper portion of the Trenton westerly from Flanagan Station in Clark county, but in the northern portion of the Central Kentucky Bluegrass area—that lying north of a line passing through Paris in Bourbon county and Forks of Elkhorn in Franklin county, the formation seems to be for the most part wanting.

Where typically developed the formation consists of apparently argillaceous (really siliceous), shaly and concretionary limestone.

The concretionary layers, which usually occur toward the top of the bed are quite characteristic, and it is this member which yields by weathering the chert, always phosphatic, which is seen distributed through the soil wherever this formation comes to the surface in the broad bluegrass uplands. Where overlaid by sufficient cover it forms a good water bearer and springs generally mark its outcrop along the hillsides.

In Franklin county excellent exposures of this bed may be seen at the following localities:

Along Little Benson Creek for some distance below Blakemore's distillery; on the Lawrenceburg pike, where it ascends from Cedar Run following the course of a tributary branch on which is a celebrated spring—Spout Spring. The exposures are above the level of this spring.

The foregoing exposures are in the southern portion of the county on the west side of the Kentucky River. In the southwestern portion of the county, in the Bridgeport precinct, there are splendid exposures in the bed of Armstrong Creek, from where it empties into South Benson Creek up stream as far as the Julian place, and

also on South Benson Creek up to and beyond Bridgeport.

There is a fine exposure in the bed of Main Benson Creek, beginning where it is crossed by the Sheep-Pen Branch pike, and extending down stream as far as the mouth of the Sheep-Pen Branch.

There are also excellent exposures in the bed and along the banks of North Benson and North Fork of North Benson—both being in the Benson precinct.

In all these localities the typical concretionary or bouldery bedding is conspicuous—"snurly," as a farmer living in the vicinity of one of its outcrops very aptly designated it. In most of these localities the Stromatocerium reef shows up in the bed of the stream a short distance below the base of the Brannon—often it is in direct contact with it.

We have before alluded to the special interest which attaches to the Brannon as a fossil sponge horizon. Both the "elephant foot" sponge—Brachiospongia digitata, and the artichoke sponge—Strobilospongia aurita, which were described in a preliminary manner by Owen and Shaler respectively, and later more completely by Beecher, occur in this bed. The latter was described from specimens found in Fayette county, and the former is known from only two localities in Franklin county. The one referred to by Owen was in the vicinity of Bright's Mill on Main Benson Creek. This is the exposure near the mouth of Sheep-Pen Branch. The writer has obtained two specimens, one each from two farmers, Smith and Kirk, living in this vicinity, who each reported them as turned up by plowing in the bottoms along the creek. This locality seems to be practically exhausted of the fossil, as these farmers report that it is seldom they plow them up now.

The other locality is somewhere in the Cedar Run precinct—just where the most diligent search on the part of the writer has failed to reveal. This appears to be the locality where E. C. Went, the Frankfort collector, got the most of his specimens, the larger number of which are now in the State University collection at Lexington.

The label simply states that they came from two and one-half miles south of Frankfort. We strongly suspect that this was in the vicinity of the "Spout" spring.

Being thoroughly silicified, these Brachiospongia weather out from the matrix, and, as indicated above, are usually found loose in the soil.

The finest collection of these sponges—those used by Beecher in describing the genus and species—are in the Yale Museum, New Haven, Conn.

The remainder of the Flanagan—the Woodburn—has in its unweathered condition the same unleached phosphatic characters as it has in Woodford county.

Due to the westerly dip of the rocks, however, it comes to the surface in less extensive level, upland areas, and for that reason less opportunity has been afforded for leaching and reconcentration of the phosphate than exists in the latter county.

It does, however, in that portion of the county lying next to Woodford, and especially in that portion drained by South Elkhorn Creek, and in that portion of the N. Elkhorn drainage north of the Georgetown-Frankfort pike, present some of these favorable conditions for the accumulation of phosphate rock in commercial quantities.

Especially favorable indications of the presence of phosphate were found along a lane leading north from the Leestown pike just east of where the pike crosses Dry Run, and 1.6 miles from the junction of this lane with the pike, and again on the north side of South Elkhorn, along the private lane leading into Geo. Hanan's place from the Georgetown and Frankfort pike. Also on South Trimble's land good indications were found. The same characteristic fossils which occur in the Woodburn of Woodford are found in this formation in Franklin. They are the "wasp nest" coral, Columnaria halli, Nich., the smallest snail shell known, Cyclora minuta, Hall, and the "star-cluster-twig" bryozoan, Constellaria teres, U. and B. It is Cyclora minuta especially which indicates the presence of phosphate, and it is evidently from the layers containing this fossil that the phosphate concentrated below originally came. "No Cyclora without phosphate, no phosphate without Cyclora," is the invariable rule in our Trenton Blue Grass area. The shell, or rather cast of the shell, is so small that it can scarcely be detected by the naked eye.

THE PERRYVILLE.

Maximum thickness, 25 feet.

This formation is represented in the county by the two lowest members—the Faulconer and the Salvisa. No trace of the Cornishville has been found this far north. Considerable variations in the thickness of the formation are noticeable in going short distances and in some portions of the county it is wanting entirely, the next formation above—the Cynthiana—resting directly upon the Woodburn.

It is this evidence of unconformity which is one of our reasons for drawing the line between the Trenton and the Cincinnatian at the base of the Cynthiana.

The Perryville may be found in all sections on both sides of the Kentucky River in the immediate vicinity of the river as far north as Frankfort. It is absent throughout most of the Bridgeport precinct, and in the northern portion of the county east of the Kentucky River it is thin or wanting.

On the other hand, it is unusually well developed in the Benson precinct and in the northern portion of the Bridgeport precinct.

The maximum thickness for the formation in the county was found in the former precinct in that portion drained by the head waters of Brighton Branch. Here exceptionally good sections are exhibited along the line of the old Newcastle stage road, now abandoned.

The lowest member of the Perryville—the Faulconer Bed—has a maximum thickness in the county of about ten feet. Where typically developed it consists of massive ledges crowded with gastropod shells belonging to Bellerophon troosti, Oxydiscus subacutus and Lophospira (species medialis or sumnerensis).

The whole constitutes a rather porous, soft rock, but durable, and dressing readily into a desirable building stone. In certain sections it has been used for making gate posts for entrances to country estates.

Places where the Faulconer outcrop may be well seen are:

(1) In the L. & N. R. R. cut at Jones Station.

(2) On the Leestown pike where a private pike leads off to the north to what was once the "Old Ayres Place."

(3) Well up to the top of the hills in the vicinity of the Old Crow Distillery, in the southeastern part of the county.

(4) Near the top of the hill overlooking from the north the old deserted meander of the Kentucky River, the alluvial valley of which is now traversed by the lower course of Vaughn Creek. This is just east of the gap in the ridge through which the Glenn Creek pike passes, in order to enter the old valley.

(The foregoing localities are all east of the Kentucky River.)

(5) Point of the hill top between Benson Creek and the Kentucky River and overlooking Frankfort from the west (old quarry).

(6) Head of Devil's Hollow, north side of pike, lower of the two quarries now worked at this point. (The upper quarry is in the Salvisa Bed.)

(7) Near the top of Fort Hill overlooking Frankfort from the north.

(8) First overhead bridge on the Frankfort & Cincinnati R. R., where the Stedmantown road crosses.

(9) Near residence on the "Old Cox Place," top of hill overlooking from the south a deserted meander valley of Elkhorn Creek. (This is as far north as an outcrop of the Faulconer was seen in this direction.)

(10) Bald Knob pike, west side of Kentucky River, near top of the hill beyond Belle Point. The Faulconer has been quarried here.

(11) Traces of Faulconer may also be found near the top of the river bluff along the west side of Kentucky River as far north as mouth of Stony Creek.

(12) On Stony Creek where the Bald Knob pike strikes it. The massive character is here wanting and the gastropods are not so abundant.

(13) Near the top of the bluff overlooking the Kentucky River from the west and south of the pike leading east from Elmore.

(14) Along the "Old Lawrenceburg road"—now almost abandoned—where it is trenched by the headwaters of branches flowing east into Cedar Run.

(15) Headwaters of Cedar Run itself.

(16) Junction with the Louisville pike of the next road (pike) west of the "Old Lawrenceburg road."

(17) On Main Benson Creek a short distance above the ford where the Sheep-Pen pike crosses. This is almost the only place in the Bridgeport precinct where the formation is recognizable and it is here not typical, the abundant gastropods and massive character being wanting.

(18) Top of hill on the Frankfort-Benson Station pike, where it begins to descend to South Benson and Main Benson Creeks. The bedding is here very massive and may be seen extending south along the east side of the South Benson valley as a distinct ledge near the upper margin of the cultivated slope.

(19) At the junction of the Frankfort-Benson Station pike with the pike leading north to the St. John pike. This is about one-half mile north of Benson Station. Conspicuous ledges of Faulconer appear along the slopes in this vicinity.

The streams which flow south into Benson Creek in this precinct all afford fine exposures of the Faulconer in their upper courses, and great blocks of it fill the channels as the points are approached where the formation passes below drainage. (Brighton Branch is one of these streams.)

(20) Near foot of hill on Plum Branch, where the Bald Knob pike passes over on to Flat Creek.

(21) Near junction of Flag Fork and Willow Branch with Flat Creek in the neighborhood of Bald Knob.

Neither of the last two foregoing exposures are typical, nor does the typical Faulconer appear to be developed in this section of the county.

The second division of the Perryville—the Salvisa—has a maximum thickness of about 20 feet. This is reached in the upper drainage of Brighton Branch, referred to under locality No. 19 above.

This formation is generally a light-colored, fine-grained, compact "birdseye" limestone, resembling much the Tyrone. It was this resemblance that led Linney in his report on Boyle and Mercer counties to designate it the "Upper Birdseye." It does not always possess this character, however. Sometimes it is dark, and it is also sometimes granular in texture.

Northward, where exposed in the drainage of Flat Creek and Sand Ripple Creek and in the only place in the northern part of the county on the east side of the Kentucky River where it is known to be present, it is a bluish shaly concretionary limestone, resembling except in color the contorted layers of the Brannon.

Where the rock exhibits the birdseye or granular phase it is a valuable building stone. Fine grained, granular Salvisa limestone is obtained from the upper quarry, near the head of Devil's Hollow. Here its contact with the overlying Cynthiana is well shown.*

The characteristic fossils of the Salvisa are the ostracods Leperditia caecigena and Isochilina jonesi. (The latter is doubtless the fossil referred to under the name "Cytherea baltica" by Owen.)

The Brachiopod, Orthorhynchula linneyi, and a single species each of Gomphoceras and Orthoceras belonging to the Cephalopods are also abundant at this horizon.

The Salvisa varies greatly in thickness and is sometimes wanting even where the Faulconer is present. It is never found where the Faulconer is wanting entirely.

Until recently it was not known that the Perryville ever passed eastward over the Cincinnati Arch, but since the field work was done on Franklin county, the writer, in company with E. O. Ulrich, found a fine exposure in Bourbon county, about one mile northeast of Paris, Kentucky, and it now seems probable that the Perryville once covered all this region previous to the doming of the Arch.

During a time of elevation and erosion it was removed from most of the area occupied by North Central Kentucky—especially north and eastward. This was previous to the deposition of the Cynthiana.

*A fine example of the stone from this quarry can be seen in the fence fronting the E. H. Taylor place, which is built of this stone.

THE CYNTHIANA.

Maximum thickness, 60 feet. Areal outcrop, 40.3 square miles.

This formation, which is never less than 40 feet in thickness, has its typical characteristics in nearly all its exposures in the county, consisting in its lower and middle portions of "rubbly" limestone alternating with considerable shale. There is commonly present in the upper portion thin-bedded granular limestones resembling somewhat the Woodburn. The formation, especially the lower portion, is richly fossiliferous. Some of the most characteristic fossils are:

Corals: Columnaria alveolata.
Bryozoa: Eridotrypa briareus, Heterotrypa parvulipora, Constellaria emaciata, Peronopora milleri.
Brachiopoda: Hebertella (like sinuata), Rafinesquina (like alternata, but probably a different species).
Lamellibranchiata: Orthodesma sp. ? Byssonychia sp.?
Gastropoda: Cyclonema varicosum; Allonychia flanaganensis, which may be taken as the best index fossil for the Cynthiana.
Cephalopoda: Various species of Orthoceras.
Trilobita: Various species of Isotellus and a Calymmene.

It is not often that the Cynthiana yields good building stone in this section. The soil formed from it is reddish yellow in contrast with the darker red of the underlying Trenton limestone soil. It is only slightly inferior to the latter in quality, so that in contrast to the much poorer soil from the Eden above, this distinction is seldom noted by the landowner, and lands bedded on it are generally classed in with those from the Trenton as "limestone soil."

Where it is the surface rock it weathers into a rolling topography which constitutes fine pasturage land. Much of the land in the vicinity of Bridgeport is of this class.

Throughout most of the county, however, the formation forms a relatively narrow outcrop band at the top of the steep river hill and tributary stream slopes, and does not enter much into soil formation. It sinks to drainage level in the upper course of these streams, as on Cedar Creek, near Elmville.

THE EDEN.

Thickness, about 200 feet. Areal outcrop, 91.5 square miles.

This formation, which has been divided by Professor Foerste into "Million" and "Paint Lick," covers most of the higher uplands in the county.

The lower portion, or Million, consists of shales and thin limestones. The Paint Lick is more sandy, being the Garrard Sandstone of Campbell, but the sandy layers are not so massive as in Garrard and adjoining counties. These sandstones are exceedingly fine-grained and not firmly cemented. They are the "siliceous mudstones" of Owen. The presence of these soft sandstones in the midst of such a great thickness of calcareous sediments offers problems in derivation that have not yet been satisfactorily worked out. There is much to be said in favor of these sandstones being a delta deposit derived from an Appalachian river entering the interior Ordovician Sea from the southeast.

The Eden begins at the base with a crinoidal limestone composed almost exclusively of the stemplates of the crinoid Ectenocrinus simplex. Perfect specimens of the heads of this crinoid, however, are rare. This basal layer is generally "wave marked," with the distance from crest to crest about three or four feet.

Some fragments of the brachiopod Plectambonites rugosus are generally found here. Perfect specimens of this shell, however, come higher up and extend throughout the whole formation as its most characteristic fossil. This species described by U. P. James as "rugosus" had been previously identified incorrectly by Meek as the "sericeus" of Hall.

Other brachiopods are Clitambonites diversus and Plectorthis rogerensis.

The Eden is rich in bryozoa. Common forms found are Amplexopora petasiformis, Callopora nodulosa, Callopora sigillaroides, Callopora communis, Batostoma implicatum, Escharopora falciformis, Dekayella ulrich, Peronopora vera.

Some traces of trilobites are found, among which are Calymmene senaria and Trinucleus concentricus. The latter occurs in the basal layers.

The Eden everywhere in the county, except in the vicinity of Farmdale, in the southern part, presents the characteristic topography of that formation, which is one of steep slopes and a highly ramified drainage. Under the combined action of frost and rain the soil, which is clayey and sandy, tends to slough down into the valleys. Cultivation favors this action, so that in a few years after a field is cleared its steep slope is covered with slabs of limestone which have slipped out on the surface, the soil has washed into the stream below, and it is necessary to turn the land out to cat-briars and sassafras bushes for a number of years to allow it to recuperate. Often whole farms are ruined for a time in this way and present with their bare hillsides a very desolate appearance.

For this reason the Eden sections of the county are relatively much less productive than the Trenton and Cynthiana sections. None realize this difference between Eden "soapstone" land and Trenton "limestone" land better than those farmers whose holdings include both types—those living along the line of that disturbance, which, in our account of the geology of the Georgetown Quadrangle, we have called the "North Elkhorn Fault."

This fault, from where it and North Elkhorn Creek enter the county, in its northwest course nearly to Camp Pleasant, brings Eden Shale on the southwest side into contact with Trenton and Cynthiana limestone on the northeast side and affords in the uplands sharp soil contrasts, causing poor yellow clay land to abut against good chocolate-colored limestone land. Phosphate fertilizers invariably improve the productiveness of this yellow clay land, but what the soil most needs is care to prevent washing.

The greatest continuous area of Eden in the county is in the Bald Knob precinct, where the rough topography and the poor, rain-washed hillsides are much in evidence. Another large area is that lying in the northern part of the county east of the Kentucky River. It is bounded on the south roughly by the valley of Main Elkhorn Creek as far east as Peaks Mill, and then by nearly a straight line to Switzer.

In the southern part of the county there is a patch of Eden on each side of the river. That on the east side overlooks the valley of Glenns Creek on the south and that of Vaughn's Creek on the north. That on the west side of the river is central about Farmdale. For some reason this Farmdale area does not exhibit the usual deeply dissected Eden topography.

West of Frankfort along the Pearidge pike there is an Eden area, which is connected with the Farmdale area by a narrow isthmus stretching across the Louisville pike where it passes over the divide between S. Benson Creek and the Kentucky River.

Also between Main and South Benson Creeks and between Main Benson and the Shelby county line there is considerable Eden on the uplands.

THE MAYSVILLE.

Thickness in the county, 50 feet. Areal outcrop, 4.4 square miles.

This formation is sparingly represented in the northern portion of the county by its two lowest divisions—the Mt. Hope and the Fairmount. A little of the former alone is found capping summits of the highest narrow ridges in the western portion of the Bald Knob precinct. A small patch of Mt. Hope surmounted by a little Fairmount is found between the North Elkhorn and Switzer Faults in the old Mt. Vernon School neighborhood. This is a remnant of a once continuous sheet of Maysville which doubtless once extended all over the county, and, indeed, all over North Central Kentucky. In this Mt. Vernon School neighborhood it has been protected from the general denudation as the result of down faulting.

The characteristic fossils of the lower Maysville, among which are the brachiopods Strophomena maysvillensis, Platystrophia lynx, Hebertella sinuata, and the

bryozoan, Callopora rugosa, may be found in the excellent section afforded by the neighborhood road which leads from Sulphur Lick Creek up onto the ridge on which was situated the old Mt. Vernon colored school.

TERTIARY.

Reference has been made to the old river gravels and sands covering the uplands in the vicinity of the Kentucky River, and to their evident deposition before the present gorge of the river was cut. Correlating the cutting of the gorge with the elevation of the northeastern portion of North America during the Glacial period, would make the gravels preglacial, and hence at least Pliocene in age.

M. R. Campbell, who named these deposits "Irvine" Formation in his report on the Richmond Quadrangle, considered them to be of probable Miocene age. It has seemed to the author of this present report, however, that they are not older than Pliocene. He has been led to this view largely by the finding of remains of extinct Pliocene or early Pleistocene mammals in such association with these gravels as to indicate that they are of the same age. The most extensive deposit of these gravels and sands are found west of the river in the southern portion of the county. They are found here in the Cedar Run precinct, extending over into the Benson drainage of the Bridgeport precinct.

This distribution would indicate a considerable change in the course of the Kentucky River in this region since preglacial times.

These deposits are particularly abundant in the region immediately west of the Lawrenceburg pike and south of Elmoro.

A conspicuous element in this deposit are the quartz pebbles from the Coal Measure Conglomerate and the Keokuk-Waverly geodes. The former have probably been derived from that portion of the Kentucky River drainage occupied by the western margin of the eastern coal field, and the latter from the upper Dix River drainage.

Agriculturally the land covered by these deposits is naturally unproductive. It is probable, however, that they would respond to special treatment as regards drainage, tilth, fertilizers and the right kind of crops.

DISTURBANCES.

The county is traversed by two faults, the North Elkhorn and Switzer. These were described as to their nature and causal connection in the report on the Georgetown Quadrangle.

The North Elkhorn Fault enters the county from Scott a short distance north of the Kissinger Barites and Lead Mill, and has a general trend from here N. 55 degrees W. It dies out in the region between Turkey and Camp Pleasant Branches. In this stretch with its downthrow on the south side it displaces in the lowlands Eden on Trenton and Cynthiana, and in the uplands Eden on Eden and Cynthiana.

The Switzer Fault, which is a secondary one, consequent upon the North Elkhorn Fault slip, enters the county from Scott near where the Woodlake-Stamping Ground pike crosses the county line, and roughly parallels the course of the North Elkhorn Fault. It crosses North Elkhorn Creek just south of Switzer. From here it passes over on to the head of Rocky Branch and down that stream to the mouth. Here it dies out in crossing the wide bottom land of Elkhorn Creek. This fault with its downthrow on the north side generally displaces Eden on Trenton.

MINERAL VEINS.

Several veins of barytes carrying small quantities of galena and sphalerite (zinc sulphide) are known to exist in the county. These are closely associated with the faults just described. For the most part their trend is approximately at right angles to the faults, and were evidently formed in the fractures produced by the faulting.

Two of these veins were described in the writer's report on the Lead and Zinc Bearing Rocks of Central Kentucky, Bulletin 7 of the Kentucky Geological Survey, 1905. At this time, and for a period following, an attempt was made to exploit these and other veins, the latter in the neighboring county of Scott. A mill was erected at Kissingers, on the Frankfort & Cincinnati Railroad, near the Franklin-Scott line, and both barytes products and lead fume were produced. This mill operated for a number of years under the management of Mr. Kissinger, but is now shut down.

The first vein to be worked for this plant was the Clark Vein, about three-quarters of a mile north of the mill. It has an average width of about one foot, but, like other veins in the vicinity, widens out into chambers as it is followed downward. Some large masses of galena were removed from these chambers. The strike is N. 13 degrees W. An interesting mineralogical occurrence in connection with the gangue of this vein is the mineral strontianite. It frequently covers the faces of the wall rock and the baryte.

Another vein worked subsequently to the Clark Vein by Mr. Kissinger was the Camp Pleasant Vein, at Camp Pleasant P. O., on a branch of the same name. This vein has a width of about one foot and a strike of N. 7 degrees W. It had been worked quite a number of years ago for lead and then abandoned. It was finally abandoned by Kissinger about two years ago. He sunk a shaft on the vein 205 feet deep. Strontianite also occurs here. The North Elkhorn Fault has died out before reaching this point, which is about one and a quarter miles due north of Peaks Mill (two and one-half miles by pike).

The Jones Vein is another vein formerly worked for lead. It is situated one and one-quarter miles south of Switzer and is in evident relation to the Switzer Fault, which passes close to the north of it. Its strike is N. 7 degrees W. The enclosing rock at the top of the old shaft sunk upon it is base of the Eden. The enclosing rock of the other veins described above is at the surface Trenton Limestone.

