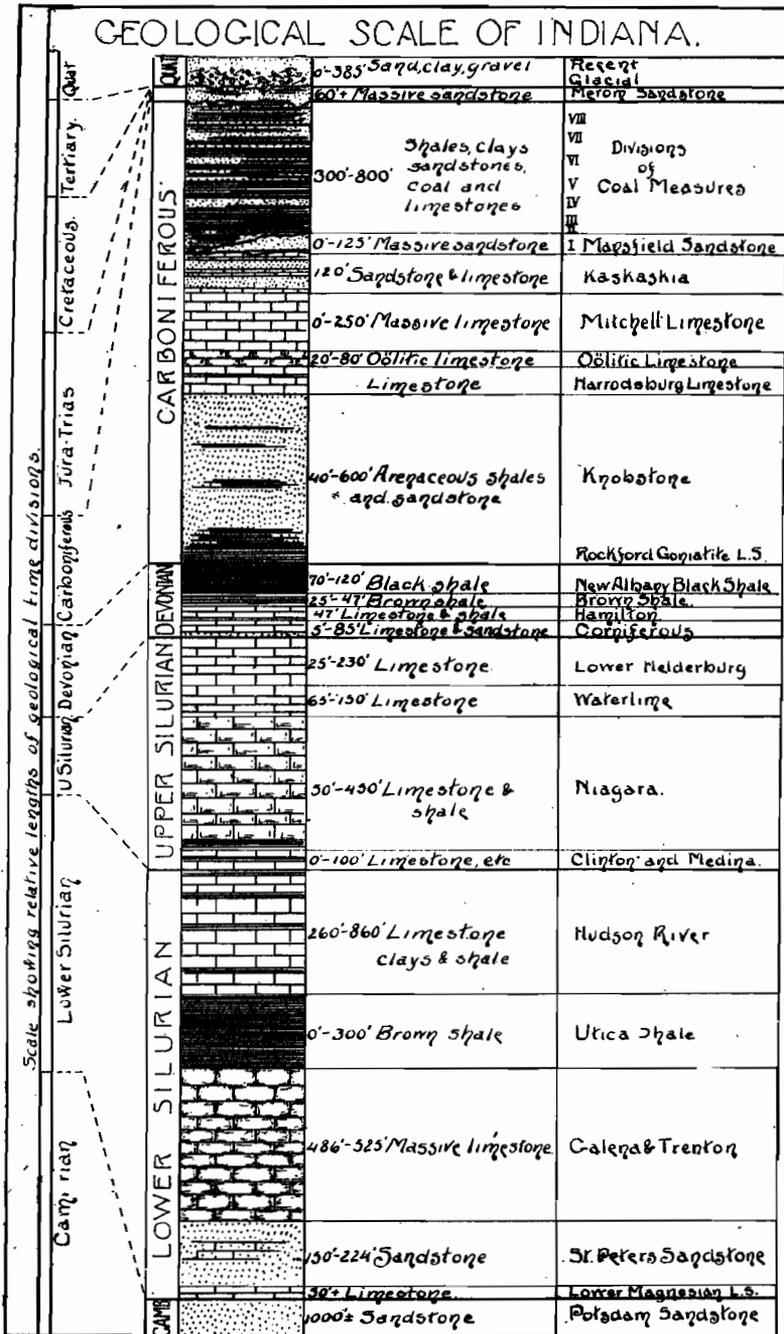


# GEOLOGICAL SCALE OF INDIANA.



## GEOLOGICAL SCALE OF INDIANA.

BY W. S. BLATCHLEY AND GEO. H. ASHLEY.

At my suggestion, Mr. Geo. H. Ashley has prepared for the present volume the accompanying table\* (Plate II.), showing a columnar section of all the rocks of the State, the time period during which each group was laid down, a statement of the character of the dominating rocks of each group, and in the last column the names given to the more important subdivisions.