Some large masses of lead were taken out of this Jones Vein when it was first opened. This seems to have been during the period of the Owen Survey, when the land on which the vein was situated belonged or was near to the farm of Dr. Duval. Owen, on page 61 of Vol. 3, has the following reference to this vein:

"Some of the best lead ore which has come, as yet, under my observation, derived from veins in the blue limestone formation of central Kentucky, has been taken from a fissure traversing this rock formation, on the banks of North Elkhorn, near Dr. Duval's farm. About a thousand dollars were expended here by Mr. Bradley, in attempting to work the vein, and a considerable quantity of ore was obtained, but not sufficient to repay expense of working it."

Prof. Owen is probably in error in locating the site of the shaft on the "banks of North Elkhorn," as what appears to have been the original shaft visited by the writer when the land was owned by the widow Jones is situated at least a mile from the banks of that stream. The land is now owned by Noah Thomas.

The Wait Vein. Prof. Norwood, in his report on the Lead Region of Henry County, with some notes on Owen and Franklin counties, Shaler Survey, 1875, refers to a 'lode'' crossing the land of Mrs. Fanny Wait on Flat Creek, about two miles above the mouth. The vein was covered, but fragments of baryta scattered along the surface indicated that it bore north. One piece of lead ore weighing about 100 lbs. had been picked up by Mr. Wait about 15 years before this time, which would make the date 1860. In 1907 Mr. Frank Kavanaugh submitted to the Norwood Survey a piece of lead and zinc ore weighting about one-half pound with the statement that it came from a vein on Flat Creek. This is probably from the Wait Vein. An analysis of the ore appears on a subsequent page of this report.

ANALYSES OF ROCKS, MINERALS, MINERAL WATERS AND SOILS COLLECTED FROM FRANKLIN COUNTY UNDER THE OWEN, SHALER, PROCTER AND NORWOOD SURVEYS.

These are compiled from the chemical reports of the above surveys and the records of the Kentucky Agricultural Experiment Station.

LIMESTONES.

From Vol. 2 of the Owen Report, 1857, beginning on page 172.

No. 514.—Labeled "Hydraulic Limestone, main Benson near Bright's Mill, Franklin county." "A pretty dense, gray, fine granular rock, generally dull, but glimmering in spots with particles of calcareous spar; powder light bluish-grey." This is evidently from what we have designated in this report the "Brannon Bed."

Sp. gr.	2.699
Lime	50.19
Magnesia	.66
Alumina and oxide of iron	1.24
Carbonic acid	40.15
Phosphoric acid	.44
Sulphuric acid	.68
Potash	.23
Soda	.29
Silex and insoluble silicates	6.94
Total	100.82

"This limestone does not contain enough silica, alumina, etc., to constitute a good water lime."

No. 515.—Labeled "Limestone from near Bridgeport, Franklin County, Ky." "A fine grained, dark bluish-grey rock, weathered surface brownish buff. No fossils except what might be the cast of a small fucoid body, and certain similar appearances of small stems traversing the rock and of a dirty buff color, very apparent on the generally dark-grey surface. Powder light-grey." It would appear that this specimen is also from the Brannon hoizon.

Sp. gr.	2.7
Carbonate of lime	76.75
Carbonate of magnesia	.19
Alumina, oxide of iron, etc.	2.25
Phosphoric acid	.09
Sulphuric acid	.65
Potash	.48
Soda	.44
Silex and insol. residue	18.86
Loss	.04
Total	100.00

"The proportion of silex in this limestone is sufficient to constitute it a water lime, provided it is in such a state of aggregation as to unite readily with the lime, which can be ascertained by a practical trial."

No. 516.—Labeled "Encrinital Limestone from near Bridgeport, Franklin County, Ky." "On recent fracture this rock appears to be made up of coarse, confused crystalline grains of calcareous spar, colored dark-grey and brownish by ferruginous admixture, but on the weathered surfaces, which are of a dirty buff color, innumerable joints and portions of small encrinal stems appear." From the description this specimen must be from the Eden formation.

Composition dried at 212 degrees Fahr.

Carbonate of lime	92.65
Carbonate of magnesia	1.54
Alumina, oxide of iron, etc.	1.19
Phosphoric acid	.09
Sulphuric acid	1.27
Potash	.30
Soda	.13
Silica and insol. silicates	3.63
Total	100.85

Vol. 3, Owen Survey, 1857, page 249.

No. 605.—Labeled "Porous Limestone, found in the soil from the 'sick spot' (analysis of the soil from which is given under No. 604). Blue limestone of the Lower Silurian formation, near the Kentucky River two miles from Frankfort."

Dried at 212 degrees F., it lost 0.3 per cent of its moisture.

Carbonate of lime	95.15
Carbonate of magnesia	2.55
Alumina and oxides of iron and manganese	.87
Phosphoric acid	.08
Sulphuric acid	.85
Potash	.23
Soda	.23
Silex and insol. silicates	.58
Total	100.54

Vol. 3, Owen Survey, page 258.

No. 615.—Labeled "Limestone under Robert W. Scott's land near Frankfort, Franklin County, Kentucky. Blue limestone of the Lower Silurian formation." This is the Locust Grove Farm just east of Jett's Station on the L. & N. R. R.

"A bluish-grey limestone, with blotches of yellowish; full of fossil shells, chaetetes, &c." By "chaetetes" the earlier geologists of the Kentucky surveys generally meant what we now identify as "bryozoa." Most of this land is bedded on the Woodburn Bed of the Trenton (Lexington) Limestone.

Composition dried at 212 degrees F.

Carbonate of lime	95.380
Carbonate of magnesia	1.510
Alumina and oxides of iron and manganese	.769
Phosphoric acid	.311
Sulphuric acid	.579
Potash	.108
Soda	.003
Silex and insol. silicates	2.080
Total	100.740

"This limestone, which is the substratum of soil specimens numbers 612, 613, 614" (the analyses of which are given under "Soils" in his report) "is of a composition to renovate the soil above, if, as is generally the case with this kind of limestone, it is easily disintegrated under the action of soil and moisture."

In this same volume, page 60, Owen refers to "a peculiar bed of limestone" about ten to fifteen feet beneath the level of the turnpike leading into Scott county in the John R. Scott neighborhood, "which is esteemed the best building stone of the blue limestone formation."

He states "that the thickest and best building stones are quarried on John R. Scott's land, and the farms adjacent to South Elkhorn" that it affords "dimension stones of from one to five feet," and is much used "as foundations of some of the best houses in the county, as well as for gateposts and steps and has stood well the test of years in trying situations." He gives no analysis of this rock. The John R. Scott land referred to here is now the land of Attorney J. A. Scott, of Frankfort, and it would appear that the formation is Lower Bigby.

Vol. 4, Owen Survey 1859, page 155.

No. 981.—Labeled "Building Stone": a bed in the Blue Limestone, in the northwest part of Franklin county, Ky. Said to be fire and frost proof.

Dried at 212 degrees F., it lost 0.2 per cent. of moisture.

Carbonate of lime	93.580
Carbonate of magnesia	3.663
Alumina and oxides of iron and manganese	.880
Phosphoric acid	.117
Sulphuric acid	.441
Potash	.057
Soda	.165
Silex and insol. silicates	.380
Loss	.717
Total	100.000

I have not been able to locate definitely enough the locality from which No. 981 comes to determine its geological horizon.

In "Chemical Analyses A, Part 2," of the Procter Survey submitted by Dr. Robert Peter in 1879, but not printed until 1885, appears on page 28 the following:

No. 2121.—Labeled "Supposed hydraulic or water lime, Kentucky River bluffs; north side; at end of Dam No. 4. Bed three to ten feet thick. Trenton Group. Collected by John R. Procter." There seems little doubt but that this specimen is from the Hermitage Bed. "A pretty compact or fine granular rock; not adhering to the tongue. Some layers laminated and slightly adherent. Generally of a dull, dark brownish, olive-grey color. Contains a few indistinct, small encrinital joints in the compact portion."

Composition dried at 212 degrees F.

Carbonate of lime	70.360
Carbonate of magnesia	6.784
Alumina	5.458
Iron peroxide	1.342
Phosphoric acid	not est.
Potash	1.118
Soda	.281
Silica	14.020
Total	99.363

Tested for cement qualities by Dr. Robert Peter, the powder from this rock calcined did not become hard enough to warrant attempts to use this rock as a "natural" cement rock.

Same report as above, page 125.

Average of two analyses, Nos. 548 and 968, "Birdseye" (Tyrone) limestones.

Lime carbonate	95.215
Magnesia carbonate	2.002
Alumina and iron and magnesia oxides	.505
Phosphoric acid	.091
Sulphuric acid	.233
Potash	.207
Soda	.040
Silica and silicates	1.880
Total	100.123

Same report as above, page 188.

No. 2305.—Labeled "Phosphatic limestone from the Lower Trenton formation, Big Benson Creek. Collected by W. M. Linney." A drab-grey rock, mainly made up of small fragments of fossil shells, easily breaking into irregular lamellae.

Composition (air dried).

Composition (air dried).	
Carbonate of lime	87.780
Carbonate of magnesia	2.482
Alumina and iron oxide	3.812
Phosphoric acid	2.968
Sulphuric acid	not est.
Silica and silicates	1.780
Moisture and loss	1.278
Total	100.00

Dr. Robert Peter identified this specimen as from the same geological horizon as that from which phosphatic rock of Fayette county comes, though commenting upon the fact that it does not contain as much phosphoric acid as does the Fayette county rock.

The Norwood Survey—unpublished analysis.

No. 3434.—Labeled "Phosphatic limestone exposed along the Louisville pike near the top of the hill where it ascends from Frankfort." Woodburn Bed containing Columnaria. Collected by August Foerste, 1911. Analysis by J. S. McHargue.

Moisture	.31
Carbon dioxide	1.92
Insoluble residue	5.76
Oxide of aluminum	1.28
Oxide of iron	.87
Phosphate of lime	38.67
Carbonate of lime	48.30
Total	97.11
Phosphoric pentoxide	17.70

Unpublished analyses—Kentucky Agricultural Experiment Station.

These analyses were made with a view to determining the fitness of these limestones as a source of limestone dust for liming land and hence complete analyses were not made.

No. 36926.—Labeled "From quarry of Mr. Guy Barret, from his crusher, just below St. Clair St. Bridge on south side of the river, Frankfort. Sent by E. H. Taylor." The face of this quarry is mostly in the Curdsville, Hermitage and Wilmore divisions of the Lexington (Trenton) limestone.

Lime	44.84
Magnesia	.79
Phosphorus pentoxide	1.2
Alumina, iron and insol. silicates, considerable.	
The value of the limestone is equal to 80 per cent of calcium carbonate.	

The value of the limestone is equal to 80 per cent of calcium carbonate."

No. 43304.—Labeled "From land of Judge T. H. Paynter, near Frankfort, Kentucky." A hard dark-grey crystalline stone.

Contains:	
Insoluble matter	3.67
Calcium carbonate (with some magnesium carbonate)	96.33

No. 43305.—Also from land of Judge Paynter. A buff-colored, imperfectly crystalline stone, not so hard as No. 43304.

Contains:	
Insoluble matter	2.66
Calcium carbonate including little magnesium carbonate	97.34

No. 43306.—Also from land of Judge Paynter. A grey fossiliferous limestone.

Contains:	
Insoluble matter	11.41
Calcium carbonate, including a trace of magnesium carbonate	88.59

Of the foregoing three limestones the last two would be better for grinding for limestone dust because softer than the first one.

No. 43391.—Labeled "Limestone dust from a crusher in Col. Taylor's Thistleton place, in the rear of the Frankfort waterworks."

If from the level of the bottom, this is probably from the Tyrone Limestone.

Contains:	
Insoluble matter	3.2
Calcium carbonate with a little magnesian carbonate	96.8

This is a very pure limestone.

SANDSTONE.

Vol. 3, Owen Survey, pages 253-254.

No. 610.—Labeled "Soft green rock, Frankfort, Franklin county, Kentucky. Lower Silurian." Rounded fragments of a soft granular rock, of a bluish-green color; adheres strongly to the tongue; powder greenish-white.

Dried at 212 degrees F. it lost 4 per cent of moisture.

Alumina, and oxides of iron and manganese	9.47
Carbonate of lime	.99
Carbonate of magnesia	2.44
Phosphoric acid	.18
Sulphuric acid	2.60
Potash	2.37
Soda	.13
Silex and insol. silicates	80.68
Water and loss	1.14

SHALES AND CLAYS.

The tabular presentation of the following four analyses (corrected) is from the Norwood Survey, Bulletin No. 6, page 199. The first four of these are repeated from the Shaler Survey, Chemical Analyses A, pages 75-76, and the last one from page 384 of the same volume.

	No. 1431	No. 1432	No. 1433	No. 1434	No. 2007
Ignition and moisture	5.35	6.40	8.30	7.67	5.43
Silica	77.38	70.06	50.36	52.06	69.30
Alumina	10.41	15.39	16.81	18.83	21.78
Ferric oxide	In. Al.	In. Al.	6.99	9.20	In. Al.
Carbonate of lime	1.44				.15
Magnesia	.80	2.29	.93	1.21	.33
Potash	3.48	3.56	3.62	5.40	2.31
Soda	.04	.31	1.73	.72	.58
Sulphuric acid	.73	.57	2.28	.92	
Phosphoric acid	.43	.46	.21	.31	.06
Lime		.87	8.73	3.66	

No. 1431.—Labeled "A green marly shale from below the Arsenal at Frankfort. Bed about 8 inches thick (Upper Cambrian Group). Collected by N. S. Shaler." This shale is from the Tyrone formation which is not Cambrian. "A friable shale of greyish-green color."

No. 1432.—Labeled "Marly shale, same locality as preceding, but lying above that. Collected by N. S. Shaler." "Quite friable. Of dull olive and brownish colors."

No. 1433.—Labeled "Marly shale; used as a paint at Frankfort. Sent by Mr. James L. Sneed for analysis." Of an olive-grey color, with some brownish yellow mixed.

No. 1434.—Labeled "marly shale from Armstrong farm, Bridgeport. Geological position Cincinnati Group, just below the siliceous mudstone. In same position as the marl near Newport. Collected by N. S. Shaler." Used for paint. Said to be good for polishing iron, etc. Of a handsome light olive-grey color.

The geological position of this shale is Eden.

The comment of Dr. Robert Peter on these shales is as follows:

"These marly shales are remarkable for their large percentage of potash, which probably make them valuable for application to exhausted land of a light and sandy nature. A previous moderate calcination with lime intimately mixed might, if practicable, make them more available in this respect by setting free more or less of the potash locked up in insoluble silicates. It will be seen that No. 1431 contains in all as much as 8.479 per cent of potash, and No. 1432 a total amount of 7.130 per cent.

"These, and similar marly shales, have been used as pigments, for which they are quite appropriate, if of an agreeable tint, as they will not decompose the oil with which they are mixed, are not readily altered by atmospheric agencies under such conditions, and contain nothing of a poisonous nature. Their use for scouring or polishing depends on the very fine siliceous sand contained in them."

"No. 2007.—Labeled 'Potter's clay, from a bed several feet in thickness, in the bottom land, in what is supposed to be an old prehistoric channel of the Kentucky River, half a mile north of Frankfort. Collected by Jno. R. Procter.' The specimen is part of an unburnt vessel made of the clay at the pottery. The clay is of a grey-drab or neutral tint; it contains some very small specks of mica and ferruginous matter. It calcines to a very light brick color. Fuses before the blowpipe." * * * "This clay, while fitted for the manufacture of ordinary pottery ware, is not sufficiently refractory to be used as a fire clay."

Zinc and Lead Ore.

From an unpublished analysis made by Graham Edgar for the Norwood Survey.

No. G-2787.—Labeled "Zinc and lead ore, from a vein on Flat Creek, Franklin county, Ky., sent by Frank Kavanaugh, Asst. State Librarian, May 23, 1907." The sample was a hand specimen, weighing about ½ lb., consisting of a light colored zinc blende with a little galena in barite.

Analysis in the Wet Way.

Lead	1.6, equivalent to 1.8 lead sulphide.
Zinc	50.9, equivalent to 75.8 zinc sulphide."

Iron Ore.

Vol. 3, Owen Survey, page 253.

No. 609.—Limonite (impure). Labeled "Iron ore from Mr. Alexander Julian's farm, Franklin county, Kentucky." (The Julian neighborhood is contiguous to Bridegport.) A friable cellular limonite; mottled; dark brown and yellowish, and whitish; powder of a brown color. Dried at 212 degrees F. it lost 6.20 per cent moisture.

Composition dried at 212 degrees F.

Oxide of iron	26.69=18.69 iron
Alumina	7.55
Lime, a small trace.	
Brown oxide of manganese	3.68
Magnesia	1.15
Phosphoric acid	.63
Sulphur	.05
Potash	.63
Soda, a small trace.	
Combined water	7.50
Silex and insoluble silicates	52.68
Total	100.56

Rather too poor for profitable smelting by itself, but it might be used in mixture with calcareous ores, or with ores which contained too large a percentage of iron to furnish materials for cinder.

From page 38, Bulletin No. 3, Norwood Survey, 1905.

No. 3151.—Labeled "Iron ore, from a farm about 12 miles from Frankfort." Impure limonite in thin layers.

Oxide of iron	20.6=14.4 iron

It is of no value as an ore.

From an unpublished analysis made by J. S. McHargue for the Norwood Survey, 1908.

No. 2881.—Labeled "Sandy limonite with iridescent colors. Sent by H. H. Story, of Benson, Franklin county, Ky."

Oxide of iron	52.16=36.51 iron
Insoluble residue	34.92

Waters.

Chemical Analyses A—Part 2, the Procter Survey, 1885, page 189.

No. 2306.—Labeled "Water from a new reservoir about two miles from Frankfort, situated in a large ravine, across which a dam is built, forming a reservoir, which is said to contain an area of an acre and a half, and an average depth of 20 feet. It is supplied with surface water from the adjoining hills and some two or three low springs.''

This water, which was from what is now known as the ''old abandoned reservoir,'' had become very foul from decaying algae and was sent in Aug., 1881, by Mr. E. A. Fellmer and Dr. J. Lampton Price.

The analysis is here omitted as the water from this reservoir is no longer used.

Same report, page 190.

No. 2307.—Labeled ''Salt water, from a bored well one hundred and ten feet deep, four and one-half inches bore, through solid limestone; the last three feet probably sandstone. Situated four miles east of Frankfort and one mile from the Georgetown pike. Sample sent by A. Stedman, owner of the well, Stedmantown.''

No sandstone is due at 110 feet below the level of the top of the well, and it is not likely that any was struck at that depth.

''Much gas escaped at the well at first. The water stands at about 25 feet of the top. It has the odor of petroleum, some little of which is found in the well.''

Sp. gr.	1.02
Brownish saline matter, mainly solium chloride, carbonate of iron, lime and magnesia, some sulphates and a little of bromides. Parts in 1000	29.70

From an unpublished analysis made by S. D. Averitt for the Norwood Survey, May, 1906.

No. G-2690.—Labeled ''From a well within one-half mile of Frankfort, Kentucky.'' The well is 1760 feet deep, probably reaching the Calciferous. Sent by Dr. H. H. Roberts, of Lexington, Ky., who says that for 18 months the well has been flowing about 2,000 gallons per minute, and that the water resembles French Lick water in its effects. Sample a one-gallon jug well sealed.

	Grams per liter	Grains per gallon
Iron, strontium and lithium carbonates	trace	trace
Calcium carbonate	.1100	6.41
Magnesium carbonate	.0626	3.65
Sodium carbonate	.0941	5.49
Sodium chloride	.8733	50.90
Sodium sulphate	.2389	13.93
Potassium sulphate	.0450	2.62
Silicon dioxide	.0126	.73
Total solids	1.4365	83.73

Bromides and borates—a trace.

Comment of Dr. Alfred Peter: ''A very good alkaline water. It should be valuable both for table and medicinal use. It might be called a lithia water.''

It would seem to the writer, however, that one would have to drink a good deal of this water to get much lithia into his system, and it would be better for him to resort to lithia tablets dissolved in glasses of water.

SOILS.

The character of soils as to natural productiveness, etc., has been discussed under the treatment of the various geological formations exposed in the county. There is here appended the analyses compiled from the various reports of the Kentucky Geological Survey.

Owen Survey, Vol. 2, pages 173-177.

No. 517.—Labeled ''Virgin upland soil, from waters of Benson Creek, near Hardinsville, Franklin county, Ky., farm of John J. Julian.''

No. 518.—Labeled ''Same kind of soil and growth as the preceding; has been twelve years in cultivation, in corn chiefly. Waters of Benson Creek, near Hardinsville, farm of John J. Julian, Franklin county, Ky.''

No. 518 (A).—Labeled ''Same kind of soil and growth as the preceding, from a field that has been from forty to fifty years in cultivation; waters of Benson Creek, Franklin county, near Hardinsville, farm of Mr. John J. Julian.''

No. 518 (B).—Labeled ''Subsoil from a field on John J. Julian's farm, waters of Benson Creek, Franklin county, Ky.''

Analyses of the Foregoing Four Samples.

Color, buff-grey.

	No. 517	No. 518	No. 518A	No. 518B
Grains fine sand left after washing 1,000 grains soil	677	705	720	630.7
Grains of this fine sand too coarse to pass through finest bolting cloth	90	30	21.7	18.
Per cent. loss of moisture on drying at 400 F.	5.18	1.98	2.52	3.30
Per cent. composition thus dried—				
Organic and volatile matters	9.133	3.790	4.206	3.79
Alumina and oxides of iron and manganese	8.100	4.589		
Alumina			2.120	4.470
Oxide of iron			2.915	4.825
Brown oxide of manganese			.004	.005
Carbonate of lime	.917	.196	.173	.082
Carbonate of magnesia	.517	.066	.233	.312
Phosphoric acid	.243	.151	.128	.148
Sulphuric acid	.068	.054	.043	.033
Potash	.173	.135	.130	.282
Soda	.049	.026	.051	.002
Sand and insoluble silicates	80.754	90.734	90.170	86.380
Loss	.647	.259		.282
Total	100.000	100.000	100.173	100.000

1,000 grains digested from one to two months in water containing carbonic acid yielded the following extract in grains	3.5	2.5	2.33	less than one grain.
Color of this extract	dark brown	yellowish brown	brown	whitish
Composition of this extract—				
Organic and volatile matters in grains	1.430	.570	.470	.217
Alumina, oxides of iron and manganese and phosphates	.758	.615	.287	.063
Carbonate of lime	.917	.857	.913	.181
Magnesia	.056	.100	.091	.030
Sulphuric acid	.037	.295	.081	.034
Potash	.096	.050	.086	.046
Soda	.047	.031	.017	.038
Silica	.339	.119	.200	.200
Loss			.222	.006
Total grains	3.680	2.637	2.366	.830

Dr. Robert Peter's comment upon the preceding four analyses is as follows:

"It will be seen that the soil No. 518-A, which has been from forty to fifty years in cultivation, contains a smaller relative proportion of phosphoric and sulphuric acids, of potash and of carbonate of lime, than the virgin soil, or the soil from the field which has been but twelve years in cultivation; and that it yielded a smaller quantity of nutritious extract to the carbonated water than those soils."

The bottom lands in the vicinity of Hardinsville are bedded on Cynthiana Limestone. It is probable that the soils came from these lands.

Owen Survey, Vol. 3, 1857, pages 246-258.

No. 603.—Labeled "Soil from an unproductive spot, where a kiln of lime was formerly burnt, about 30 years ago, on Mr. Clarke's farm, two miles from Frankfort. Blue limestone formation. Franklin county, Kentucky."

This is probably the old J. Clarke place on the east side of the first road turning off from the Louisville pike —this road was formerly the road to Lawrenceburg. The surface formation here is Woodburn.

No. 604.—Labeled "Soil from a sick spot on the blue limestone formation, near the Kentucky River, two miles from Frankfort, Franklin county, Ky. From limited spots where the soil is entirely bare of vegetation and the grass beyond for twenty paces is yellow and sickly."

No. 606.—Labeled "Virgin soil from a new field for the first time in cultivation in a crop of corn, Alexander Julian's farm, four miles from Frankfort, Franklin county, Ky. Primitive forest growth principally sugar-tree and mulberry. Lower Silurian formation, nearest to the encrinal member of the blue limestone."

This land lies on the south side of the Louisville pike in the drainage of Armstrong Branch, and is bedded on Woodburn Bed of Lexington, on Cynthiana and on the ridges to the south on Eden. "Nearest to the encrinal member of the blue limestone" probably means on Cynthiana.

No. 607.—Labeled "Same soil, from adjoining old field, forty years in cultivation; chiefly in corn, wheat, oats and rye; for last ten years occasionally in clover; usually pastured down."

No. 608.—Labeled "Sub soil from same old field as the preceding."

No. 611.—Labeled "Clay one and a half to two feet under the surface soil, waters of Benson, near Hardinsville, Franklin county, Ky."

No. 612.—Labeled "Virgin soil from woodland pasture on Robt. W. Scott's farm, five miles from Frankfort, near Versailles and Frankfort turnpike, and Lexington and Frankfort R. R.; primitive forest growth; sugar-tree, white, red and black oak, black walnut, mulberry and honey-locust. Lower Silurian formation, Franklin county, Ky."

The "Robt. Scott farm" is "the Locust Grove farm," near Jetts. The geological formation is Woodburn.

No. 613.—Labeled "Soil from an adjoining field, forty to fifty years in cultivation; rotation of crops and grasses, without manure."

No. 614.—Labeled "Sub-soil from an old field, same farm as preceding."

	No. 603	No. 604
Color	Dirty grey-buff	Dirty reddish grey-brown
Per cent fine sand left after washing	67.7	68.4
Per cent of this too coarse to pass through finest bolting cloth	6.3	8.4
Per cent loss of moisture on drying at 400° F.	3.44	3.92
Composition in per cents of this dried soil—		
Organic and volatile matters	4.722	5.911
Alumina	2.156	2.550
Oxide of iron	5.120	4.380
Carbonate of lime	1.490	1.470
Magnesia	.832	.826
Brown oxide of manganese	.038	.376
Phosphoric acid	.304	.433
Sulphuric acid	.055	.095
Potash	.212	.251
Soda	.065	.007
Sand and insoluble silicates	84.974	83.936
Loss	.032	
Total	100.000	100.235
1,000 grains digested for one month in water charged with carbonic acid yielded brownish-grey extracts with the following composition in grains—		
Organic and volatile matters	.600	.340
Alumina, oxide of iron and phosphates	.068	.098
Carbonate of lime	3.898	4.838
Magnesia	.126	.110
Brown oxide of manganese	trace	.029
Sulphuric acid	.185	.157
Potash	.057	.057
Soda	.037	.026
Silica	.099	.118
Loss	.032	.087
Total brownish grey powder	5.070	5.860

Dr. Robert Peter, in commenting upon the results of these two analyses, could derive nothing from them in explanation of the unproductiveness of the soils from which the samples were taken.

	No. 606. Greyish-brown.	No. 607.	No. 608. Dark, dirty buff.	No. 612. Light umber.	No. 613. More yellow than No. 612.	No. 614. Dirty buff.	No. 611. Greyish buff.
Per cent. of fine sand left after washing	81.9	78.83	63.33	82.90	67.37	70.90	48.10
Per cent. of this too coarse to pass through finest bolting cloth	4.03	9.20	3.83	6.10	6.96	5.40	.86
Per cent. of loss of moisture on drying at 400° F.	3.79	4.125	4.815	5.625	4.25	4.475	4.40
Composition in per cent. of this dried soil—							
Organic and vol. matter	5.935	3.911	3.405	7.072	6.292	3.611	4.205
Alumina	2.840	3.220	4.095	3.890	3.975	5.740	6.390
Oxide of iron	2.370	4.290	4.825	4.785	4.045	7.085	7.240
Carbonate of lime	.295	.305	.246	.495	.430	.445	.097
Magnesia	.296	.271	.450	.607	.515	.383	.781
Brown oxide of manganese	.220	.320	.335	.272	.197	.222	.145
Phosphoric acid	.182	.350	.359	.404	.305	.316	.182
Sulphuric acid	.084	.050	.081	.153	.093	.101	.033
Potash	.198	.200	.202	.215	.206	.173	.444
Soda	.040	.017	.029	.084	.054	.048	.032
Sand and insol. silicates	87.280	87.280	85.810	82.270	84.120	82.450	80.580
Loss	.260		.163				
Total	100.000	100.214	100.000	100.000	100.236	100.574	100.129
1000 grains digested for one month in water charged with carbonic acid yielded extracts with the following composition in grains—							
Organic and volatile matters	.580	.240	.282	.692	.783	.392	.200
Alumina, oxides of iron and manganese and phosphates	.143	.163	.063	.688	.463	.055	.055
Carbonate of lime	.997	.697	.614	2.113	1.280	.163	.214
Magnesia	.130	.056	.053	.208	.158	.050	.028
Sulphuric acid	.060	.078	.136	.028	.039	.028	.022
Potash	.130	.079	.047	.096	.094	.046	.073
Soda	.080	.012	.010	.144	.081	.057	.079
Silica	.214	.200	.231	.114	.139	.106	.298
Loss	.046						.031
Total	2.380	1.525	1.436	4.083	3.037	.897	1.000

Dr. Robert Peter, in commenting upon the results of the foregoing analyses published in Vol. 3 of the Owen Reports, interpreted the loss of phosphoric acid and potash in the soil of the old field as compared with that in the virgin soil, placing it at 2.970 lbs. per acre of the former and 270 lbs per acre of the latter, as due to removal of crops. It seems quite likely, however, that part of loss in the surface and sub-surface soil may be due to greater leaching action going on in cultivated fields, and the carrying of some of these materials down to the "rotten stone layer."

Owen Survey, Vol. 4, pages 155-156.

No. 982.—Labeled "Virgin soil from the Bluegrass lands of Franklin county, Ky., farm of Isaac Wingate. Primitive growth, large ash, burr oak, black locust, walnut." Dried soil of a light chocolate color. Some chert and iron gravel were sifted out from it with a coarse sieve.

No. 983.—Labeled "Soil from an old field, fifty or sixty years in cultivation. Bluegrass land of Franklin county, Ky. Farm of Isaac Wingate." Dried soil of a light chocolate color, a shade darker than the preceding. Some iron gravel was sifted out.

No. 984.—Labeled "Sub-soil from an old field. Bluegrass lands of Franklin county, Ky. Farm of Isaac Wingate."

This land is on the north side of the Georgetown pike near Woodlake. The geological horizon is the very phosphatic Woodburn.

Composition of These Three soils dried at 400 degrees F.

	No. 982	No. 983	No. 984
Organic and volatile matters	6.372	6.147	4.281
Alumina	4.185	5.435	5.035
Oxide of iron	4.310	4.560	4.785
Carbonate of lime	.320	.320	.520
Magnesia	.563	.801	.526
Brown oxide of manganese	.220	.445	.095
Phosphoric acid	.350	.270	.553
Sulphuric acid	.076	.076	.050
Potash	.222	.288	.290
Soda	.052	.058	.073
Sand and insoluble silicates	82.270	81.470	83.445
Loss	.960	.130	.347
Total	100.000	100.000	100.000

Moisture lost at 400 degrees F.	2.700	2.400	2.125
1,000 grains each of these soils digested for one month in water charged with carbonic acid yielded soluble extracts which analyzed (in grains) as follows:			
Organic and volatile matters	.583	.633	.367
Alumina, oxides of iron and manganese and phosphates	.145	.230	.064
Carbonate of lime	.787	1.507	1.130
Magnesia	.123	.144	.113
Sulphuric acid	.041	.050	.033
Potash	.066	.077	.038
Soda	.017	.055	.012
Silica	.314	.200	.297
Total dried at 212 degrees F.	2.076	2.896	2.054

In comment Dr. Robert Peter noted that except in the phosphoric acid content the soil of the old field is as rich as the virgin soil.

From unpublished analyses of the Kentucky Agricultural Experiment Station.

All analyses made from the soil after sifting through a 2 m.m. sieve, calculated as parts per million of the moisture free sample.

No. 25601.—Sample from garden of old Executive Mansion, Frankfort. Sent by Governor Willson, September 28, 1909.

No. 25602.—Ditto, from another part of the garden. Comment of Dr. A. M. Peter: "Plenty of phosphoric acid, potash and lime; organic matter low."

No. 25908.—Sample sent by Jas. A. Violett, Frankfort. Locality not stated. Comment of Dr. A. M. Peter: "Soil poor in all important constituents and distinctly acid."

No. 36719.—Sample taken from farm of E. H. Taylor, Jr. Situation, "adjoining State Capitol Grounds, Frankfort." Collector, A. B. Rumley, Aug. 16, 1912. Comment of Dr. A. M. Peter: "Well supplied with phosphate but low in nitrogen, indicating deficiency in organic matter."

No. 36720.—From same farm as preceding, but from "meadow in the grove." Collector, A. B. Rumley, August 16, 1912. Comment of Dr. A. M. Peter same as on preceding sample.

No. 36721.—From same farm as preceding, but "from hill in front of the bottom." Collector, A. B. Rumley, Aug. 16, 1912. Comment of Dr. A. M. Peter: "Soil unusually rich in phosphate, but low in nitrogen, indicating deficiency in organic matter."

No. 36722.—From "meadow in the grove" on same farm as preceding. Collector, A. B. Rumley, Aug. 16, 1912. Comment by Dr. A. M. Peter: "The total phosphoric acid is about equal to the average of the poorer type of bluegrass soil. The nitrogen is low, indicating deficiency in organic matter."

No. 36723.—From same field as No. 36721, by same collector. Comment by Dr. A. M. Peter: "Soil is unusually rich in phosphate, but low in nitrogen, indicating deficiency in organic matter."

	No. 25,601	No. 25,602	No. 25,908	No. 36,719	No. 36,720	No. 36,721	No. 36,722	No. 36,723
Total nitrogen	1,700	1,330	930	1,580	1,140	1,230	1,260	1,200
Aailable phosphoric acid	2,588	2,126	12					
Available potash	918	662	143					
Available lime	17,830	12,840	840					
Total phosphoric acid	4,300	3,825	725	5,925	4,100	11,325	3,720	21,020
Acidity, calculated as lime	11	6	80	30	30	40	20	40
Nitrogen or nitrates	20	2						

NATIVE TREES AND SHRUBS (Woody Plants).

The following list follows the order of arrangement in Garman's "The Woody Plants of Kentucky," Bulletin No. 169, Kentucky Agricultural Experiment Station.

There is included in this list not only those species observed growing in Franklin county, but also a few not actually noted, but which are due to be found there, because seen in contiguous counties.

Pine Family (Pinaceae).

Red Cedar (Juniperus virginiana). On thin lands (Eden shale) and cliffs of the Kentucky River. Wood used for fence posts and for moth-proof clothing boxes.

Lily Family (Liliacea).

Smilaceae.

Green Brier (Smilax rotundifolia)—Cat brier—Common.

Willow Family (Salicaceae).

Black Willow (Salix nigra). In wet places. Wood good for charcoal.
Sage Willow (Salix tristis).

Walnut Family (Juglandaceae).

Butternut (Juglans cinerea)—Not common. A fine shade tree. Nuts edible. Used also green for pickling. Wood used for interior finishing and for cabinet work. Inner bark yields yellow dye.

Black Walnut (Juglans nigra)—Common, especially on Trenton limestone soil. A valuable tree for shade and lumber. The wood highly prized for cabinet work and interior finishing. Nuts edible.

Shell-bark Hickory (Carya ovata)—Common, especially on Eden shale soil. A valuable shade tree. Wood used extensively in manufacture of vehicles, agricultural implements, axe handles, etc. Nuts edible.

Big Shell-bark Hickory (Carya laciniosa)—Common, especially on Eden shale soil. Similar to C. ovata in quality of lumber and nuts.

Pignut Hickory (Carya cordiformis)—Common. Nuts inedible. Similar to C. ovata in quality of lumber.

Birch Family (Betulaceae).

Hazelnut (Corylus americana)—Not observed, but found in Scott and Woodford. Nuts edible.

Hop Hornbeam, Ironwood (Ostrya virginiana)—Common. Wood used for mallets, tool handles, etc.

Hornbeam, Ironwood (Carpinus caroliniana)—Common. Banks of streams. Wood similar in quality to that of O. virginiana.

Beech Family (Fagaceae).

Beech (Fagus grandifolia)—On bottom lands along the Kentucky River. Occasionally mounts to the uplands in vicinity of the river. Also on Eden shale soil. Nuts edible. Valuable for fattening hogs. Wood used for tool handles, chairs, shoe lasts and for fuel.

White Oak (Quercus alba)—Common, especially on Eden shale soil. The finest of oaks. The wood highly prized for furniture, hard wood floors, etc.

Burr Oak (Quercus macrocarpa)—Along with quercus muhlenbergii, the most characteristic oak of the Trenton limestone soil. Rivals the white oak as a stately tree and for lumber.

Chinquepin Oak (Quercus muhlendergii)—Along with quercus macrocarpa, the most characteristic oak of Trenton limestone soil.

Red Oak (Quercus rubra)—Common. Wood inferior to that of the white oak. Bark rich in tannin and used for tanning leather.

Texas Red Oak (Quercus texana)—Not observed, but probably occurs. Tallest of American oaks.

Black Oak (Quercus velutina)—Common. Wood used in cooperage, for furniture and in general construction. Bark used in tanning and dyeing.

Laurel Oak (Quercus imbricaria)—As common here as in the other Blue Grass Counties. Wood valued for shingles, hence one of the names "shingle oak."

Elm Family (Urticaceae).

Slippery Elm (Ulmus fulva)—Common. Inner bark mucilaginous and used for poultices. Wood used for posts, ties, wheel hubs, agricultural implements, etc.

White Elm (Ulmus Americana)—Common. Unexcelled as a shade tree. Wood used for hubs, saddle trees, barrels, flooring, etc.

Cork Elm (Ulmus racemesa—thomasi)—Not observed, but probably occurs. Wood best of the elms for the wheelwright.

Hackberry (Celtis occidentalis)—Very common, especially along old fence rows. Trenton limestone soil. Wood used for fencing and cheap furniture.

Mississippi Hackberry (Celtis mississippiensis)—Reported by Garman from this part of the State only along Benson Creek of Franklin County, but noted by the writer as widely distributed and common in the county.

Red Mulberry (Morus rubra)—As common as anywhere else in the State. Berries edible. Wood used in cooperage and for fencing.

Mistletoe Family (Loranthaceae).

Mistletoe (Phoradendron flavescens)—Common as a parasite, chiefly on the black walnut in central Kentucky.

Crowfoot Family (Ranunculaceae).

Clematis (Clematis virginiana)—Common. A vine clambering over shrubby growths and fences by road sides.

Leather Flower (Clematis viorna)—Not observed, but probably occurs.

Magnolia Family (Magnoliacea).

Cucumber Tree (Magnolia acuminata)—Not observed, but almost certainly occurs sparingly. Would make a good shade tree. Lumber similar to that of yellow poplar.

Tulip Tree, Yellow Poplar (Liriodendron tulipifera)—The "State tree." A magnificent shade and lumber tree.

Custard Apple Family (Anonaceae).

Pawpaw (Asimina triloba)—A small tree. Fruit edible.

Moonseed Family (Menispermaceae).

Moonseed (Menispermum canadense)—A vine, common, clambering over fences.

Laurel Family (Lauracea).

Sassafras (Sassafras variifolium)—A small tree common on Eden shale soil. Wood used for posts, rails, ox yokes, etc. Bark aromatic, used for flavoring medicines, etc. Roots used for making tea.

Spice Bush (Benzoin aestivale)—A moderately common shrub.

Saxifrage Family (Saxifragaceae).

Wild Hydrangea (Hydrangea arborescens)—A small shrub common in shady places.

Wild Gooseberry (Ribes cynosbati)—A shrub, not observed, but probably occurs sparingly. Berries sour, but used in making pies.

Wild Gooseberry (Ribes gracile)—A shrub. The commonest of the Kentucky wild gooseberries. Berries sour, but used in making pies.

Witch Hazel Family (Hamamelidaceae).

Witch Hazel (Hamamelis virginiana)—A small tree, common on stream banks. Bark and leaves yield an extract of supposed medicinal value.

Plane Tree Family (Platanaceae).

Sycamore (Platanus occidentalis)—Common along streams. Thrives well in other situations. A handsome shade tree. Wood used for furniture, and inside work, and for butcher's blocks and tobacco boxes.

Rose Family (Rosaceae).

Nine-bark (Physocarpus opulifera)—A shrub. Common on upper waters of Benson Creek.

Narrow-leaved Crabapple (Pyrus) (Malus) augustifolia—A small tree. Not observed, but probably occurs as it is the commonest of the two crab apple trees occuring in Kentucky. Flowers fragrant. Apples exceedingly sour, but make fine jelly.

Service Berry (Amelanchier canadensis)—A small tree. Berries edible, speedily eaten by birds.

Red Haw (Crategus crus-galli)—A small tree. Almost certainly occurs.

Red Haw (Crategus polita)—A small tree. Has been noted to occur in Fayette County.

Black Raspberry (Rubus occidentalis)—Yields the well known edible berry.

Purple Flowering Raspberry (Rubus odoratus)—Reported by Garman.

Tall Southern Blackberry (Rubus andrewsianus)—The commonest Kentucky species. Berry edible and a staple for preserving.

Dwarf Wild Rose (Rosa humilis).

Wild Black Cherry (Prunus serotina)—Very common by road sides. Fruit hardly edible, but with the bark used for a flavor. Wood valuable for furniture.

Common Wild Plum (Prunus americana)—A shrubby small tree in thickets. Not reported by Garman as occurring in Franklin, but certainly found there. Fruit edible.

Pulse Family (Leguminosae).

Kentucky Coffee Tree (Gymnocladus dioicus)—A common tree in the Blue Grass region. A good shade tree. Wood good for fencing and construction.

Honey Locust (Gleditschia triacanthos)—A thorny tree, very common. Wood used for wheel hubs, fencing and fuel.

Red Bud (Cercis canadensis)—A very common small tree, conspicuous in early spring on account of its purple blossoms.

Black Locust (Robinia pseudacacia)—Common, especially along road sides and old fence rows. Wood splendid for posts, wagon hubs, spokes, etc.

Rue Family (Rutacea).

Hop Tree (Ptelea trifoliata)--A slender graceful small tree.

Sumach Family (Anacardiaceae).

Smooth Sumach (Rhus glabra)—A shrub. Common. An acid beverage is made from the berries.

Dwarf Sumach (Rhus copallina)—A very common small shrub forming thickets by road sides and in waste places.

Poison Ivy, Poison Oak (Rhus toxicodendron)—An all too common vine. Often every fence post by road sides will be entwined and tufted with it.

Fragrant Sumach (Rhus canadensis)—A common shrub, especially by road sides.

Staff Tree Family (Celastraceae).

Wahoo (Evonymus atropurpureus)—A shrub or slender tree, common along fences. Wood hard and dense. Used in making spindles, skewers, etc.

Bitter Sweet (Celastrus scandens)—A vine, common everywhere in tangles over vegetation. Conspicuous in the fall from its bright orange fruit.

Bladdernut Family (Staphyleaceae).

American Bladder Nut (Staphylea trifolia)—A small tree.

Maple Family (Aceraceae).

Sugar Maple (Acer saccharum)—A common tree. Best of maples for lumber, shade and sugar.

Black Maple (Acer nigrum)—Formerly regarded simply as a variety of "saccharum."

Soft or White Maple (Acer saccharinum)—Common on moist ground (hence one of its names "water maple.") Much planted for shade.

Red Maple (Acer rubrum)—Common in similar habitat to the foregoing with which it is frequently confounded. Not noted by Garman as occurring in Franklin County, but almost certainly to be found there. A common shade tree.

Box Elder (Acer negundo)—Common along streams. Wood used for cooperage and making wooden ware.

Soapberry Family (Sapindaceae).

Ohio Buckeye (Aesculus glabra)—Common. Wood used for artificial limbs, small wares, and in the making of "grape baskets."

Buckthorn Family (Rhamnaceae).

Narrow-leaved Buckthorn (Rhamnus lanceolata)—A shrub. Noted by the writer in fruit in northern part of the county, July 16, 1913.

Vine Family (Vitaceae).