**THE POTSDAM SANDSTONE.**—In most instances in which bores for gas or oil have pierced the full thickness of the Trenton limestone, the underlying sandstone has been recorded as Potsdam sandstone. It is probable, however, that Potsdam sandstone has been reached only in the deep wells at Hammond, Crown Point and La-Porte at a depth of about 600 feet below the bottom of the Trenton. At Crown Point it was pierced about 1,000 feet without reaching its base. It does not outcrop in the State.

**THE LOWER MAGNESIAN LIMESTONE.**—According to Phinney, (loc. cit. p. 625) this stratum is represented by the last 50 feet pierced by the drill at Bloomington, and probably also by the boring at Greenwood, Johnson County. It is a grayish, sandy limestone, and outcrops near Utica, Illinois, but nowhere in this State.

**THE ST. PETER'S SANDSTONE.**—This formation has been penetrated by a number of bores which have passed through the Trenton limestone, and has usually been recorded as Potsdam sandstone. It varies from a pure sandstone to a sandy limestone, and is usually of a light color. It outcrops near Utica, Oregon and Polo, Illinois, and also in Wisconsin, but not in Indiana. It is a very porous rock, well

---

\*In the preparation of this table and text Mr. Ashley and myself have drawn largely on the details given by Mr. A. J. Phinney in his paper on the "Natural Gas Field of Indiana," published in the Eleventh Annual Report of the U. S. Geol. Survey; and also upon the recent papers of Messrs. Hopkins, Siebenthal and Kindle in the last two reports of this Department; while upon Mr. Ashley's work in the field is based that portion of the table pertaining to the coal measures and overlying beds.

adapted for transmitting water, and is a common source of much of the water in many of the deep artesian wells of northern Illinois and Indiana.

**THE TRENTON AND GALENA LIMESTONES.**—This formation has become popularly known as the reservoir of most of the natural gas and oil found in the State. It is a massive stratum of limestone with a very little shale in places. Where containing gas and oil it is dolomitic in nature, and much more porous than where devoid of those bitumens. It probably underlies the entire State, with an average thickness of about 500 feet. It does not outcrop within the State, and its known closest proximity to the surface is near Lawrenceburg, where it is 348 feet below.

The upper and later portions of the Trenton are lead-bearing in Illinois and other States, and to them the name Galena limestone has been applied. These portions are darker than the typical oil-bearing Trenton, and have been struck in a number of the deep wells in northern Indiana.

**THE UTICA SHALE.**—This formation is a persistent, fine grained, dark brown or black shale, which immediately overlies the Trenton and forms the necessary impervious cover above the oil and gas-bearing portions of that limestone. In the eastern half of the State the Utica has a recorded thickness of nearly 400 feet, but grows thinner to the northwest, and seems to be wholly absent in the bores in Lake and Porter counties. It does not outcrop in Indiana, but probably underlies the greater portion of the State.

**THE HUDSON RIVER LIMESTONES AND SHALES.**—These are the oldest rocks which come to the surface in Indiana. They outcrop only in the southeastern corner of the State; forming the surface rocks over all or a portion of the counties of Switzerland, Ohio, Dearborn, Franklin, Union, Wayne, Fayette and Ripley. In several of the adjoining counties to the west they are also exposed in the ravines and deep cuts. This formation consists of bluish-green shale, bluish limestone and clays; the limestone being most prominent in the upper part of the series. The greatest recorded thickness of the formation is 860 feet. It thins to the northwest, being represented in the bores at Crown Point by only 122 feet of bluish-green shale. The upper part of the series is very fossiliferous, and has been long and extensively studied.

**THE CLINTON LIMESTONES.**—This formation, which is represented by thick deposits in some of the Eastern States, is known in Indiana only as a thin stratum of salmon brown or reddish, rather

coarse-grained limestone. It outcrops over small areas in several counties of the southeastern corner of the State,\* and has been pierced by a number of bores in the northern portions.

**THE NIAGARA LIMESTONE.**—In the stratigraphy of Indiana, this subdivision comprises the greater portion of the Upper Silurian period, forming the surface rocks in a number of counties in the eastern and northern portions of the State. The base of the formation consists of a characteristic bed of bluish-green shale ranging in thickness from 2 to 40 feet. Overlying this is a heavy stratum of limestone varying from 100 feet in thickness along the Ohio River to 440 feet in the northern and northwestern portions of the State. This limestone ranges from a sub-crystalline buff, through a bluish cryptocrystalline to a bluish-green shaly limestone. In Decatur, Franklin and Wabash counties, it is largely quarried for flagging, curbing and similar uses; and near Huntington and Delphi it is used extensively for lime.