Virginia Creeper (Psedera quinquefolia)—A common vine, often completely enveloping trunks of trees.

Cissus ampelopsis—A vine. Not common.

Frost Grape (Vitis cordifolia)—Common.

Linden Family (Tiliaceae).

White Basswood (Tilia heterophylla)—Common along streams. Wood prized by turners. Blossoms frequented by bees, hence "bee tree." Seeds furnish an oil equal to olive oil.

Dogwood Family (Cornaceae).

Flowering Dogwood (Cornus florida)—A small tree conspicuous in early spring by reason of its large white blossoms. Common in moist woodlands. Bark furnishes tonic drugs, dyes and inks. Wood hard and tough, valuable for engravers' blocks and tool handles.

Silky Cornel (Cornus stolenifera).

Cornus paniculata.

Black Gum (Nyssa sylvatica)—Fairly common. Makes a beautiful shade tree. Wood tough and cross grained, suitable for mauls, pulleys, hubs, rollers, ox yokes and wooden ware.

Ebony Family (Ebenacea).

Persimmon (Diospyrus virginiana)—Common on Eden shale soil. Fruit edible after frost. Wood hard, dark brown, suitable for shoe lasts, plane stocks and shuttles.

Olive Family (Oleacae).

White Ash (Fraxinus americana)—Common, especially on Trenton limestone soil. A noble tree. Wood suitable for agricultural implements, frames of vehicles, tool handles, oars, furniture and interior finishing.

Red Ash (Fraxinus pennsylvanica)—On moist soils. Wood inferior to F. americana.

Green Ash (Fraxinus lanceolata)—On most soils. Wood inferior to F. americana, but a fine shade tree.

Blue Ash (Fraxinus quadrangulata)—On rich bottom lands. A fine shade tree. Wood equal to or superior to F. americana. More durable than that of the latter.

Bignonia Family (Bignoniaceae).

Trumpet Creeper (Tecoma radicans)—An ornamental vine.

Madder Family (Rubiaceae).

Button bush (Cephalanthus occidentalis)—A shrub partial to wet ground.

Honeysuckle Family (Caprifoliaceae).

Buckberry, Coralberry (Symphoricarpos orbiculatus)—Very common in old pastures. A troublesome shrub.

Arrowwood (Viburnum detantum)—A shrub. Not observed, but should be present.

Withe Rod (Viburnum cassinoides)—A shrub. Not observed, but should be present.

Sheepberry (Viburnum lentago)—A shrub. Not observed, but should be present.

Black Haw (Viburnum prunifolium)—A slender shrub or small tree. Common. Fruit, plum like, mostly seed, but edible.

Rusty Nannyberry (Viburnum rufidulum)—A pretty shrub. Berries blue. Not observed, but probably occurs.

Common Elder (Sambucus canadensis)—A common shrub along fence rows. Pithy stems. Wine and pies sometimes made from the berries. Sugar water spiles made from the stems.

List of fossils known to occur in Kentucky from the base of the Tyrone to the top of the Fairmount, and hence should include any occurring in the formations exposed in Franklin county.

Genera and species marked with an * have been reported from the county.

VEGETABLE KINGDOM.

ALGAE (?) (SEAWEED?)

*Bythotrephis gracilis, Hall: Tyrone to Fairmount.
*Bythotrephis succulens, Hall: Trenton.
Bythotrephis ramulosa, Miller: Eden.
Dactylophycus quadripartitum, Miller and Dyer: Eden.
Lorkeia siliquaria, James: Cynthiana.
Lycrophycus sp.?: Tyrone.
*Paleophychus simplex, Hall: Trenton.
*Phytopsis tubulosa, Hall: Tyrone.
Rusophychus bilobatum, Vanuxem: Cynthiana to Maysville.
*Solenopora compacta, Billings: Trenton.
Solenopora irregularis, Ulrich: Cynthiana.
Trichophycus sulcatum, M. and D.: Eden.

ANIMAL KINGDOM.

II. PORIFERA (SPONGES).

*Anthaspidella nov. sp., Woodburn Bed of Trenton.
*Brachiospongia digitata, Beecher: Brannon Bed of Trenton. Known only from Franklin County.
Brachiospongia laevis, Foerste: Mt. Hope Bed of Maysville.
*Hindia parva, Ulrich: Woodburn Bed of Trenton.
Pattersonia aurita, Beecher: Brannon Bed of Trenton.
Saccospongia danvillensis, Ulrich: Perryville Bed of Trenton.
Saccospongia rudis, Ulrich: Upper Trenton.
Streptospongia confusa, Ulrich: Trenton.

III. COELENTERATA (HYDROIDS, CORALS).

Hydroidea.

Chaunograptus gemmatus, Ruedeman: Eden.
Climacograptus putillus, Hall: Eden.
Climacograptus typicalis, Hall: Eden.
Dicranograptus nicholsoni, Hopkinson: Eden.
Dictyonema sp. ? Trenton.
Dictyonema arbuscula, Ulrich: Eden.
Lasiograptus tumidus, Ruedeman: Eden.

Leptograptus annectans, Walcott: Eden.
Mastigograptus gracillimus, Lesq.: Fairmount Bed of Maysville.
Mastigograptus simplex, Walcott: Eden.
Mastigograptus tenuiramosus, Walcott: Eden.
Orthograptus quadrimucronatus, Hall: Trenton.
*Stromatocerium pustolosum, Safford: Top of Bigby and sparingly in Woodburn of Trenton.
Stromatocerium rugosum, Hall: Top of Tyrone.
Tetradium sp. ? Cynthiana.
Tetradium cellulosum, Hall: Tyrone.
Tetradium libratum, Safford: Upper Trenton, Cynthiana.
Tetradium halysitoides, Raymond: Tyrone.
Tetradium minus, Safford: Lower Trenton.
Anthozoa (corals)—
Columnaria alveolata, Hall: Cynthiana.
Columnaria goldfussi, Billings: Curdsville Bed of Trenton.
Columnaria halli, Nicholson: Woodburn Bed of Trenton.
Streptelasma profundum, Owen: Tyrone—Curdsville.

IV. ECHINODERMATA.

1. Crinoidea (Crinoids).

Cystidea—
*Agelacrinus Nov. sp.: Woodburn Bed of Trenton.
Agelacrinus Nov. sp.: Cynthiana.
Aesiocystites priscus, Miller and Gurley: Curdsville Bed of Trenton.
Amygdalocystites florealis, Billings: Curdsville Bed of Trenton.
Amygdalocystites radiatus, Billings: Curdsville Bed of Trenton.
Belemnocystites wetherbyi, Miller and Gurley: Curdsville Bed of Trenton.
Edrioaster bigsbyi, Billings: Curdsville Bed of Trenton.
Hybocystites problematicus, Wetherby: Curdsville Bed of Trenton.
Pleurocystites mercerensis, Miller and Gurley: Curdsville Bed of Trenton.
Crinidea—
Carabocrinus radiatus ovalis, Miller and Gurley: Curdsville Bed of Trenton.
Cleiocrinus regius, Billings: or nov. sp.: Curdsville Bed of Trenton.
Cremacrinus kentuckyensis, Miller and Gurley: Curdsville Bed of Trenton.
Dendrocrinus acutidactylus, Billings: Eden.
Dendrocrinus jewetti, Billings: Curdsville Bed of Trenton.
*Ectenocrinus simplex, Hall: Eden.
Glyptocrinus priscus mercerensis, Miller and Gurley: Curdsville Bed of Trenton.
Hybocrinus conicus, Billings: Curdsville Bed of Trenton.
Hybocrinus tumidus, Billings: Curdsville Bed of Trenton.
*Iocrinus subcrassus, Meek and Worthen: Cynthiana.

Iocrinus trentonensis, Wallcott: Trenton.
Lichenocrinus crateriformis, Hall: Eden.
Lichenocrinus pattersoni, S. A. Miller: Trenton.
Paleocrinus angulatus, Billings: Curdsville Bed of Trenton.
Porocrinus conicus kentuckyensis, M. and G.: Curdsville Bed of Trenton.
Reteocrinus alveolatus, Miller and Gurley: Curdsville Bed of Trenton.

2. Asteroidea (Starfishes).

Palaeasterella milleri, Schuchert: Wilmore Bed of Trenton: Rare—only one specimen known.
*Sladenaster prenuncia, Schuchert: Trenton: Rare—only one specimen known.

V. VERMES (WORMS).

Conchicolites flexuosus, Hall: Wilmore Bed of Trenton.
Conchicolites minor, Nicholson: Eden.

VI. MOLLUSCOIDEA.

Bryozoa (Moss Animals).

Amplexopora ampla, Ulrich and Bassler: Fairmount Bed of Maysville.
Amplexopora cingulata, Ulrich: Fairmount Bed of Maysville.
Amplexopora discoidea, Nicholson: Fairmount Bed of Maysville.
Amplexopora persimilis, Nichles: Eden.
Amplexopora petasiformis, Nicholson: Eden.
Amplexopora petasiformis welchi: James: Eden.
Amplexopora septosa, Ulrich: Mt. Hope and Fairmount Beds of Maysville.
Arthropora cf. bifurcata, Ulrich: Trenton, Cynthiana.
Arthropora cleavlandi, James: Eden.
Arthropora sp. ? Maysville.
Arthrostylus curtus, Ulrich: Eden.
Arthrostylus tenuris, James: Eden.
Aspidopora areolata, Ulrich: Eden.
Aspidopora calycula, James: Cynthiana.
Aspidopora eccentrica, James: Eden.
Aspidopora newberryi, Nicholson: Eden.
Atactopora hirsuta, Ulrich: Fairmount Bed of Maysville.
Atactopora maculata, Ulrich: Fairmount Bed of Maysville.
Atactoporella sp.? Trenton.
Atactoporella multigranosa, Ulrich: Fairmount Bed of Maysville.
Atactoporella mundula, Ulrich: Fairmount Bed of Maysville.
Atactoporella newportensis, Ulrich: Eden.
Atactoporella typicalis, Ulrich: Eden.

Batostoma cf. humile, Ulrich: Trenton.
*Batostoma implicatum, Nicholson: Eden.
Batostoma jamesi, Nicholson: Eden:
Batostoma maysvillensis, Nickles: Mt. Hope Bed of Maysville.
Berenicia vesiculosa, Ulrich: Eden.
Bythopora arctipora, Nicholson: Eden.
Bythopora dendrina, James: Fairmount Bed of Maysville.
Bythopora gracilis, Nicholson: Fairmount Bed of Maysville.
Bythopora parvula, James: Eden.
Callopora communis, James: Eden.
Callopora dalei, Edwards and Haime: Fairmount Bed of Maysville.
*Callopora multitabulata, Ulrich: Wilmore Bed of Trenton.
Callopora nodulosa, Nicholson: Eden.
Callopora onealli, James: Eden.
Callopora var. of ramosa, or nov. sp.: Cynthiana.
*Callopora sigillaroides, Nicholson: Eden.
Callopora subplana, Ulrich: Mt. Hope.
Ceramoporella complexata, Ulrich: Eden.
Ceramoporella distincta, Ulrich: Eden and Fairmount Bed of Maysville.
Ceramoporella interporosa, Ulrich: Eden.
Ceramoporella milfordensis, James: Eden.
Ceramoporella ohioensis, Nicholson: Cynthiana and Eden.
Ceramoporella whitii, James: Fairmount Bed of Maysville.
Coeloclema alternatum, James: Eden.
Coeloclema concentricum, James: Eden.
Constellaria emaciata, Ul. and Bass.: Cynthiana.
Constellaria fisheri, Ulrich: Cynthiana.
Constellaria florida, Ulrich: Fairmount Bed of Maysville.
Constellaria plana, Ulrich: Mt. Hope and Fairmount Beds of Maysville.
Constellaria prominens, Ulrich: Mt. Hope Bed of Maysville.
*Constellaria teres, Ulrich and Bass.: Woodburn Bed of Trenton.
Crepipora impressa, Ulrich: Fairmount Bed of Maysville.
Crepipora simulans, Ulrich: Eden and Mt. Hope Bed of Maysville.
Crepipora solida, Ulrich: Eden.
Crepipora spatiosa, Ulrich: Cynthiana.
Crepipora venusta, Ulrich: Eden.
Cyphotrypa semipilaris, Ulrich: Fairmount Bed of Maysville.
Cyphotrypa acervulosa, Ulrich: Wilmore Bed of Trenton.
Cyphotrypa cortex, Ulrich: Eden.
*Cyphotrypa frankfortensis, Nickles: Top of Bigby Bed of Trenton.
Dekaya aspera, Edwards and Haime: Fairmount Bed of Maysville.
Dekaya maculata, James: Eden.
Dekaya multispinosa, Ulrich: Fairmount Bed of Maysville.
Dekayella foliacea, Ulrich and Bass.: Cynthiana.
Dekayella obscura, Ulrich: Eden.

Dekayella trentonensis, Ulrich: Wilmore Bed of Trenton.
*Dekayella ulrichi, Nicholson: Eden.
Dekayella ulrichi robusta, Foord: Eden.
Dicranopora emacerata, Nicholson: Mt. Hope and Fairmount Beds of Maysville.
Discotrypa elegans, Ulrich: Fairmount Bed of Maysville.
*Eridotrypa briareus, Nicholson: Bigby and Cynthiana.
*Eridotrypa mutabilis, Ulrich: Cynthiana.
Eridotrypa trentonensis, Nicholson: Wilmore Bed of Trenton.
Escharopora acuminata, James: Cynthiana and Eden.
Escharopora falciformis, Nicholson: Fairmount Bed of Maysville.
Escharopora hilli, James: Fairmount Bed of Maysville.
Escharopora maculata, Ulrich: Fairmount Bed of Maysville.
Escharopora pavonia, D'Orbigny: Fairmount Bed of Maysville.
Escharopora ponderosa, Ulrich: Cynthiana.
Escharopora ramosa, Ulrich: Tyrone.
Eurydictya multipora, Hall: Wilmore Bed of Trenton.
Hemiphragma whitfieldi, James: Eden.
Heterotrypa cystata, Cumings: Fairmount Bed of Maysville.
Heterotrypa foerstei, Nickles: Eden.
Heterotrypa frondosa, D'Orbigny: Fairmount Bed of Maysville.
*Heterotrypa parvulipora, Ulrich and Bass.: Cynthiana.
Heterotrypa solitaria, Ulrich: Fairmount Bed of Maysville.
Heterotrypa subfrondosa, Cumings: Mt. Hope Bed of Maysville.
Heterotrypa subpulchella, Nicholson: Mt. Hope Bed of Maysville.
Homotrypa callosa, Ulrich: Trenton.
Homotrypa cincinnatiense, Bassler: Fairmount Bed of Maysville.
Homotrypa curvata, Ulrich: Fairmount Bed of Maysville.
Homotrypa curvata praecipta, Bassler: Eden.
Homotrypa dumosa, Bassler: Fairmount Bed of Maysville.
Homotrypa flabellaris, Ulrich: Fairmount Bed of Maysville.
Homotrypa flabellaris spinifera, Bassler, Fairmount Bed of Maysville.
Homotrypa obliqua, Ulrich: Fairmount Bed of Maysville.
Homotrypella granulifera, Ulrich: Wilmore Bed of Trenton.
Homotrypella norwoodi, Nickles: Cynthiana.
Mesotrypa angularis, Ulrich and Bassler: Hermitage Bed of Trenton.
Mesotrypa echinata, Ulrich and Bassler: Hermitage Bed of Trenton.
Mesotrypa quebecensis, Ami: Hermitage Bed of Trenton.
Monotrypa arbuscula, Ulrich: Tyrone.
Monotrypa turbinata, James: Eden.
Monotrypella aequalis, Ulrich: Eden.
Monticulipora arborea, Ulrich: Wilmore Bed of Trenton.
Monticulipora mammulata, D'Orbigny: Mt. Hope and Fairmount Beds of Maysville.
Orbignyella wetherby, Ulrich: Tyrone.
Peronopora nov. sp., Top of Bigby Bed of Trenton.
Peronopora milleri, Nickles: Cynthiana.

Peronopora vera, Ulrich: Eden and Mt. Hope Bed of Maysville.
Petigopora sp. ? Cynthiana.
Petigopora gregaria, Ulrich: Fairmount Bed of Maysville.
Petigopora petechialis, Nicholson: Mt. Hope and Fairmount Beds of Maysville.
*Phyllodictya frondosa, Ulrich: Tyrone.
Phylloporina clathrata, S. A. Miller and Dyer: Fairmount Bed of Maysville.
Phylloporina variolata, Ulrich: Eden and Mt. Hope Bed of Maysville.
Prasopora sp. ? Cynthiana.
Prasopora falesi, James: Hermitage Bed of Trenton.
Prasopora nodulosa, Ulrich: Wilmore Bed of Trenton.
*Prasopora simulatrix, Ulrich: Wilmore Bed of Trenton.
Proboscina confusa, Nicholson: Eden.
*Rhinidictya neglecta, Ulrich: Trenton.
Rhinidictya nicholsoni, Ulrich: Tyrone.
Rhinidictya parellela, James: Eden.
Spatiopora aspera, Ulrich: Fairmount Bed of Maysville.
Spatiopora lineata, Ulrich: Fairmount Bed of Maysville.
Spatiopora maculosa, Ulrich; Fairmount Bed of Maysville.
Stictoporella flexuosa, James: Eden.
Stictoporella interporosa, Ulrich: Cynthiana.
Stigmatella clavis, Ulrich: Eden.
Stigmatella nana, Ulrich and Bassler: Eden.
Stigmatella nicklesi, Ulrich and Bassler: Fairmount Bed of Maysville.
Stomatopora arachnoidea, Hall: Eden, and Mt. Hope and Fairmount Beds of Maysville.
Stomatopora (Corynotrypa) delicatula, James: Tyrone.
Stomatopora (Corynotrypa) inflata, Hall: Fairmount Bed of Maysville.
Stomatopora (Corynotrypa) tenuissima, Ulrich: Eden and Maysville.

2. Brachiopoda.

?Catazyga sp. ? Trenton.
Clitambonites diversus, Shaler: Eden.
Clitambonites cf. diversus, Shaler: Trenton.
Dalmanella bassleri, Foerste: Hermitage and Wilmore Beds of Trenton.
Dalmanella bellula, James: Fairmount Bed of Maysville.
Dalmanella fairmountensis, Foerste: Fairmount Bed of Maysville.
Dalmanella meeki, S. A. Miller: Fairmount Bed of Maysville.
Dalmanella multisecta, Meek: Eden.
Dalmanella perveta, Conrad: Tyrone.
Dalmanella subaequata, Conrad: Tyrone.
*Dinorthis deflecta, Conrad: Tyrone.
*Dinorthis pectinella, Hall: Curdsville Bed of Trenton.

*Dinorthis ulrichi, Foerste: Top of Bigby Bed of Trenton.
*Glossina trentonensis, Conrad: Trenton.
Hebertella frankfortensis, Foerste: Wilmore and Lower Bigby Beds of Trenton.
Hebertella maria parkensis, Foerste: Cynthiana.
Hebertella occidentalis, Hall: Fairmount Bed of Maysville.
*Hebertella sinuata, Hall: Cynthiana and Fairmount Bed of Maysville.
Hebertella subjugata, Hall: Maysville.
*Heterorthis clytie, Hall: Hermitage Bed of Trenton.
Leptaena gibbosa, James: Eden.
Lingula sp. ? Eden.
*Lingula coburgensis, Billings: Cynthiana.
Lingula covingtonensis, Hall and Whitfield: Hermitage Bed of Trenton.
*Lingula curta, Conrad: Trenton.
*Lingula rectilateralis, Emmons: Trenton.
*Orthis tricenaria, Conrad: Tyrone and Curdsville Bed of Trenton.
*Orthorhyncula linneyi, James: Perryville Bed of Trenton, Cynthiana and Fairmount Bed of Maysville.
Pholidops cincinnatiensis, Hall: Eden.
Platystrophia colbyensis, Foerste: Bigby and Flanagan Beds of Trenton and Cynthiana.
Platystrophia crassa, James: Fairmount Bed of Maysville.
*Platystrophia lynx, Eichwald: Fairmount Bed of Maysville.
Platystrophia profundosulcata, Meek: Fairmount Bed of Maysville.
*Plectambonites rugosus, James: Eden.
*Plectambonites sericeus, Sowerby: Curdsville Bed of Trenton.
Plectorthis dichotoma, Hall: Fairmount Bed of Maysville.
Plectorthis equivalvis, Hall: Fairmount Bed of Maysville.
Plectorthis fissicosta, Hall: Fairmount Bed of Maysville.
Plectorthis neglecta, James: Fairmount Bed of Maysville.
Plectorthis nicklesi, Foerste: Eden.
Plectorthis plicatella, Hall: Trenton ? and Fairmount Bed of Maysville.
Plectorthis rogerensis, Foerste: Eden.
*Rafinesquina alternata, Emmons: Trenton, Eden and Fairmount Bed of Maysville.
Rafinesquina declivis, James: Cynthiana.
*Rafinesquina minnesotensis, A. H. Winchell: Tyrone.
Rafinesquina squamula, James: Eden and Fairmount Bed of Maysville.
*Rafinesquina winchesterensis, Foerste: Cynthiana.
*Rhynchotrema inaequivalve, Castelnau: Bigby and Flanagan Beds of Trenton.
*Rhynchotrema subtrigonale, Hall: Curdsville Bed of Trenton.
Scenidium anthonense, Sardeson: Tyrone.

Schizocrania filiosa, Hall: Hermitage and Wilmore Beds of Trenton, Eden, and Fairmount Bed of Maysville.
Strophomena hallei, S. A. Miller: Cynthiana and Eden.
*Strophomena incurvata, Shepard: Tyrone and Curdsville Bed of Trenton.
*Strophomena maysvillensis, Foerste: Mt. Hope Bed of Maysville.
Strophomena planoconvexa, Hall: Fairmount Bed of Maysville.
Strophomena vicina, Foerste: Top of Bigby Bed of Trenton.
?Trematis fragilis, Ulrich: Cynthiana.
*Trematis ottawaensis, Billings: Hermitage Bed of Trenton.
?Trematis umbonata, Ulrich: Hermitage Bed of Trenton.
?Zygospira cincinnatiensis, Meek: Eden.?
Zygospira kentuckyensis, James: Fairmount Bed of Maysville.
*Zygospira modesta, Hall: Cincinnatian.
*Zygospira recurvirostra, Hall: Trenton and Cynthiana.

VII. MOLLUSCA.

1. Lamellibranchiata. (Pelecypoda.)

*Allonychia flanaganensis, Foerste: Woodburn Bed of Trenton, and Cynthiana.
*Byssonychia intermedia, Meek and Worthen: Bigby Bed of Trenton, and Cynthiana.
Byssonychia vera, Ulrich: Eden.
*Ctenodonta sp.?: Top of Cynthiana.
Ctenodonta alta, Hall: Trenton.
Ctenodonta hartsvillensis, Safford: Perryville Bed of Trenton.
Ctenodonta socialis, Ulrich: Hermitage Bed of Trenton.
Cyrtodonta grandis, Ulrich: Woodburn Bed of Trenton.
Cyrtodonta obesa, Ulrich: Curdsville Bed of Trenton.
Cyrtodonta rotulata, Ulrich: Curdsville Bed of Trenton.
Cyrtodonta subovata, Ulrich: Tyrone.
Lyrodesma acuminatum intermedium, Ulrich: Trenton.
Modiolodon oviformis, Ulrich: Hermitage Bed of Trenton.
Modiolodon patulus, Ulrich: Trenton.
Modiolopsis modiolaris, Conrad: Eden and Fairmount Bed of Maysville.
*Modiolopsis sinuata, Emmons: Cynthiana.
Orthodesma sp.?
Plethocardia umbonata, Ulrich: Top of Tyrone.
Vanuxemia hayniana, Safford: Curdsville Bed of Trenton.
Vanuxemia umbonata, Ulrich: Curdsville Bed of Trenton.
Whiteavesia cincinnatiensis, Hall and Whitfield: Hermitage bed of Trenton and Cynthiana.
Whiteavesia kentuckyensis, Ulrich: Cynthiana.

2. Gastropoda.

Archinacella cingulata, Ulrich: Curdsville Bed of Trenton.
Archinacella simulatrix, Ulrich and Scofield: Hermitage Bed of Trenton.
Bellerophon bilineatus, Ulrich: Perryville Bed of Trenton.
Bellerophon capax, Ulrich: Eden and Mt. Hope and Fairmount Beds of Maysville.
*Bellerophon clausus, Ulrich: Perryville Bed of Trenton.
Bellerophon saffordi, Ulrich: Trenton.
Bellerophon subglobulus, Ulrich: Curdsville and Hermitage Beds of Trenton.
Bellerophon troosti, Safford: Perryville Bed of Trenton.
Bucania eliptica, Ulrich and Scofield: Curdsville and Hermitage Beds of Trenton.
*Bucania frankfortensis, Ulrich: Perryville Bed of Trenton.
Bucania halli, Ulrich and Scofield: Curdsville Bed of Trenton.
Bucania micronema, Ulrich: Perryville Bed of Trenton.
Bucania nana, Ulrich: Perryville Bed of Trenton.
Bucania rugatina, Ulrich: Woodburn Bed of Trenton.
Bucania subangulata, Ulrich: Woodburn Bed of Trenton.
Bucania subspatulata, Ulrich and Scofield: Trenton.
Bucanopsis, carinifera, Ulrich: Perryville Bed of Trenton and Maysville.
Carinaropsis cunulae, Hall: Perryville Bed of Trenton.
Carinaropsis cymbula, Hall: Perryville Bed of Trenton.
Carinaropsis explanata, Ulrich: Cynthiana.
Clathrospira conica, Ulrich and Scofield: Trenton.
Clathrospira subconica, Hall: Tyrone and Curdsville Bed of Trenton.
Conradella bellula, Ulrich: Fairmount Bed of Maysville.
Conradella elegans, S. A. Miller: Curdsville Bed of Trenton.
Conradella similis, Ulrich: Curdsville Bed of Trenton.
Cyclonema cincinnatiensis, Miller: Cynthiana.
Cyclonema inflatum, Ulrich: Lower Maysville (Fairview).
Cyclonema limatum, Ulrich: Lower Maysville (Fairview).
Cyclonema mediale, Ulrich: Lower Maysville (Fairview).
Cyclonema pyramidatum, James: Maysville.
Cyclonema sublaeve, Ulrich: Lower Maysville (Fairview).
Cyclonema transversum, Ulrich.
Cyclonema varicosum, Hall: Cynthiana.
Cyclora minuta, Hall: Woodburn Bed of Lexington and up to top of Maysville.
Cyrtolina nitidula, Ulrich: Cynthiana.
Cyrtolites carinatus, Miller: Eden.
Cyrtolites parvus, Ulrich: Cynthiana.
Cyrtolites retrorsus, Ulrich and Scofield: Trenton and Cynthiana.
Cyrtospira bicurvata, Ulrich, Tyrone.
Eccyliopterus beloitensis, Ulrich and Scofield: Tyrone.

Eotomaria vicina, Ulrich and Scofield: Tyrone.
Fusispira angusta, Ulrich and Scofield: Lower Trenton.
*Fusispira subfusiformis, Hall: Trenton.
Fusispira sulcata, Ulrich: Cynthiana.
?Gyronema pulchellum, Ulrich and Scofield: Curdsville or Hermitage Bed of Trenton.
Helicotoma granosa, Ulrich: Tyrone.
Helicotoma planulatoides, Ulrich: Tyrone.
Helicotoma verticalis, Ulrich: Tyrone.
?Holopea appressa, Ulrich and Scofield: Hermitage (?).
Holopea parvula, Ulrich: Upper Trenton.
*Holopea ventricosa, Hall: Trenton.
Hormotoma angustata, Hall: Tyrone.
*?Hormotoma bellicincta, Hall: Trenton.
*Hormotoma gracilis, Hall: Cynthiana.
Hormotoma salteri, Ulrich: Woodburn or Perryville Bed of Trenton.
Hormotoma trentonensis, Ulrich and Scofield: Trenton.
Liospira sp. ? Cynthiana.
Liospira abrupta, Ulrich and Scofield: Tyrone.
*Liospira americana, Billings: Trenton.
?Liospira micula, Hall: Hermitage Bed of Trenton.
?Liospira mundula, Ulrich: Hermitage and also Upper Trenton.
Liospira progne, Billings: Curdsville and Hermitage Beds of Trenton.
?Liospira vitruvia, Billings: Base of Tyrone to top of Maysville?
Lophospira abnormis, Ulrich: Cynthiana.
Lophospira ampla, Ulrich: Maysville.
Lophospira bicincta, Hall: Curdsville and Perryville Beds of Trenton.
Lophospira bowdeni, Trenton, Eden and Maysville.
Lophospira decursa, Ulrich: Trenton.
Lophospira helicteres, Salter: Upper Tyrone.
Lophospira humilis, Ulrich: Perryville Bed of Trenton.
*Lophospira medialis, Ulrich and Scofield: Perryville Bed of Trenton.
Lophospira multigruma, S. A. Miller: Eden ? Maysville?
Lophospira notabilis? Ulrich and Scofield: Tyrone.
Lophospira obliqua, Ulrich: Tyrone and Curdsville and Hermitage Beds of Trenton.
Lophospira oweni, Ulrich and Scofield: Tyrone.
*Lophospira perangulata, Hall: Tyrone, Trenton.
Lophospira pulchella, Ulrich and Scofield: Woodburn or Perryville Bed of Trenton.
Lophospira sumnerensis, Safford: Perryville, Bed of Trenton, Cynthiana.
Lophospira tenuistriata, Ulrich: Eden.
Omospira alexandra, Billings: Hermitage Bed of Trenton.
Oxydiscus subacutus, Ulrich: Perryville Bed of Trenton.
Protowarthia cancellata, Hall: Curdsville Bed of Trenton, and Eden.
Protowarthia granistriata, Ulrich: Eden.

Protowarthia obesa, Ulrich: Hermitage Bed of Trenton.
Protowarthia pervoluta, Ulrich and Scofield: Curdsville and Hermitage Beds of Trenton.
Protowarthia planodorsata, Ulrich: Eden.
Raphistominia denticulata, Ulrich: Curdsville Bed of Trenton.
Schizolopha moorei ? Ulrich: Maysville.
Seelya mundula, Ulrich: Mt. Hope Bed of Maysville.
Stenotheca unguiformis, Ulrich: Upper Trenton.
Strophostylus textilis, Ulrich and Scofield: Upper Trenton.
Subulites sp.? Tyrone.
Subulites nanus, Ulrich: Tyrone?
Subulites parvus, Ulrich: Tyrone.
Subulites regularis, Ulrich and Scofield: Tyrone.
Tetranota bidorsata, Hall: Curdsville and Hermitage Beds of Trenton.
Tetranota obsoleta, Hall: Curdsville and Hermitage Beds of Trenton and Eden.
Trochonema arctatum, Ulrich: Upper Trenton.
Trochonema beachi ? Whitfield: Curdsville Bed of Trenton.
Trochonema nitidum, Ulrich: Eden.
Trochonema obsoletum, Ulrich: Upper Trenton.
Trochonema subcrassum, Ulrich and Scofield: Upper Trenton.
Trochonema umbilicatum, Hall: Tyrone and Trenton.

3. Cephalopoda.

Actinoceras bigsbyi, Stokes: Tyrone.
Cameroceras sp.? Cynthiana.
Cameroceras (Endoceras) sp.? Tyrone.
Endoceras proteiforme, Hall: Trenton.
*Orthoceras bilineatum—frankfortensis, Foerste: Curdsville Bed of Trenton.
Orthoceras lesueri, Clarke: Tyrone.
*Orthoceras milleri, Foerste: Perryville Bed of Trenton.

VIII. ARTHROPODA.

1. Crustacea.

Ostracoda.

Ceratopsis chambersi, S. A. Miller: Eden.
Ceratopsis intermedia, Ulrich: Cynthiana.
Drepanella ampla, Ulrich: Tyrone.
Drepanella crassinoda, Ulrich: Tyrone.
*Isochilina armata, Walcott: Tyrone.
*Isochilina jonesi, Wetherby: Perryville Bed of Trenton.
Isochilina subnodosa, Ulrich: Perryville Bed of Trenton.
Krausella arcuata, Ulrich: Tyrone.
Leperditia appressa, Ulrich: Perryville Bed of Trenton.

*Leperditia caecigena—frankfortensis, Ulrich: Perryville Bed of Trenton.
Leperditia fabulites, Conrad: Tyrone and Curdsville Bed of Trenton.
Leperditia linneyi, Ulrich: Perryville Bed of Trenton.
Leperditia tumidula, Ulrich: Perryville Bed of Trenton.
Primitia centralis, Ulrich: Eden.
Primitella constricta, Ulrich: Tyrone.
Macronotella scofieldi, Ulrich: Tyrone.
Schmidtella umbonata, Ulrich: Tyrone.
Tetradella quadrilirata, Hall and Whitfield: Tyrone.
Ulrichia nodosa, Ulrich: Eden.
"The Cynthiana and Eden contain a dozen or so addition Ostracoda, among which are the following genera, each represented by one to four species:
"Aparchitis, Primitella, Primitia, Jonesella, Ctenobolbina, Bythocypris, Octonaria, Placentula," Ulrich.

Trilobita.

Acidaspis crassatus, Locke: Eden.
Bathyurus extana, Hall: Tyrone.
Bathyurus spiniger, Hall: Tyrone.
Calymmene sp.? Brannon Bed of Trenton.
Calymmene sp.? Bigby Bed of Trenton.
Calymmene abreviata, Foerste: Cynthiana.
Calymmene callicephala—granulosa, Foerste: Eden.
Calymmene meeki, Foerste: Fairmount Bed of Maysville.
?Ceraurus sp.? Eden.
Dalmanites breviculus, Foerste: Eden.
Dalmanites carleyi—rogerensis, Foerste: Eden.
Isotelus nov. sp. Cynthiana.
Isotelus nov. sp. Cynthiana.
Isotelus latus ? Raymond: Trenton.
Isotelus megistos, Locke: Fairmount Bed of Maysville.
Isotelus stegops, Greene: Eden.
Pterygometopus callicephalus, Hall: Woodburn Bed of Trenton.
Trinucleus bellulus, Ulrich: Eden.
*Trinucleus concentricus, Eaton: Hermitage Bed of Trenton and Cynthiana and Eden.
Fossils of uncertain systematic position (Problematic Fossils).
*Conularia trentonensis, Hall: Hermitage Bed of Trenton.
Pasceolus claudii, S. A. Miller: Fairmount Bed of Maysville.
Pasceolus darwini, S. A. Miller: Fairmount Bed of Maysville.
Receptaculites occidentalis, Salter: Curdsville Bed of Trenton.

TABLE SHOWING SHORTEST DISTANCES IN MILES BY PUBLIC ROADS BETWEEN PLACES IN FRANKLIN COUNTY

Place——————to	Benson Station	Bridgeport	Elmville	Farmdale	Flag Fork	Forks of Elkhorn	Frankfort	Jetts	Peaks Mill	Polsgrove	Swallowfield	Switzer	Woodlake
Benson Station	0	4.	20.8	8.5	11.2	10.8	6.1	11.2	16.8	15.1	18.7	14.4	13.5
Bridgeport	4.	0	20.5	4.5	15.2	10.5	5.8	10.8	16.5	19.1	18.7	14.1	13.2
Elmville	22.1	21.8	0	21.8	17.6	10.5	16.	15.9	5.3	11.1	9.3	8.6	12.9
Farmdale	8.5	4.5	20.3	0	18.1	10.3	5.6	10.7	16.3	19.6	18.1	13.9	13.
Flag Fork (Bailey's Mill)	11.2	15.2	17.6	18.1	0	17.2	12.5	17.6	13.7	6.5	10.1	19.3	19.9
Forks of Elkhorn	10.8	10.5	10.5	10.3	17.2	0	4.7	5.4	7.3	14.5	12.4	3.6	2.7
Frankfort	6.1	5.8	14.7	5.6	12.5	4.7	0	5.1	10.7	14.	12.5	8.3	7.4
Jetts	11.2	10.8	15.9	10.7	17.6	5.4	5.1	0	12.7	19.1	17.6	9.	6.3
Peaks Mill	16.8	16.5	5.3	16.3	12.9	7.3	10.7	12.7	0	7.2	5.1	5.6	9.2
Polsgrove	15.1	19.1	11.1	18.9	6.5	14.5	13.3	18.4	7.2	0	3.6	12.8	17.2
Swallowfield (Dottsville)	18.7	18.7	8.6	18.1	10.	12.4	12.5	17.6	5.1	3.6	0	10.7	14.3
Switzer	14.4	14.1	9.3	13.9	19.3	3.6	8.3	9.	5.6	12.8	10.7	0	3.6
Woodlake	13.5	13.2	12.9	13.	19.9	2.7	7.4	6.3	9.2	17.2	14.3	3.6	0

GEOGRAPHIC POSITIONS WITHIN FRANKLIN COUNTY DETERMINED BY THE U. S. GEOLOGICAL SURVEY.

	Latitude	Longitude
Franklin, Henry and Shelby Counties, corner of, nail in cross painted on corner post to barbed wire fence, about 400 feet north of road intersection at Backbone Creek	38° 20′ 19″.4	84° 59′ 42″.1
Benson Station, L. & N. R. R., road crossing east and west, 80 feet northwest of	38° 12′ 25″.2	84° 57′ 32″.2
Kennebec Station, L. & N. R. R., road crossing east and west	38° 12′ 28″.8	84° 54′ 46″.5
West Frankfort, L. & N. R. R., pike crossing northwest and southeast west of water tank	38° 12′ 14″.	84° 53′ 07″.9
Frankfort, primary traverse station No. 25, bench mark, post set in west corner of old Capitol grounds, 4.5 feet distant to corner post, 230.6 feet to west corner post of porch of old Capitol building	38° 11. 59″.7	84° 52′ 38″.8
Stedmantown, crossing of Cincinnati & Frankfort R. R.	38° 13′ 13″.6	84° 49′ 10″.6
Elkhorn Station, crossing of Cincinnati and Frankfort R. R. at Boles stables	38° 13′ 08″.6	84° 47′ 58″.6
Switzer, Cincinnati and Frankfort R. R., pike crossing east and west, 1,100 feet southwest of station	38° 15′ 10″.1	84° 45′ 25″.3
Kissinger's Lead Works, Cincinnati and Frankfort R. R., road crossing at	38° 15′ 51″.6	84° 44′ 26″.5

ELEVATIONS IN FEET ABOVE SEA LEVEL OF POINTS IN FRANKLIN COUNTY*

	Feet
Forks of road on Sand Ripple Creek, one fork leading down the creek to the mouth and the other over the hill to Polsgrove	625
Forks of road in creek about one mile above last point	688
Crossing of Owen-Franklin County line by Owenton and Frankfort Pike	702
Forks of road on Henry-Franklin line about one half mile west of Pleasant View Church	837
Junction of Bald Knob Pike with east and west pike about 0.7 miles east of Pleasant View Church	906
Junction of this same east and west pike (pike to Polsgrove) with private lane to north west	890
Junction of this same pike with old road down Willow Branch (now closed), two miles north east of the B. M	888
Junction of this same pike with private lane to north about one mile southeast of last (Wadkin's Place)	890
Junction of road to Polsgrove with one to south near Brewer place, about one-tenth of a mile south of Flat Creek	482
Intersection of roads at McDonald Ferry	503
Junction of roads near Flat Creek about one-half mile southwest of last	558
Forks of roads at Forks of Branch at Swallowfield	527
Forks of road on Owen-Franklin line about one-half mile south of Truesville, Owen County	862
Forks of same road on Owen-Franklin line about 0.2 miles east of Mt. Vernon Church	909
Junction of same road on Owen-Franklin line with lane leading down branch tributary to Cedar Creek to north	901
Junction of Elmville-Monterey Pike with road to southwest near Owen-Franklin line about 1.3 miles west of Elmville	689
Elmville, Forks of road at church	720
Flag Fork, cross roads	662
Forks of roads mouth of Willow Branch, about 0.6 miles east of Flag Fork	627
Ottusville, junction with private road to east	529
Forks of Owenton and Frankfort Pike with road to McDonalds Ferry	486
Forks of Owenton and Frankfort Pike with road to Manford Ferry	486
Junction of Owenton and Frankfort Pike with private road to west, about one mile north of forks of pike at mouth of Camp Pleasant Branch	520
Junction of private road at top of divide with pike leading over from Camp Pleasant to Gregory Branch	876

*See elevations on accompanying map.

Crossing of Camp Pleasant-Elmville Pike with east and west pike. The east-west pike passes over north-south pike by overhead bridge. Level of the pike underneath the bridge........ 856
Junction of road leading up branch to southwest with Elmville-Stamping Ground Pike about 1.3 miles from Elmville........ 725
B. M. at forks of pike, Lebanon Church........ 889
Junction of foregoing pike leading east with one leading north and south, about 0.2 miles east of Lebanon Church........ 884
Forks of road leading over to Bald Knob Pike about 0.5 miles northeast of last........ 889
Junction of foregoing pike with Bald Knob Pike at point where the latter leads over the hill to Flag Fork........ 653
Cross roads at mouth of Marshall Branch on Flat Creek........ 589
Forks of road on Flat Creek Pike about one mile up on Marshall Branch........ 638
Forks of Pike on Flat Creek, mouth of Parks Branch........ 552
Junction of private road with pike leading south from foregoing and about one-half mile from same........ 590
Owenton Pike, cross roads, one branch leads across to Peaks Mill Pike at mouth of Camp Pleasant........ 707
Junction of this cross pike with a private road from south at foot of hill near Elkhorn Creek........ 506
Peaks Mill Pike to Elmville, B. M. at Forks of pike where a private road leads up over steep hill to east........ 525
Forks of pike at school house, 1.4 miles southwest of Lebanon Church, and about 0.1 mile east of Franklin-Shelby line........ 898
Forks of road on Flat Creek, northwest fork leads to Lebanon Church, distant about 1.5 miles........ 697
Junction of this road down Flat Creek with Bald Knob pike at mouth of Bald Knob Creek........ 684
Junction of this Bald Knob Pike with a road leading over on to west fork of Marshall Branch, which junction is about 0.5 miles down stream from the last reading........ 678
Junction of this cross road mentioned in last with road on west fork of Marshall Branch........ 668
Junction at church of pike leading up from Parks Branch with a road going over onto head waters and down Duvall Branch........ 850
Owenton Pike at point where private road from west joins 0.6 miles south of Owenton Pike cross roads........ 766
Junction of road up Sulphur Lick Branch with Frankfort and Peaks Mill Pike........ 531
Junction of Zion Pike with St. John Pike, B. M., about one-tenth mile east of Shelby-Franklin line........ 912
Junction of pike from here to Lebanon Church with road leading down on to head waters of Flat Creek and thence down it to mouth........ 886
Junction of St. John Pike with one leading east to Saffel........ 912

Junction of this cross pike with Bald Knob Pike at Saffell........ 890
Junction of road leading east from Saffell with one leading from west fork of Marshall Branch to Davis Pike, the point being 1.6 miles from last named point........ 901
Junction of this road with Davis Pike........ 840
Junction of Owenton Pike with a road leading down Steeles Branch........ 718
Junction of road leading northeast from Owenton Pike and distant about one-half mile from same, with a private road leading down over steep slope and south through old deserted valley of Elkhorn........ 801
Junction of Frankfort-Peaks Mill Pike with a road leading across Elkhorn Creek and up Big John Branch........ 580
Crossing of Elkhorn Creek by bridge, Frankfort-Peaks Mill Pike about 0.8 miles south of last point........ 558
B. M. Junction of Pike up Rocky Branch with Frankfort and Peaks Mill Pike........ 542
Cross roads at head of Rocky Branch, rough road north by Mt. Vernon School, pike south to Forks of Elkhorn, pike southeastward to Switzer........ 804
Junction of road leading north from last point with private road leading east and about 0.3 miles south of Mt. Vernon school........ 852
Top of uplands, about one mile east of last........ 871
Zion Pike, junction with a private road leading west about 0.2 miles north of the southern limit of the quadrangle........ 880
Junction of pike on ridge between Sudduth and Quire Branches with a private road leading down onto Sudduth Branch........ 885
Bald Knob Pike near head of Stony Creek, at foot of hill where pike ascends to Saffell........ 723
Junction of Johnson Ferry Pike with a road up Grindstone Creek 481
Junction at Bethel Church of Owenton Pike with a road leading northeast........ 772
Junction of Owenton Pike with a road leading across to the Frankfort-Peaks Mill Pike to east and about one mile south of Bethel Church........ 785
Junction of Frankfort and Peaks Mill Pike with a private road leading south eastward across Elkhorn Creek at cut off of old ox bow of Elkhorn Creek........ 581
B. M. at Switzer, cross pikes........ 732
Junction of Woodlake-Stamping Ground Pike with Pike to Switzer 839
Junction of Woodlake-Stamping Ground Pike with private road to west about 0.4 miles southwest of last........ 861
Zion Pike at old A. J. Hulette place........ 857
Crossing of Sudduth Branch by a road leading across to St. John Pike........ 691