**THE WATERLIME AND LOWER HELDERBURG.**—These are closely related limestones, whose known thickness in the State varies from 15 to 150 feet, and 25 to 250 feet, respectively. The Lower Helderburg is a buff to gray cherty limestone, which, when exposed by erosion, is often irregular and uneven in its bedding. It outcrops along the Wabash River near Logansport and farther northwest near Monon and Rensselaer. The Waterlime is chiefly represented in northern Indiana, outcropping near Kokomo, where it is extensively quarried for building material, and also near Logansport. Farther north it so merges into the Lower Helderburg that the two are difficult to distinguish.

**THE CORNIFEROUS.**—This formation is represented in Indiana by sandstones 15 to 20 feet thick, thought to correlate with the Schoharie group of New York, and by limestones 5 to 65 feet thick, correlated with the Upper Helderburg. The petroleum at Terre Haute probably has its origin in the limestone of this subdivision.

**THE HAMILTON.**—Dr. Phinney ascribes to this group a 20-foot stratum of brown calcareous shale and an overlying bed of dark gray limestone, 27 feet in thickness, which were penetrated by a bore at Goshen. The formation has not yet been recognized in southern Indiana.

**THE NEW ALBANY OR GENESEE SHALE.**—This shale, and a persistent underlying brown shale, forms the top of the Devonian system in Indiana, and has been recognized in all the deep bores

\*See paper by August Foerste, 21st Rep. Ind. Geol. Surv., 226; also paper by same author in this volume.

drilled west of its eastern outcrop. This outcrop extends from the Ohio near New Albany in a northeasterly direction through Floyd, Clark, Scott, Jefferson and Jennings counties, then northwestwardly through Bartholomew, Johnson, Marion, Boone, Clinton, Carroll and White counties. The shale forms the surface rock of an area eight to fifteen miles wide in these counties or those adjacent on the west. It is also known to be the formation immediately underlying the drift over quite a large area of the two northern tiers of counties in the State.

This shale is rich in bitumens, and when kindled will burn until they are consumed. These bitumens are, by natural processes, often separated from the shale, and in the form of gas or petroleum, are collected in reservoirs in it or underlying strata. Such reservoirs form the source of the gas and oil hitherto developed in Washington, Harrison and Pike counties. As a rule the quantity so collected is not large and the supply is, therefore, soon exhausted.

**THE KNOBSTONE.**—Overlying the Rockford Goniatite Limestone, which is a thin bed of limestone and calcareous shale forming the base of the Subcarboniferous, is the Knobstone. This formation consists of a series of alternating shales and sandstones, which, in places, reach a thickness of 600 feet. It can probably be correlated with the Waverly group of Ohio and Michigan. The Knobstone comes to the surface in a strip five to forty miles in width, extending over a portion or all of Clark, Washington, Jackson, Brown, Morgan, Hendricks, Boone and Montgomery counties. In some places the shales of this horizon will be found to be excellently adapted to the making of vitrified wares, as paving brick, sewer pipe, etc., though, as yet, their possibilities of service in this way have been ignored.

**THE HARRODSBURGH LIMESTONE.**—This subdivision, sometimes called the Keokuk, consists of limestones and shales with a total thickness of 60 to 90 feet. It forms the surface of a belt four or five miles in width between the Knobstone and the oölitic limestone. Where found it is accompanied by great numbers of geodes or "mutton heads."

**THE OÖLITIC LIMESTONE.**—This subdivision is the source of the "Bedford Oölitic limestone," so widely and favorably known as a building and ornamental material. The stone is a calcareous sandstone or freestone, differing from other sandstones in having the grains composed of practically pure carbonate of lime instead of quartz: and from other limestones in its granular texture and freestone grain. It usually appears as a massive bed, varying in thickness

from 25 to 100 feet, and in color from buff to blue. It comes close to the surface in a belt two to fourteen miles in width, which extends from Greencastle, Putnam County, to the Ohio River, through Owen, Monroe, Lawrence, Washington, Perry and Crawford counties.