Cross roads where this cross pike intersects old Newcastle Stage Road 1.5 miles from Zion Pike	711
Cross roads head of Barks Branch 1.3 miles east of last station	855
Benson Station, R. R. level	594
Benson-Bridgeport Pike about 1.5 miles south of Benson Station, old R. D. Armstrong Place	817
Benson-Bridgeport Pike, about 0.3 miles south of last station	836
Benson-Bridgeport Pike, crossing of South Benson Creek, at ford just north of Bridgeport	658
Bridgeport, Town level, B. M. 20	700
Junction of Sheep Pen Branch Pike with Louisville State Pike, B. M., 27	783
Crossing of Big Benson Creek on Bridge by Louisville State Pike, B. M., 26	718
Crossing of Big Benson Creek by Louisville and Crab Orchard Pike, B. M. 24	727
Junction of Louisville and Crab Orchard Pike with pike to Farmdale, B. M. 23	788
Crossing of South Benson Creek on bridge by this pike to Farmdale, B. M. 22	729
Junction of this same pike with Bridgeport and Farmdale Pike at old South Benson Church	813
Junction of Louisville State Pike with road from north at crossing of Armstrong Branch	714
Junction of Louisville State Pike with road from south near old A. P. Branch residence, B. M. 31	770
Forks of road (east and west branch now closed), on this road from south at the old Julian place, B. M. 32	743
Crossing of Armstrong Branch by this same road at the old Julian place, B. M. 33	734
Cross pikes at Elmoro (aneroid determination)	615
Junction of Little Benson-Lanes Mill Pike with a cross pike west, 2.2 miles south of Elmoro	751
About 0.5 miles north on this South Benson-Lanes Mill Pike	805
Junction of Lawrenceburg Pike with the old Lawrenceburg Road, 0.9 miles southwest of Elmoro (aneroid determination)	780
Junction of Lawrenceburg Pike with Bridgeport and Farmdale Pike	849
Farmdale, U. S. B. M.	849
Junction of Lawrenceburg Pike with pike to south and then northeast 0.6 miles south of Farmdale	814
Junction of this branch pike with one to Lanes Mill to southeast, top of hill above quarry	807
Forks of pike on Owenton Pike at church and schoolhouse, 4.4 miles from Frankfort	825
Junction of this Owenton Pike with the Peaks Mill Pike 3.5 miles from Frankfort	716

Store near crossing of branch by the Frankfort and Peaks Mill Pike about two miles north of Frankfort	501
Junction of Bald Knob Pike with St. John Pike (cross roads)	906
Antioch School on this Bald Knob Pike about 2.8 miles from Frankfort	909
Junction of Glen Creek Pike with Frankfort and Versailles Pike at Feeble Minded Institute (aneroid determination)	675
Junction of Stedmantown road with Frankfort-Versailles Pike	782
Forks of Frankfort-Versailles and Frankfort-Georgetown Pikes	800
Junction of Stedmantown Pike with Georgetown Pike at Black's Pond	750
Crossing of Frankfort and Cincinnati R. R. by Stedmantown Pike	711
Junction of this Stedmantown Pike with Stedmantown Road, 1.3 miles from junction of former with Georgetown Pike	738
Crossing of L. and N. R. R. by Glenn Creek Pike (aneroid determination)	555
Jones Station, level of track underneath Versailles Pike (aneroid determination)	790
Jones Station, junction of this same pike with lane to south (aneroid determination)	815
Junction of this same pike with pike to mouth of Glenn Creek (aneroid determination)	775
Jetts Station, foundation of mill, U. S. B. M.	791
Woodlake, U. S. B. M.	738
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THE SOILS OF FRANKLIN COUNTY

BY

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INTRODUCTION.

The following report on the Soils of Franklin County is the result of a soil survey of that county made in the summer and fall of 1914 by the Kentucky Geological Survey, J. B. Hoeing, State Geologist, and the Kentucky Agricultural Experiment Station, Dr. J. H. Kastle, Director, acting in co-operation. The accompanying map was prepared in the office of the Survey, using the geologic map of the county as a basis.

SOILS OF FRANKLIN COUNTY.

The soils of Kentucky may be divided into ten great areas, which agree primarily with the principal geological areas of the State. The soils of these areas are derived from deposits of materials belonging to formations ranging from the most recent to much older geological epochs. Having been formed at different periods, and under varying conditions, these formations give rise to soils varying in their chemical composition and physical nature. Other conditions, such as altitude, topography, drainage, etc., affect to a very marked degree the character of the soils.

These areas are given below in the order of their geologic age, beginning with the most recent.

River alluvium	760	square miles
Purchase Region (Quaternary)	2,275	square miles
Western Coal Field	4,500	square miles
Eastern Coal Field	10,000	square miles
St. Louis and Chester	8,000	square miles
Waverly	4,400	square miles
Devonian	900	square miles
Silurian	875	square miles
Cincinnatian	7,900	square miles
Mohawkian (Lexington)	1,200	square miles
	40,810*	

The 760 square miles of river alluvium includes only the recent deposits (river bottoms) along the Ohio and Mississippi rivers. The total amount of bottom land in the State probably amounts to from 4,000 to 5,000 square miles.

*These areas are approximate only, the total area of the State being somewhat larger than figures given.

The Purchase Region is that portion of Kentucky lying west of the Tennessee River. The whole of this area is covered by transported soils. Graves County is typical of this area. The soils of this county have been recently mapped and reported.

The Western Coal Field occupies the north central portion of the western half of the State, while the Eastern Coal Field embraces the mountains of Eastern and Southeastern Kentucky.

The topography, soils and agricultural conditions of these two areas are so vastly different that they really constitute separate soil areas. The soils of Webster County, which is in the Western Coal Field, have been mapped and reported in Bulletin No. 162.*

The St. Louis-Chester area extends from the Ohio River around the Western Coal Field in a strip somewhat in the shape of a horseshoe, averaging about 50 miles in width. A narrow strip of the same character borders the Eastern Coal Field on the west. The Waverly area lies in the main in south central Kentucky, extending south from the Blue Grass region to the Tennessee State line. From this main area an arm extends northwest to the Ohio River below Louisville and another arm extends northeast to the Ohio River at Vanceburg in Lewis County.

The Devonian area occupies a narrow crescent-shaped strip extending from Vanceburg on the Ohio River, in Lewis County, around the border of the Central Kentucky region to the Ohio River again at Louisville.

The Silurian occupies a narrow strip between the Devonian and the Central Kentucky region, but is not continuous, being absent in the greater part of Lincoln, Boyle and Marion counties.

The Ordovician system of rocks furnishes the surface formation immediately underlying the Blue Grass region proper and the adjoining counties, comprising all of Central Kentucky from the outcrop of the Devonian and Silurian to the Ohio River. This system con-

*For reports on some of the soils of the Eastern Coal Field, see Kentucky Geological Survey, Vol. 1, Series 4.

sists of the Cincinnatian and Mohawkian series. The maximum thickness of the formations comprising these two series outcropping in Kentucky is approximately 1,500 feet. This region embraces about 35 counties in north Central Kentucky, representing an area of about 9,000 square miles, or slightly less than one-fourth of the entire State. Of this amount, about 7,900 square miles lies in the Cincinnatian and about 1,200 square miles in the underlying Mohawkian series.

Franklin County lies in both areas and contains a number of soil types found throughout the Blue Grass region and Central Kentucky.*

The diversity of Franklin County soils is due to the diversified geology, the varied topography, and to a very great extent to the work of its drainage system through long periods of time. This system is comprised principally of the three streams, the Kentucky River, Elkhorn and Benson Creeks and their tributaries.

GEOLOGY.

Below is given a table of geological formations taken from a report on the Geology of Franklin County by Professor A. M. Miller. (See preceding report.)

TABLE I. GEOLOGICAL FORMATIONS—FRANKLIN COUNTY.

Ordovician.	Cincinnatian	Cincinnati	Maysville	50 feet
			Eden	200 feet
			Cynthiana	60 feet
	Mohawkian	Lexington (Trenton)	Perryville	25 feet
			Flanagan	45 feet
			Bigby	75 feet
			Wilmore	80 feet
			Hermitage	45 feet
			Curdsville	10 feet
		High Bridge (Stones River)	Tyrone	60 feet
			Total	650 feet

*By "Central Kentucky" in this report is meant all of the region embraced between the Ohio River and the Devonian—Silurian outcrop.

Quoting Professor Miller: "The Ordovician column begins about 50 feet below the top of the Tyrone member of the High Bridge or Stones River series, and ends a short distance up in the Maysville member of the Cincinnatian."

"The maximum thickness of the strata included within these limits is about 650 feet. The actual range in altitude of the county is about 450 feet. The seeming discrepancy in these figures is explained by the dip of the rocks and also, but to a much smaller extent, by faulting."

PHYSIOGRAPHY AND DRAINAGE.

Franklin County may be divided in a general way into four phases or types of topography. First, along practically all of the streams are found more or less flat or undulating valley lands. Also along the Kentucky River and Elkhorn Creek are found a number of deserted ox-bow channels containing hundreds of acres of fertile valley land. The valleys lie mainly between 470 feet and 660 feet above sea level.

The abrupt cliffs and outcropping ledges of limestone enclosing the valley lands constitute a second phase of topography. These hills and bluffs rise from 100 feet to 300 feet above the valleys.

Throughout the Eden area the long sloping and more or less abrupt hills constitute a third phase of topography. The altitude of these hills varies from about 550 feet at the base to about 900 for the highest summits, above sea level.

The fourth phase of topography consists of the more gently rolling or undulating table lands. These table lands are found mainly in the Lexington and Cynthiana formations in the southeastern portion of the county. Another area of undulating land is found south of Benson Creek and west of the Kentucky River, between Bridgeport and the Anderson county line.

Franklin County is drained by the Kentucky River, Elkhorn Creek, Benson Creek and Flat Creek, and their tributaries. The Kentucky River flows from south to north practically dividing the county into halves. The distance from the southern to the northern boundary, measured along its meanderings, is 26 miles, while measured in a straight line, the distance is only 16 miles. Elkhorn Creek flows northwest through the eastern half of the county, and empties into the Kentucky River about 4 miles above the point where the river crosses the northern boundary line. Benson Creek flows east, dividing the west half of the county, and empties into the Kentucky River just opposite Frankfort. Flat Creek drains the northern part of the west half of the county, and empties into the Kentucky River just north of the Franklin-Henry county line. Cedar Creek drains a small section in the northeastern part of the county.

SOILS AND SOIL TYPES.

The soils of Franklin County consist of both transported and residual deposits. Of the total area of the county, 200.73 square miles, about 15 per cent, or 31 square miles, is covered with transported soils. These soils are in part recent deposits and in part old river deposits, and are found from the lowest to practically the highest elevations. The materials composing these soils have been derived from formations ranging from the Coal Measures down through the Lexington Limestone. This, together with the varying conditions under which they have been deposited, has rendered them diversified in both their physical and chemical nature.

The diversity of the residual soils in Franklin County is very largely due to the variations in the character of the formations from which they have been derived. The soil types in the main may be correlated with the geology. The types differing from the geology have been more or less modified by their topography and by the presence of an intermixture of transported materials.

As shown on the soil map, there are thirteen soil types in Franklin County. Seven of these types are of transported origin, and six of residual origin. Two of the transported types are upland and five are bottom soils. Three of the residual types are made up of hills and bluffs and three are rolling to undulating lands.

The following factors were taken into account in studying and establishing the thirteen soil types outlined on the Franklin County soil map: (1) The geological origin of the soil, whether residual or transported; (2) if transported, whether a recent or an old deposit; (3) the topography or lay of the land; (4) the native vegetation; (5) the physical or mechanical nature of the surface and sub-soil; (6) color of the soil strata; (7) the chemical composition and reaction.

The soil is composed of both organic and inorganic constituents, as indicated in the following outline:

Soil Constituents.

Organic matter—Comprising decomposed and undecomposed vegetable and animal material.

Inorganic matter	1. Fine gravel	2 — 1	mm. in diameter.*
	2. Coarse sand	1 — .5	mm. in diameter.
	3. Medium sand	.5 — .25	mm. in diameter.
	4. Fine sand	.25 — .1	mm. in diameter.
	5. Very fine sand	.1 — .05	mm. in diameter.
	6. Silt	.05 — .005	mm. in diameter.
	7. Clay	.005— .000	mm. in diameter.

The above system of textural grouping is the one employed by the U. S. Bureau of Soils in mechanical analyses. The different types of soils, such as sand, sandy loam, silt loam, loam, clay loam, and clay, are determined by the proportional amounts of these different separates found in a soil when subjected to a physical analysis. For instance, a loam is a soil containing less than 55 per cent of silt, with from 15 to 25 per cent of clay, and more than 50 per cent of both silt and clay, containing, of course, varying amounts of the different grades of sand. A silt loam is a soil containing more than 55 per cent of silt and less than 25 per cent of clay, with varying amounts of the different grades of sand, while a clay loam is a soil containing from 25 to 55 per cent of silt and from 25 to 35 per cent of clay and more than 60 per cent of both, etc.

*1mm. (1 millimetre) equals about 1-25 of an inch.

TABLE 2. SOIL TYPES OF FRANKLIN COUNTY.

Name of Type.	Area in square miles.	Area in acres.	Per cent of total area.
I. Transported soils—Uplands.			
1. Yellow silt loam	6.07	3,885	3.02
2. Yellow fine sandy loam	4.41	2,822	2.20
II. Transported soils—Bottoms.			
1. Brown loam	8.07	5,165	4.02
2. Gray fine sandy loam	6.18	3,955	3.08
3. Yellow loam	2.05	1,312	1.02
4. Black clay loam	1.37	877	.69
5. Brown fine sandy loam	1.15	736	.57
III. Residual soils—Hills and bluffs.			
1. Yellow clay loam	91.98	58,867	45.82
2. Stony loam	28.61	18,310	14.25
3. Bluffs and cliffs	4.39	2,810	2.19
IV. Residual soils—Table lands.			
1. Brown loam	22.91	14,662	11.41
2. Yellow loam	19.27	12,333	9.60
3. Light brown loam	4.28	2,739	2.13
Total area	200.74	128,473	100.00

I. TRANSPORTED SOILS—UPLANDS.

(1) YELLOW SILT LOAM.

The soil of this type covers an area of 6.07 square miles, equivalent to 3,885 acres, or 3.02 per cent of the entire area. This area lies in the southern part of the county west of the Kentucky River, and immediately north of the Anderson County line. It is rolling or undulating and its altitude is practically on a level with the highest uplands. It is an old river deposit, and was evidently deposited at a time when the river had a very wide valley or flood plane.

The materials composing this soil have no doubt been very largely derived from higher formations and perhaps chiefly from the coal measures, as is evidenced by the presence of sand and conglomerate pebbles.

The surface soil, averaging about 6 inches, is a yellow silt loam, varying from a heavy silt loam to a light silt loam and in places becomes rather sandy. The subsoil is yellowish to grayish in color, and varies from a heavy clay loam to a loam or sandy loam, generally, however, containing a large per cent of clay and in places water worn pebbles.

In tabulating the results of the chemical analyses, the plant food content is calculated on an acre basis. In sampling the surface soil the samples were taken from the first 6 inches, the subsoil from the succeeding 12 inches, or from 7th to 18th inches inclusive. The surface soil over an acre to a depth of 6 or 6½ inches weighs approximately 2,000,000 pounds, while the foot of subsoil weighs approximately twice that amount, or 4,000,000 pounds. The results of the chemical analyses reported in this bulletin are expressed on these bases.

The chemical analyses were made by the Chemical Department of the Kentucky Agricultural Experiment Station.

TABLE 3. FERTILITY IN YELLOW SILT LOAM.

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).							
43,726	2,220	640	12	16,000	218	1,240	288
43,722	2,640	1,376	114	24,400	530	2,580	72
Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).							
43,727	2,320	1,000	24	45,200	332	2,480	144
43,723	2,240	1,536	112	50,000	876	46,400	288

Geologically, this soil lies in the Eden horizon and has no doubt some residual material from this formation, especially the southern portion of the area where transported materials are not so much in evidence.

The native vegetation and crop yields as well as the chemical analysis of this type indicate a poor soil. It resembles southern and western Kentucky in that Japanese clover and pennyroyal were found growing, while blue grass is practically absent throughout the area. Hay is made very largely from red top and timothy. It appears to be naturally adapted to fruit, especially apples, peaches and grapes, and is known as a good fruit country.

The difference in the plant food content of the two samples is perhaps due to the presence of more or less residual material in the sample containing the larger amount of plant food.

(2) YELLOW FINE SANDY LOAM.

This type contains 4.41 square miles, equivalent to 2,822 acres, or 2.20 per cent of the entire area. The soil of this type is a much more recent deposit than that of the yellow silt loam. It occurs in the vicinity of the Kentucky River, occupying areas in the bends of both the present and the deserted channels. These areas slope gradually from the valleys and attain altitudes of from 100 to 150 feet above the valley level. Other isolated areas occur away from the river channels and at slightly higher elevations. They are probably remnants of an old flood plain.

The material composing this soil has evidently been shifted very considerably from its original position. Since this material was deposited the river, in the process of erosion, has deepened its channel some 200 feet or more. There is evidence of this material having come very largely from higher formations. Fragments of coal measures sandstone and gravel are very common. The soil materials now rest on the lower Cincinnatian and are no doubt in part derived from these rocks.

The surface soil, 0 to 6 inches, varies from a yellow to a gray fine sandy loam or silt loam. In this type, as in the yellow silt loam, patches of more or less sandy areas are found. The subsoil, 6 to 18 inches, is yellowish or brownish in color and varies from a clay loam to a loam.

TABLE 4. FERTILITY IN YELLOW FINE SANDY LOAM.

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
43,736	2,640	2,300	216	24,800	168	2,760	54
43,700	2,680	1,840	190	23,800	212	1,680	288

Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
43,737	2,880	6,920	948	47,600	196	16,800	216
43,701	2,480	3,480	308	56,000	356	4,080	864

The native vegetation, crop yields and plant food content agree in indicating this to be a much more fertile soil than that of the yellow silt loam. This soil is very largely underlain by limestone and in places contains loose limestone. The wide variation in the calcium content in the subsoil of the two samples is perhaps due to this fact.

II. TRANSPORTED SOILS—BOTTOMS.

The total area of the five types of bottom land is 18.82 square miles, equivalent to 12,045 acres, or 9.38 per cent of the entire area.

The agencies of formation and the conditions under which these soils have been formed are numerous and varied and the respective types possess many distinctive and well defined characteristics.

(1) BROWN LOAM.

The brown loam is the most important of the bottom soils, both from the standpoint of area and agricultural possibilities. It contains 8.07 square miles, or 5,165 acres, or 4.02 per cent of the total area, or 42.88 per cent of the total bottom land. It forms the first bottom along all the streams with the exception of the present valleys of the Kentucky River and the deserted channels of Elkhorn Creek. It is also found to some extent along the deserted channels of the Kentucky River. It lies in geological horizons ranging from the upper Eden down through the Cynthiana and Lexington into the High Bridge formation. Also a portion lies in the yellow silt loam (transported upland).

These bottoms are generally rather flat, but as a rule are fairly well drained. Much of this land overflows during freshets, but the streams have a rapid fall and the overflow is soon removed.

The soil has been derived chiefly from the formations through which these streams flow (the Cincinnatian and Lexington limestone). It has of course been to some extent contributed to by the upland transported soils.

In its physical nature the surface soil varies from a light clay loam to a loam. It varies in color from yellow to brown, but is normally a brown loam. The subsoil is generally very similar to the surface, containing, however, a larger percentage of clay.

TABLE 5. FERTILITY IN BROWN LOAM. BOTTOM LAND.

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
43,712	3,520	11,440	3,480	37,400	288	21,920	36
43,714	2,840	13,880	2,840	32,000	336	27,360	36
Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).							
43,713	4,400	21,680	6,680	65,600	348	36,480	72
43,715	3,280	16,880	5,240	68,000	456	64,640	36

In the bottoms extending into the yellow silt loam (transported upland) are found patches of gray or white silty soil that is very different from the normal first bottom soil. This soil has been derived from the transported soil. The chemical analysis of a typical sample is given below:

TABLE 6. GRAY OR WHITE SILT LOAM.

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
43,724	2,800	640	34	18,400	110	1,540	4,860
Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).							
43,725	2,720	960	48	30,800	260	1,320	18,792

(2) GRAY FINE SANDY LOAM.

The gray fine sandy loam is the second most extensive bottom type. It contains an area of 6.18 square miles, equivalent to 3,955 acres, or 3.08 per cent of the total area. It constitutes 32.31 per cent of the total bottom land.

This type is a river deposit and is confined to the river bottom and to some extent to the deserted river channels. It is a rather old deposit and lies in the main above the overflow line. In places near the river it is flat and overflows during high water. It appears to have been originally made up of a first, second and even a third bottom. The second and third bottoms are now far above the overflow line. These bottoms have undergone erosion and have a rolling topography.

The Kentucky River in its total length now flows through all of the formations from the coal measures to the oldest exposed formation in the State. Therefore, the bottom soils along the Kentucky River have been derived in varying proportions from all of these formations. However, the character of the soil indicates the presence of coal measures materials predominating.

The character of both the surface and subsoil of this type varies quite widely. The variations are local and it would be of little practical value to outline them as distinct types. The surface soil varies from a loam to a fine sandy loam and sand, being in the main a fine sandy loam. The subsoil varies from a clay loam to a loam, and in places becomes rather silty and sandy. Both the surface and subsoil have usually a grayish or yellowish color.

TABLE 7. FERTILITY IN GRAY FINE SANDY LOAM.

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutraize acid
Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).							
43,574	2,440	1,760	220	25,000	258	2,340	36
43,720	2,320	1,480	188	28,800	258	1,280	324
Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).							
43,575	2,800	3,640	316	54,800	328	3,920	72
43,721	2,560	2,592	104	71,200	324	1,960	3,816

(3) YELLOW LOAM.

The yellow loam is second bottom land found in disconnected areas along Elkhorn, Benson and Flat creeks, and to some extent along the deserted channels of Elkhorn Creek. It contains 2.05 square miles, equivalent to 1,312 acres, or 1.02 per cent of the entire area. It is gently rolling and has been derived primarily from the different divisions of the Cincinnatian and Lexington formations. It lies mainly in the Lexington limestone horzon and perhaps contains more or less residual material from the underlying formations. These bottoms lie adjacent to the upland, and usually away from the streams. They seldom attain elevations more than 15 or 20 feet above the first bottom.

The surface soil is a yellow loam varying in depth from 6 to 8 or 10 inches. The soil is much more compact than that of the first bottoms. It has long been under cultivation and is apparently depleted of organic matter. The subsoil is a yellow clay loam, often rather compact, but not impervious and is naturally well drained.

TABLE 8. FERTILITY IN YELLOW LOAM.

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
43,633	2,640	7,120	2,920	26,000	226	5,700	36
43,702	2,360	6,360	1,410	33,000	324	16,480	90

Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
43,703	3,440	20,960	6,040	55,600	184	24,600	72
43,634	2,920	12,600	6,600	68,000	484	50,480	54

(4) BLACK CLAY LOAM.

The black clay loam is found in the deserted channels of Elkhorn Creek and the Kentucky River. There are also two isolated areas in the wide bottoms of Elkhorn Creek a short distance below Peaks Mill. It embraces 1.37 square miles, equivalent to 877 acres, or .69 per cent of the entire area.

The land of this type is rather flat, and in the deserted channels has been deposited very largely by back-water, while in the wide bottoms it has been deposited mainly by overflow water. In these areas this overflow and back-water evidently remained for a period after each recession of the high water. Therefore the soil has been formed largely by the slow sedimentation of the fine particles held in suspension in the overflow water.

The surface soil, 6 to 10 or 12 inches, varies from a dark brown loam to a heavy black clay loam. The subsoil varies from a dark loam to a bluish heavy plastic clay or clay loam. This soil is naturally poorly drained and in places is "crawfishy."

TABLE 9. FERTILITY IN BLACK CLAY LOAM.

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid	Calcium carbonate
43,710	4,320	8,280	3,000	41,800	286	21,920	18	1,080
43,704	5,560	13,080	3,570	32,400	224	29,000	None.	3,080

Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid	Calcium carbonate
43,711	5,120	14,800	5,400	102,400	348	40,000	36	3,280
43,705	8,480	29,040	7,100	79,200	188	73,400	None.	8,800

(5) BROWN FINE SANDY LOAM.

The brown fine sandy loam includes only 1.15 square miles, equivalent to 736 acres, or only .57 per cent of the entire county. It is found along the Kentucky River and is a much more recent deposit than the other river type, the gray fine sandy loam. It usually occurs at or immediately below the mouth of streams. The character of the soil has been very greatly modified by materials deposited by these streams. The land of this type lies rather flat, but the greater portion is above the overflow line except during unusually high water. It is naturally fairly well drained.

The surface is a loose deep soil, varying from a brown loam to a brown fine sandy loam, and in places becoming quite sandy. The subsoil is very similar to that of the surface, except that it is more compact and contains a slightly larger percentage of clayey material.

This type has long been under cultivation, but is still recognized as a very productive soil.

TABLE 10. FERTILITY IN BROWN FINE SANDY LOAM.

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid	Calcium carbonate
43,708	3,160	8,160	2,680	36,400	346	16,800	Alkaline.	5,860
43,576	2,380	2,640	730	39,200	220	14,100	Alkaline.	25,340

Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid	Calcium carbonate
43,709	4,720	15,520	4,420	74,800	328	22,080	72	3,760
43,577	2,720	6,200	1,560	69,200	420	22,000	Neutral.	24,480

III. RESIDUAL SOILS—HILLS AND BLUFFS.

From the standpoint of area, this class of soils is by far the most important of the four classes. It includes three types embracing a total area of 124.98 square miles, or 62.26 per cent of the entire county.

(1) YELLOW CLAY LOAM.

The yellow clay loam is by far the most extensive soil type in the county. Its area is 91.98 square miles, equivalent to 58,867 acres, or 45.82 per cent of the county. It occurs in the main in four disconnected areas. One lies north and east of Elkhorn Creek and the Kentucky River. A second area occupies the central portion of the county, and is enclosed between Elkhorn Creek and the Kentucky River. A third area lies north of Benson Creek and west of the Kentucky River, while the fourth lies south of Benson Creek and west of the Kentucky River. Other small isolated areas are found in the southeastern portion of the county.

The rocks from which this soil is derived belong to the Eden division of the Cincinnatian formation. The Eden formation is made up of a succession of thinly-bedded layers of limestone and shale, alternating with partings of clayey or marly materials. The beds of limestone and clay vary in thickness from a few inches to 10 to 12 inches. In the upper Eden are found thin beds of sandstone and siliceous shale that in places slightly modify the character of the soil. The character of the materials composing the Eden formation is such that on exposure it readily undergoes weathering.

The broken and hilly topography prevalent throughout the Eden area may be attributed to the fact that this formation is so susceptible to the erosive powers of surface waters.

The surface soil consists of a heavy textured brown or yellow clay loam from 3 to 12 inches in depth. The subsoil is a heavy yellow clay and usually extends to a depth of 3 feet or more. The sloping surfaces are usually generously strewn with thin limestone fragments of varying size, which generally makes it unnecessary to apply lime.

TABLE 11. FERTILITY IN YELLOW CLAY LOAM. (EDEN.)

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid	Calcium carbonate
43,734	2,980	2,330	292	63,400	252	11,380	None.	1,740
43,631	2,980	2,080	118	75,400	458	7,220	18	780
43,703	5,040	1,920	296	69,000	230	22,700	None.	23,120

Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid	Calcium carbonate
43,735	3,040	5,040	532	128,800	332	16,760	720	
43,632	3,840	4,440	452	159,600	780	16,600	36	2,040
43,707	6,560	4,720	536	139,200	196	10,840	None.	206,200

(2) STONY LOAM.

This type is found covering the cliffs and steep hillsides along the streams which have cut into or through the Cynthiana and Lexington formations. These hills reach from 30 to 150 or 200 feet above the valleys. This area embraces 28.61 square miles, or 18,310 acres, 14.25 per cent of the county. The soil is derived from the Cynthiana and Lexington limestones, chiefly, however, from the Lexington limestone.

The surface soil varies from 0 to 10 or 12 inches deep, and rests either on the underlying rock or on a yellow clay or clay loam subsoil. The surface is a loose brown or chocolate colored loam, usually containing numerous fragments of loose limestone. In many places the earth is practically covered with these loose limestones, which vary in size from large boulders to small fragments. Often the thin ledges outcrop in the hillsides among these loose rocks.

These hillsides are often cultivated in corn and tobacco. Much of the land has recently been cleared and the soil, having come from the Lexington limestone, is naturally fertile.

(3) BLUFFS AND CLIFFS.

From the standpoint of agriculture, this type is of little importance. It embraces an area of 4.39 square miles, equivalent to 2,810 acres, or 2.19 per cent of the county. It is made up of the outcropping ledges and abrupt bluffs found along the streams that have cut into the Lexington limestone. These ledges and bluffs occur in the base of the hills throughout the stony loam area and vary in height from 20 or 30 feet to 100 feet or more.

IV. RESIDUAL SOILS—TABLE LANDS.

The three types of this class contain practically no waste land. While much of the land is rolling, if handled with care, it can be cultivated without serious erosion. These types embrace 46.46 square miles, equivalent to 23.14 per cent, or slightly less than one-fourth of the county.

(1) BROWN LOAM.

From the standpoint of both area and value per acre, the brown loam is by far the most important soil type in the county. It covers an area of 22.91 square miles, equivalent to 14,662 acres, or 11.41 per cent of the county. It lies in the main in the southeastern portion of the county. Outlying areas are also found further north along Elkhorn Creek. Also isolated areas are found west of Frankfort along Benson Creek.

The materials composing this type have been derived primarily from the Mohawkian (Lexington) series of rocks. The rocks forming the different subdivisions of the Lexington formation, vary somewhat in the character of the materials composing them. However, they are made up in the main of massive limestones which on disintegration and decomposition give rise to soils very similar in their appearance and physical compostion.

The soils of perhaps nine-tenth of the area are derived from the upper 100 feet of the Lexington formation and very largely from the upper 50 feet.

In the more rolling lands along the Kentucky River and Elkhorn Creek the soil has come primarily from the lower Lexington formation. The soil along the river has also been modified to some extent by the old river sands and gravels.

The Flanagan division of the upper Lexington limestone contains phosphatic layers, and the soil coming immediately below this division is usually highly phosphatic.

This brown loam (Lexington) is the predominating soil type found throughout the famous Blue Grass region proper, and the highly phosphatic soil common in this area has no doubt been largely derived from these phosphatic limestones.

The surface soil is a brown or brownish yellow loam varying in depth from 6 to 12 or 14 inches. The subsoil is yellowish or reddish loam or clay loam, which often, in the more level areas, contains iron stains and iron concretions. The presence of iron stains and concretions indicates that the subsoil is somewhat impervious.

TABLE 12. FERTILITY IN BROWN LOAM.

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid	Calcium carbonate
43,627	3,000	3,200	350	31,600	290	3,460	72	1,960
43,718	2,760	6,440	1,832	26,400	256	10,320	72	
43,578	3,180	2,760	484	....	494	4,280	36	
43,580	2,640	2,900	196	27,400	348	2,780	54	
43,728	2,800	2,720	220	26,600	126	4,080	72	
Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).								
43,628	2,360	5,920	492	67,200	648	7,240	72	5,280
43,719	3,920	7,360	3,728	49,600	228	78,000	72	
43,729	4,560	6,400	1,320	53,200	256	8,800	144	
43,579	4,080	6,600	1,016	....	840	9,600	108	
43,581	3,200	5,720	372	58,800	528	5,240	144	

(2) YELLOW LOAM.

This type consists of 19.27 square miles, equivalent to 12,333 acres, or 9.60 per cent of the county. It lies in a number of disconnected areas in the southeastern part of the county through the brown loam area. Also a number of areas are found south of Benson Creek and west of the Kentucky River.

It is derived chiefly from the Cynthiana or lower Cincinnatian series of rocks. It occupies the broad rolling ridges throughout the brown loam area (Lexington) while west of the river it is found in the valleys and sloping hills in the yellow clay loam (Eden) area. The Cynthinana formation is made up of blue and gray limestone with layers of clay in the upper beds.

The surface soil varies from a yellow clay loam to a yellow loam, being normally a yellow loam. It differs from the brown loam (Lexington) in that it contains a larger per cent of clay and is much more yellowish in color and is not nearly so phosphatic. It resembles to some extent the yellow clay loam (Eden) which comes from the formation immediately above. It is much more loamy, and, as shown from the chemical analysis, contains only about one-half as much potassium as the yellow clay loam. The subsoil is a yellow clay loam and in the more level places contains iron stains and iron concretions.

TABLE 13. FERTILITY IN YELLOW LOAM.

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
43,716	3,680	1,720	68	28,200	142	3,680	72
43,730	2,960	2,600	262	29,600	220	3,880	144
Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).							
43,717	4,400	3,120	104	52,800	252	6,400	144
43,731	3,280	6,880	832	62,000	296	7,520	288

(3) LIGHT BROWN LOAM.

The soil of this type embraces an area of 4.28 square miles, equivalent to 2,739 acres, or 2.13 per cent of the county. It lies in three disconnected areas, two of which are in the northwestern portion of the county, one adjoining the Henry county line and the other adjoining the Shelby county line. The third area lies in the eastern part of the county some two miles west of the Scott county line.

This soil is derived from the Maysville formation, which is composed chiefly of blue and gray limestone with thin layers of clay or shale partings. It occupies the highest geological horizon in the county. In both sections it is found occupying the tops of the ridges in the Eden area. The rocks of Franklin county dip northwestward. The areas in the northwestern portion of the county have been preserved because of this fact, while the area found in the eastern portion has been preserved because of the local faulting which resulted in a drop of this section of the county.

The surface soil varies from 6 to 10 or 12 inches in depth, and varies in color from a yellow to a light brown. The subsoil is more yellowish in color and, like the subsoil of the brown loam (Lexington) and yellow loam (Cynthiana), contains iron stains and iron concretions in the more level areas.

TABLE 14. FERTILITY IN LIGHT BROWN LOAM.

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
43,629	2,800	4,800	920	33,800	254	5,200	54
43,732	2,360	1,460	40	31,800	254	2,560	108

Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).

Lab. No.	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
43,630	4,360	15,880	5,760	64,000	428	21,120	144
43,733	2,840	2,920	36	61,600	312	4,840	3,492

PLANT FOOD.

Of the eighty known chemical elements entering into the composition of the earth and atmosphere only ten are generally believed to be essential to the life and growth of plants, although other elements are found in them. These ten are carbon, oxygen, hydrogen, nitrogen, sulphur, iron, calcium, magnesium, potassium, and phosphorus. Carbon and oxygen are taken into the leaves of plants from the air as carbon dioxide, while hydrogen, a constituent of water, is absorbed through their roots. The other seven elements, with the exception of nitrogen, have their source only from the soil, unless supplied artificially in manure or commercial fertilizers. Nitrogen has its source from both the soil and atmosphere. Such crops as wheat, corn, tobacco, potatoes, in fact, all crops except "legumes" (clover, peas, beans, alfalfa, etc.) can use only the nitrogen compounds which are liberated from the organic matter of the soil. Legumes obtain nitrogen from both the soil and atmosphere. They obtain nitrogen from the atmosphere through the nitrogen fixing bacteria which develop in the nodules found on the roots of legumes.

The amount of nitrogen obtained from a soil by leguminous plants depends upon the amount of nitrogen contained in a soil, and upon its chemical and physical condition. The nitrogen fixing bacteria of many legumes do not develop in sour or acid soils. Clover failure is often due to an excessive amount of acid in the soil. In a soil rich in nitrogen, legumes may obtain practically all of their nitrogen from the soil, even if the soil contains an abundance of lime and is not acid. On the other hand, in a soil rich in lime, but poor in nitrogen, practically all of the nitrogen may be obtained from the atmosphere.

Of the six elements that plants obtain from the soil (sulphur, iron, calcium, magnesium, potassium, and phosphorus) potassium and phosphorus have in the past been considered the most deficient. In fact, they, in combination with nitrogen, have been the only elements considered in the manufacture of what are called complete fertilizers. Recently some importance has been attached to the necessity of supplying sulphur.

A soil which is acid may contain enough calcium for plant food purposes, but not contain it in the form of calcium carbonate, the form necessary to the fixation of nitrogen by many of the legumes.

The following tabulations bring out many interesting variations in the plant food content of the soil types found in Franklin county.

TABLE 15. FERTILITY IN FRANKLIN COUNTY SOILS.

Pounds per acre in 2 million pounds of surface soil (0 to 6 inches).

	Total Nitrogen.	Total Phosphorus.	Phosphorus soluble in weak acid.	Total Potassium.	Potassium soluble in weak acid.	Calcium soluble in weak acid.	Limestone required to neutralize acidity.	Calcium carbonate.
Yellow Silt Loam (Upland Transported)	2,200 2,640	640 1,376	12 114	16,000 24,400	218 530	1,240 2,580	288 72	
Yellow Fine Sandy Loam (Upland Transported)	2,640 2,680	2,300 1,840	216 190	24,800 23,800	168 212	2,760 1,680	54 288	
Brown Loam (First Bottom)	3,520 2,840	11,440 13,880	3,480 2,840	37,400 32,000	288 336	21,920 27,360	36 36	
Gray or White Silt Loam (First Bottom)	2,800	640	34	18,400	110	1,540	4,860	
Gray Fine Sandy Loam (River Bottom)	2,440 2,320	1,760 1,480	220 188	25,000 28,800	258 258	2,340 1,280	36 324	
Yellow Loam (Second Bottom)	2,360 2,640	6,360 7,120	1,410 2,920	26,000 33,000	226 324	5,700 16,480	36 90	
Black Clay Loam (First Bottom)	4,320 5,560	8,280 13,080	3,000 3,570	41,800 32,400	286 224	21,920 29,000	18 None	1,080. 3,080.
Brown Fine Sandy Loam (River Bottom)	3,160 2,380	8,160 2,640	2,680 730	36,400 39,200	346 220	16,800 14,100	None None	5,860. 25,340.
Yellow Clay Loam (Eden)	5,040 2,980 2,980	1,920 2,360 2,080	296 292 118	69,000 66,400 75,400	260 252 458	22,700 11,380 7,220	None None 18	23,120. 1,740. 780.
Brown Loam (Lexington)	3,000 2,760 3,180 2,640 2,800	3,200 6,440 2,760 2,900 2,720	350 1,832 484 196 220	31,600 26,400 27,400 26,600	290 256 494 348 126	3,460 10,320 4,280 2,780 4,080	72 72 36 54 72	
Yellow Loam (Cynthiana)	3,680 2,960	1,720 2,600	68 262	28,200 29,600	142 220	3,680 3,880	72 144	
Light Brown Loam (Maysville)	2,800 2,360	4,800 1,460	920 40	33,800 31,800	254 254	5,200 2,560	54 108	

TABLE 16.

Pounds per acre in 4 million pounds of subsoil (6 to 18 inches).

	Total Nitrogen.	Total Phosphorus.	Phosphorus soluble in weak acid.	Total Potassium.	Potassium soluble in weak acid.	Calcium soluble in weak acid.	Limestone required to neutralize acidity	Calcium carbonate.
Yellow Silt Loam (Upland Transported)	2,320 2,240	1,000 1,536	24 112	45,200 50,000	332 876	2,480 46,400	144 288	
Yellow Fine Sandy Loam (Upland Transported)	2,880 2,480	6,920 3,480	948 308	47,600 56,000	196 356	16,800 4,080	216 864	
Brown Loam (First Bottom)	4,400 3,280	21,680 16,880	6,680 5,240	65,600 68,000	348 456	36,480 64,640	72 36	
Gray or White Silt Loam (First Bottom)	2,720	960	48	30,800	260	1,320	18,792	
Gray Fine Sandy Loam (River Bottom)	2,800 2,560	3,640 2,592	316 104	54,800 71,200	328 324	3,920 1,960	72 3,816	
Yellow Loam (Second Bottom)	3,440 2,920	20,960 12,600	6,040 6,600	55,600 68,000	184 484	24,600 50,480	72 54	
Black Clay Loam (First Bottom)	5,120 8,480	14,800 29,040	5,400 7,100	102,400 79,200	348 188	40,000 73,400	36 None	3,280. 8,800.
Brown Fine Sandy Loam (River Bottom)	4,720 2,720 6,560	15,520 6,200 4,720	4,420 1,560 536	74.800 69,200 139,200	328 420 196	22,080 22,000 10,840	72 None None	3,760. 24,480. 206,200.
Yellow Clay Loam (Eden)	3,040 3,840	5,040 4,440	432 452	128,800 159,600	332 780	16,760 16,600	720 36	2,040.
Brown Loam (Lexington)	2,360 3,920 4,560 4,080 3,200	5,920 7,360 6,400 6,600 5,720	492 3,728 1,320 1,016 372	67,200 49,600 53,200 58,800	648 228 256 840 528	7,240 78,000 8,800 9,600 5,240	72 72 144 108 144	
Yellow Loam (Cynthiana)	4,400 3,280	3,120 6,880	104 832	52,800 62,000	252 296	6,400 7,520	144 288	
Light Brown Loam (Maysville)	4,360 2,840	15,880 2,920	5,760 36	64,000 61,600	428 312	21,126 4,840	144 3,492	

It will be seen from the tabulations that the soils low in total phosphorus and total potassium and low in soluble phosphorus and soluble calcium, and the strongly acid soils are found in the transported types which have been derived very largely from the coal measures and other higher formations. The types containing the abnormally large amounts of total and soluble phosphorus have been very largely derived from the upper Lexington formation (phosphatic horizon). The highly phosphatic sample from the light brown loam (Maysville) is a residual soil and has evidently been derived from a phosphatic limestone in the upper Cincinnatian rocks. A sample of the underlying limestone was found to contain 0.32% of phosphorus. The total potassium in the yellow clay loam (Eden) is abnormally large. This, however, is characteristic of the soil formed from the Eden rocks. It has its source from the clayey or marly layers that alternate with the Eden limestone.

The soils of Franklin County are rather typical of the Central Kentucky and Blue Grass regions. The yellow clay loam (Eden), the yellow loam (Cynthiana), and the light brown loam (Maysville), are predominating types found through thirty-five counties in Central Kentucky.* The brown loam (Lexington) is the predominating type derived from the Mohawkian rocks (1,200 square miles) and is found in the counties in that portion of Central Kentucky known as the Blue Grass region proper.

The tabulations compiled below serve to show the relative amount of fertility in the Central Kentucky soils (assuming Franklin County soils typical of the Central Kentucky region) as compared with the average of a number of analyses from various portions of Kentucky outside the Central Kentucky region, including a number of samples from the Purchase region, a number from the Western Coal Field, a number from the Eastern Coal Field, a number from the St. Louis-Chester and a number from the Waverly area.

The results of the Franklin County soils consist, with two exceptions, of the average analyses of the 27

"By "Central" Kentucky is meant the counties between the Ohio River and the Silurian-Devonian outcrop.

samples reported. In the case of the total potassium and of the limestone required to neutralize acidity, the average is calculated from 26 samples. The gray or white silt loam was so strongly acid that it was not considered in this calculation. Moreover, it is not typical of the region.

For the soils outside of the Central Kentucky region the average nitrogen was calculated from surface soils of 111 samples; total phosphorus from 109; soluble phosphorus from 100; total potassium from 82; soluble potassium from 100; soluble calcium from 98, and limestone required to neutralize acidity from 104 samples. In the subsoils the averages of all of these constituents are calculated from 67 samples, with the exception of the total potassium, which is calculated from 66 samples. The tabulations for the two series of soils are as follows:

TABLE NO. 17. AVERAGE FERTILITY IN FRANKLIN COUNTY SOILS.

	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
Surface	3,025	4,295	988	32,800	272	9,194	76
Subsoil	3,685	8,622	2,225	67,970	390	22,355	427
	6,710	12,917	3,213	100,770	662	31,549	503

AVERAGE FERTILITY IN SOILS OF KENTUCKY OUTSIDE THE CENTRAL KENTUCKY REGION.

	Total Nitrogen	Total Phosphorus	Phosphorus soluble in weak acid	Total Potassium	Potassium soluble in weak acid	Calcium soluble in weak acid	Limestone required to neutralize acid
Surface	2,174	877	22.8	26,853	345	1,613	563
Subsoil	2,018	1,270	23.07	50,357	544	2,992	15,343
	4,192	2,147	45.87	77,210	889	4,605	15,906

To the depth of 18 inches (6,000,000 pounds) the Franklin County soils contain on an average more than one-third more total nitrogen, more than six times as much total phosphorus, and more than seventy times as much phosphorus soluble in weak acid as the soils outside of the Central Kentucky region. The Franklin County soils contain on an average of about one-fourth more total potassium, but about one-fourth less soluble potassium. As determined by the weak acid solution, the Franklin County soils to a depth of 18 inches contain on an average seven times as much soluble calcium as the average of the other regions considered, while the soils outside of the Central Kentucky region require about thirty-two times as much limestone to neutralize the acidity as the soils of Franklin County.

By considering the approximate amounts of plant food removed from the soil in farm produce, as given in the table below, the fertility problems for these two sets of soils may be more easily understood.

Kind of Produce.	Pounds.		
	Nitrogen	Phosphorus	Potassium
Corn, 50 bus. grain	50	8.5	9.5
1½ tons stover	24	3	26
Crop	74	11.5	35.5
Wheat, 20 bus. grain	28.4	4.73	5.2
1 ton straw	10	1.62	13.9
Crop	38.4	6.35	19.1
Soy beans, 25 bus	80	12.9	24.07
Soy bean straw, 2¼ tons	79	7.9	48.97
Crop	159	20.8	73.04
Timothy hay, 1 ton	24	3.08	23.6
Clover hay, 1 ton	40	5.06	29.8
Cowpea hay, 1 ton	43.3	4.7	32.5
Alfalfa hay, 1 ton	50	4.53	23.9
Tobacco, 1,000 lbs. whole plant	32	3.52	36.5
Fat cattle, 1,000 lbs	25	7.08	1
Fat hogs, 1,000 lbs	18	3.03	1
Butter, 500 lbs	1.0	.19	0.1

Considering the amounts of nitrogen, phosphorus, and potassium removed from soils by grain crops, as compared with the total amounts of these elements contained in the two sets of soils given above, it appears that in both soils nitrogen is the limiting element. This is no doubt true for grain crops, even with the soils outside of the Central Kentucky region, where the phosphorus content is comparatively low. When the leguminous crops are grown and nitrogen is obtained from the atmosphere, phosphorus becomes the limiting element for soils outside of the Central Kentucky region.

The average Franklin County soils are abnormally rich in the mineral elements and with the exception of the gray or white silt loam are only slightly acid. For the average soils nitrogen is decidedly the most limiting element.

The chief factors in maintaining the fertility of Franklin County soils, consist, first, and most important, in preventing soil erosion, second, in increasing the organic matter and nitrogen content, and third, in liberating plant food from the large store of mineral elements present in these soils. Of course, for the older transported soils, especially those that run low in phosphorus and that are acid, phosphorus and limestone must be supplied before they can be brought to a high state of fertility.

AGRICULTURAL CONDITIONS.

Franklin County has, in the past, depended primarily upon agriculture, and will, no doubt, continue to do so in the future. Outside of an abundance of limestone, so far as known, her mineral resources are very limited. However, lead and barite occur in the southeastern section of the county and have been mined to some extent, and phosphate rock is found at the proper horizon. (See Report on Geology of Franklin County.)

According to the last census report, the value of farm property in Franklin County increased 53.2 per cent from 1900 to 1910. The following data from this report bring out a number of interesting facts concerning farms of Franklin County:

Average Data From the 1910 Census for the Franklin County Farms.

Average number acres per farm	73.2	
Acres improved	62.1	
Value of all farm property	$4,019.00*	
Value of land	$2,423.00*	
Value of land per acre	$ 33.11	
Value of all buildings	$ 928.00	
Value of land and buildings per acre	$ 45.77	
Value of domestic animals	$ 534.00	
Value of implements and machinery	$ 112.00	
Number head of stock (horses, cattle, sheep and swine)	16	
Number of acres of land per head of stock	4.7	
Number of acres of corn	9.9	
Number of acres of other cereals	3.3	
Number of acres of hay	4.7	
Number of acres of tobacco	3.0	
Yield of corn per acre	30.8	bus.
Yield of hay per acre	1.07	tons
Yield of tobacco per acre	818	lbs.
Value of dairy products	$ 63.00	
Value of poultry and products	$ 65.00	
Value of live stock sold and slaughtered	$ 260.00	
Gross value of crops produced	$ 665.00	
Gross income	$1,053.00	

Expense Per Farm.

Hired labor	$63.91
Feed bought	19.92
Fertilizers per farm	00.56

While these figures would seem to indicate that the average Franklin County farmer is fairly prosperous, yet, no doubt, his prosperity is more largely due to the natural fertility of his land than to a superior knowledge and practice of scientific agriculture.

Practically two-thirds of Franklin County (62.26 per cent) consist of hills ranging from rolling lands to steep hills and bluffs. The soils covering these hills are naturally susceptible to erosion when under cultivation. Most of this land is naturally adapted to the growing of

*On the average farm of 73.2 acres.

grass and legumes, which afford splendid pasturage and meadow for hay as well. The price of this land ranges from $10 to $60 per acre, averaging, perhaps, from $25 to $30. Corn, tobacco, and hay are the principal crops grown, as shown by the census report.

On almost every farm there is more or less ridge land and gently sloping hillsides that could be utilized for meadows. Hay may be made a profitable crop and there should really be much more meadow in this area.

Tobacco being an intensive crop and yielding a large income per acre, when prices are normal, is a profitable crop. It certainly has a place in the type of farming that should prevail in this hill country.

On the other hand, it is doubtful if corn ever pays expenses when the cost of production, the loss the soil undergoes due to erosion, and the cost of reseeding the land to grass are considered.

Really no rotation of cultivated crops can be devised for the type of farming that should prevail in this hilly area. It is pre-eminently a grazing country and at least three-fourths of the land should be kept in permanent pasture. Blue grass affords the most permanent pasture, while timothy, orchard grass and the various clovers, such as white, red, alsike and sweet clover, enter very largely in affording pasture. Rye is often used for pasture and no doubt vetch will play a part in the future. Alfalfa is grown very extensively in the counties farther north and will no doubt play a very important part as a hay crop in the future in Franklin County.

In the past, both cattle and sheep have been grazed by the farmers of this area. With the acreage of corn reduced, sheep may be much more conveniently and no doubt more profitably kept. With plenty of alfalfa or clover hay, but little, if any corn is needed to keep sheep. On the farms that contain a fair amount of bottom land, where corn may be profitably grown, cattle raising may be equally profitable.

Shrubs, bushes and weeds of various kinds naturally thrive on this land, and after fifteen or twenty years pastures often become rather filthy. Sheep, no doubt, keep down such filth much more than cattle. In this

connection tobacco plays an important role. After a period of fifteen or twenty years grazing, these old pastures, when cleaned up and cultivated, produce a quality of burley resembling very much that grown on virgin land. After cultivation for one or two years, such land should be immediately reseeded to meadow or pasture grasses.

Handling this land as prescribed above, namely, raising only hay and tobacco and grazing three-fourths of the land, feeding the hay and returning to the soil the manure, erosion may be almost entirely prevented and the organic matter and nitrogen content very materially increased. Also much larger quantities of the mineral elements may become available. With this system of farming adhered to these hills may, no doubt, be made to yield twice the income per acre that they now yield, cultivated in corn and other crops which decrease the organic matter and nitrogen content and favor soil erosion.

According to the 1910 census report, there were in Franklin County, including all kinds of stock (horses, cattle, sheep, and swine) more than four acres of land for each animal kept. With larger amounts of hay and forage produced, and with the pasture lands properly cared for, Franklin County could, without doubt, be made to maintain twice as many animals as it now maintains.

The three classes of soils—the transported uplands, the residual table lands, and the bottom lands—constitute 37.74 per cent, or a fraction more than one-third of the county. Corn, wheat, oats, tobacco, and hay are the principal crops grown on these soils. While some of this land is rolling, practically all of it may be cultivated if properly cared for without serious injury from erosion. These lands range in value from $20 to $200 per acre, averaging, perhaps, less than $100 per acre. The cheapest land is found in the yellow silt loam area (upland transported). This land is cheap because it is poor and unproductive. It may be built up by supplying phosphorus and ground limestone and by rotating the crops in such a way as to increase the nitrogen and organic matter content. This, of course, would necessitate a rotation with one or more leguminous crops.

The residual table lands have been in the past very generally kept in grass and grazed, while the bottoms have been more generally cultivated. In the bottoms that lie above the overflow line the soils have been generally depleted of organic matter and nitrogen from a continuous cultivation in grain crops. These soils are usually rich in mineral elements. To render them again productive will require only a system of crop rotation in which legumes are grown, all produce fed and the manure returned to the soil.

These bottom lands are generally naturally very well drained. There are, however, lands in the deserted channels of Elkhorn Creek and those of the Kentucky River that would be greatly benefited by drainage. Also some of the low lands in the wide bottoms along the present channels of Elkhorn Creek and the Kentucky River would no doubt be benefited by drainage.

By far the most important factor to be considered in maintaining and increasing the productiveness of Franklin county soils consists in building up their organic matter content. The organic acids resulting from the decay of organic matter will liberate or render soluble plant food from the large store of mineral elements present in these soils. It also increases the moisture holding capacity of soils and decreases erosion and soil washing and supplies food for the soil bacteria, etc.

APPENDIX

The following are descriptions of the Franklin County soils collected by Mr. S. C. Jones in 1913 and 1914. The samples were averages, Nos. 43574 to 43581 and 43627 to 43634 having been taken with the soil auger and the rest with the sampling tube. For the first 6 inches (0—6″) 8 to 10 cores or borings, 6 inches deep, were taken for each sample but from different spots; for the next foot (6—18″) 3 to 5 cores or borings were taken for each sample from alternate holes. The chemical analyses in the body of this report were made in the chemical laboratory of the Kentucky Agricultural Experiment Station by Mr. S. D. Averitt, except the determinations of calcium carbonate, which were made by Dr. A. M. Peter.

Laboratory No. 43574—Collected April 21, 1914, from the State Reformatory farm near Frankfort. 0—6″, second bottom. Varies from a yellowish loam to a yellowish clay loam. The 2 m.m. mesh sieve removed 0.1 per cent. of gravel.

Laboratory No. 43575—Subsoil of the preceding, 6″—18″. The 2 m.m. mesh sieve removed 0.3 per cent of gravel.

Laboratory No. 43576—Collected April 21, 1914, from State Reformatory farm, 0—6″, first bottom, brown sandy loam. River deposit.

Laboratory No. 43577—Subsoil of the preceding, 6″—18″.

Laboratory No. 43578—Collected April 21, 1914, from State Reformatory farm, 0—6″, from hillside, brown loam. Characteristic growth, oak, beech, maple, locust, and walnut. Geological position, Lexington limestone. The 2 m.m. mesh sieve removed 1.25 per cent. gravel.

Laboratory No. 43579—Subsoil of the preceding, 6″—18″. Yellowish loam or clay loam. The 2m.m. mesh sieve removed 2.7 per cent. of gravel.

Laboratory No. 43580—Collected April 21, 1914, from State Reformatory farm, 0—6″, near the top of the hill. Brown or yellowish loam. Characteristic growth, oak, beech, walnut, elm, and locust. Geological position, Lexington limestone. The 2 m.m. mesh sieve removed 0.6 per cent. gravel.

Laboratory No. 43581—Subsoil of the preceding, 6″—18″. Yellowish loam or clay loam. The 2 m.m. mesh sieve removed 3.2 per cent. gravel.

Laboratory No. 43627—Collected November 25, 1913, from farm of Howard Black, 3 miles east of Frankfort, on south side of Georgetown pike, 20 yards from pike, 0—6″. Upland. Yellowish loam. Characteristic growth, walnut and oak. No fertilizers used. In cultivation 125 years. Geological position, Lexington limestone.

Laboratory No. 43628—Subsoil of the preceding, 6″—18″.

Laboratory No. 43629—Collected November 25, 1913, on old Owenton road just off of Rocky Creek pike, on farm of B. Pierce. 0—6″. Brown loam. Characteristic growth, walnut and oak. No fertilizers used. In cultivation 75 years. Geological position, Maysville.

Laboratory No. 43630—Subsoil of the preceding, 6″—18″. Yellow clay or clay loam.

Laboratory No. 43631—Collected November 25, 1913, on Sulphur Lick Creek on west hillside, 40 rods from the mouth of Claxton Creek. 0—6″. Clay loam. No fertilizers used. In cultivation 25 years. Geological position, Eden typical.

Laboratory No. 43632—Subsoil of the preceding, 6″—18″.

Laboratory No. 43633—Collected November 25, 1913, on Elkhorn Creek bottom (in second bottom), 30 rods east of covered bridge on Peaks Mill pike. 0—6″. Bottom land, yellowish loam. No fertilizers used. In cultivation 75 years. Geological position, second bottom.

Laboratory No. 43634—Subsoil of the preceding, 6″—18″. Yellowish loam or clay loam.

Laboratory No. 43700—Collected July 6, 1914. 1 mile north of Frankfort, on farm of J. W. Jones. 0—6″. Upland, sandy loam. Characteristic growth, ash, walnut, oak, and some beech. Yields 50 bu. corn, 20 bu. wheat, 1,000 lbs. tobacco. Yields heavy, but not as good quality as limestone land. 75 to 100 years in cultivation. Geological position, old river deposit.

Laboratory No. 43701—Subsoil of the preceding, 6″—18″. Fine sandy loam.

Laboratory No. 43702—Collected July 6, 1914. 1 mile N. E. of Frankfort, on Peaks Mill pike, on second terrace, on old deserted channel of Elkhorn Creek. 0—6″. Yellow loam. Land apparently worn. No fertilizers used. In cultivation from 75 to 100 years. The 2 m.m. mesh sieve removed 0.4 per cent. of gravel.

Laboratory No. 43703—Subsoil of the preceding, 6″—18″. Clay loam. The 2 m.m. mesh sieve removed 0.5 per cent. gravel.

Laboratory No. 43704—Collected July 6, 1914, from farm of J. F. Osborne. Old Elkhorn Creek channel, 4½ miles N. E. of Frankfort. 0—6″. Black clay loam.

Laboratory No. 43705—Subsoil of the preceding, 6″—18″. Heavy black clay loam.

Laboratory No. 43706—Collected July 6, 1914. From farm of G. C. Smithers, 7½ miles north of Frankfort, on Owenton pike. 0—6″. Upland. Brownish clay loam. Very rocky (small rocks), rather typical Eden. Characteristic growth, oak, hickory, walnut, cedar, and hackberry. No fertilizers used. 30 to 40 years in cultivation. Geological position, base of Eden formation.

Laboratory No. 43707—Subsoil of the preceding, 6″—18″. Yellow clay loam.

Laboratory No. 43708—Collected July 6, 1914, from farm of Marion Colbert, in bottom just east of mouth of Elkhorn Creek. 0—6″. Yellowish loam. 60 to 70 years in cultivation. Has been in corn every year for 30 years. Geological position, river bottom and Elkhorn Creek bottom.

Laboratory No. 43709—Subsoil of the preceding, 6″—18″. Yellow or brownish loam.

Laboratory No. 43710—Collected July 6, 1914, from farm of Dan Clark, 2½ miles north of Peaks Mill in Elkhorn Creek bottom. 0—6″. Black clay loam. Characteristic growth, walnut, oak, and elm. Yields 50 to 60 bu. corn. Fine grass land. No fertilizers used. 30 to 40 years in cultivation. Bottom land.

Laboratory No. 43711—Subsoil of the preceding, 6″—18″. Heavy clay loam.

Laboratory No. 43712—Collected July 6, 1914, on farm of S. Stafford, ¼ mile below Peaks Mill on Elkhorn Creek. 0—6″. First bottom. Brown loam. Good land and yields well. No fertilizers used. In cultivation 60 to 75 years.

Laboratory No. 43713—Subsoil of the preceding, 6″—18″. Brownish loam.

Laboratory No. 43714—Collected July 7, 1914, on farm of Willard Featherstone, 40 rods above Forks of Elkhorn, in bottom on North Fork. 0—6″. Brown or yellow loam. Yields 50 to 60 bushels of corn. Has been worked hard. No fertilizers used. Cultivated 75 to 100 years. The 2 m.m. mesh sieve removed 0.2 per cent. gravel.

Laboratory No. 43715—Subsoil of the preceding, 6″—18″. Brown loam.

Laboratory No. 43716—Collected July 7, 1914, on farm of Senator Paynter, 1½ miles east of Forks of Elkhorn, on Georgetown pike. 0—6″. Upland, yellowish loam. Characteristic growth, hickory, oak, ash, elm, walnut, and maple. Yields 50 to 60 bushels of corn. No fertilizers used. In cultivation 12 years. Geological position, Cynthiana.

Laboratory No. 43717—Subsoil of the preceding, 6″—18″. Yellowish-brown clay loam.

Laboratory No. 43718—Collected July 7, 1914, on farm of James Andrew Scott, ½ mile south of Woodlake and Spring Station pike. 0—6″. Upland, brown loam. Characteristic growth, ash, oak, walnut. Yields 60 to 70 bushels of corn and 20 to 25 bushels of wheat. No fertilizers used. In cultivation 60 to 75 years. Geological position, Lexington limestone. The 2 m.m. mesh sieve removed 0.3 per cent. gravel.

Laboratory No. 43719—Subsoil of the preceding, 6″—18″. Clay loam. The 2 m.m. mesh sieve removed 0.8 per cent. gravel.

Laboratory No. 43720—Collected July 7, 1914, just west of the lock at Frankfort, in the river bottom. 0—6″. Yellow or gray fine sandy loam. Corn now growing on the land is poor. No fertilizers used. In cultivation 75 to 100 years. Geological position, river bottom.

Laboratory No. 43721—Subsoil of the preceding, 6″—18″. Yellow silt loam or fine sandy loam.

Laboratory No. 43722—Collected July 7, 1914, on farm of W. F. Poindexter, 4 miles south of Frankfort, 120 yds west of Lawrenceburg pike. 0—6″. Upland, fine sandy loam. Characteristic growth, oak, walnut, sassafras. Yields 30 to 40 bushels of corn. Small amount of fertilizers used. In cultivation 75 to 100 years. Geological position, transported material on Eden formation. The 2 m.m. mesh sieve removed 0.1 per cent. gravel.

Laboratory No. 43723—Subsoil of preceding, 6″—18″.

Laboratory No. 43724—Collected July 7, 1914. Same location as No. 43722. 0—6″. Bottom land. Gray, sandy loam. Land is naturally poorly drained.

Laboratory No. 43725—Subsoil of preceding, 6″—18″.

Laboratory No. 43726—Collected July 7, 1914, on farm of W. V. Lewis, 1½ miles south of Bridgeport, on the east side of road, 40 rods north of Louisville gas pipe line. 0—6″. Upland (transported). Silt loam. Characteristic growth, beech. Yields poorly. In cultivation 40 to 50 years. Geological position, Eden horizon, transported soil. The 2 m.m. mesh sieve removed only a few pieces of gravel.

Laboratory No. 43727—Subsoil of preceding, 6″—18″. Silt loam.

Laboratory No. 43728—Collected July 7, 1914, from 1¼ miles east of Bridgeport, north of Louisville pike, 40 rods east of a bridge. 0—6″. Upland, brownish loam. Yields 50-60 bushels of corn, 15 to 20 bushels of wheat, without fertilizers. In cultivation 50 to 60 years. Geological position, upper part of Lexington limestone. The 2 m.m. mesh sieve removed 0.7 per cent. gravel.

Laboratory No. 43729—Subsoil of preceding, 6″—18″. Brownish loam. The 2 m.m. mesh sieve removed 1.2 per cent. gravel.

Laboratory No. 43730—Collected July 7, 1914, on farm of E. H. Taylor, 1 mile west of Frankfort, on the south side of the Louisville pike. 0—6″. Upland, yellowish loam. Yields 40 to 60 bushels of corn. Land in pasture and has been for some years (bluegrass). No fertilizers used. In cultivation 50 to 60 years. Geological position, Cynthiana formation.

Laboratory No. 43731—Subsoil of preceding, 6″—18″. Yellowish loam.

Laboratory No. 43732—Collected July 8, 1914, on farm of Arch Moore, ¾ mile from Shelby county line, 50 rods east of road going north and south of road going east. 0—6″. Upland, light brown loam. Characteristic growth, walnut, elm, oak, locust. Produces good yields of common crops. No fertilizers used. In cultivation 60 to 70 years. Geological position, Maysville formation.

Laboratory No. 43733—Subsoil of preceding, 6″—18″. Yellowish loam or clay loam.

Laboratory No. 43734—Collected July 8, 1914, on farm of Exie Harrod, 20 rods east of Bald Knob high school at Saffel's store. 0—6″. Upland, yellow clay loam. Characteristic growth, red oak, white oak, walnut, sassafras, hickory, and locust. Yields 30 to 40 bushels of corn, 12 to 15 bushels of wheat. No fertilizers used. In cultivation 30 to 40 years. Geological position, Upper Eden.

Laboratory No. 43735—Subsoil of preceding, 6″—18″. Yellow clay loam.

Laboratory No. 43736—Collected July 8, 1914, just west of mouth of Stony Creek, 60 rods from river. 0—6″. Transported soil. Yellow, fine sandy loam. No fertilizers used. In cultivation 60 to 70 years.

Laboratory No. 43737—Subsoil of preceding, 6″—18″. Transported upland. Yellow, fine-sandy loam. The 2 m.m. mesh sieve removed 0.4 per cent. gravel.