**THE MITCHELL LIMESTONE.**—The name was applied by Messrs. Hopkins and Siebenthal to the series of impure limestones and calcareous shales, aggregating nearly 250 feet in thickness, which overlies the oölitic limestone. It is in this formation that the many sink-hole and caves of southern Indiana occur. Lithographic stone of good quality has also been found to be a member of the series, but as yet has not been discovered in commercial quantities.

**THE CHESTER OR KASKASKIA.**—This group, recognized by E. M. Kindle, occurs in the counties bordering the coal measures on the east from Putnam County southward. It consists of three limestones separated from each other by sandstones,\* the total thickness of the series being about 120 feet. It contains some stone suitable for building purposes.

**THE MANSFIELD SANDSTONE.**—This, the basal member of the coal measures, corresponds to the "Millstone Grit" of adjoining States. It consists of a medium to coarse-grained massive sandstone, associated with isolated deposits of conglomerate shaly sandstone, shale, coal and fire clay, the whole approximating 125 feet in thickness. It forms the surface rock over a strip of two to twelve miles in width, extending from the north part of Warren County in an east-of-south direction to the Ohio River, a distance of 175 miles. In a number of localities, notably at Attica, Williamsport and St. Anthony, the sandstone is quarried; while at Portland Mills and Mansfield, Parke County, and near Bloomfield, Greene County, are excellent deposits of a brown variety of the stone which is especially adapted for a finishing material for buildings whose fronts are composed of pressed brick. The whetstone and grindstone rocks of Orange and Martin counties are also members of this group. The kaolin of Lawrence and Martin counties also occurs near the base of this division.

**THE COAL MEASURES.**—The coal measures, including the Mansfield sandstone, occupy all of fifteen counties from Vermillion and Parke southward, and most or part of 11 additional counties extending from Benton southeast to Perry County. The rocks consist of shales, sandstones, clays, coal and limestone. Of these, the first greatly predominates. In thickness the coal measures vary from 300 to 800 feet. Measurements across the outcrop show an average of about 400 feet, but a number of deep drillings in Daviess and Knox counties indicate

\* See 20th Rep. Ind. Dep. Geol. and Nat. Res., 1886, 331.

that the lower part of the measures have been overlapped, and increase the thickness in that region to 800 feet.

The shales of the coal measures are in many places very suitable for the manufacture of paving brick, sewer pipe and allied products, and with the clays underlying the coals, are being extensively developed. The coal occurs in basins ranging from a part of an acre up to hundreds of square miles, the coal veins and accompanying strata increasing in persistency and in size of coal basins from the bottom to the top. About 30 horizons have been noted at which coal is found, though only a few of these show coal persistently. The most of the coal is obtained from five horizons, though locally, coal of good, workable thickness occurs at, at least, five other horizons. Most of the coal is of the caking bituminous variety, though much of that occurring in small basins near the bottom of the measures is either non-caking or splint (the so-called "block coal"), or semi-caking. Good cannel coal occurs locally. In thickness the beds vary up to 10 feet, the "block coal" having an average in the mines of 3 feet 1 inch, the caking coals where extensively mined, will probably average four and one-half or five feet. The "semi-block" coals will average between the others. The total thickness of coal at any given point will range up to 32 feet, but over much of the field will range between 10 and 15 feet, not more than one-third or one-half of which is workable under present trade conditions.

The coal measure sandstones, though often of considerable thickness, are seldom of desirable quality, though locally very desirable stone is found. The limestones, though thin, are usually quite persistent. Some gas has been obtained from the bituminous shales which often accompany the coal.

**THE MEROM SANDSTONE.**—This is a massive, coarse-grained sandstone, some 60 to 200 feet thick, lying unconformably on the coal measures. Its age is in doubt, being probably either Permian or Triassic. With some doubt the sandstone filling deep and broad erosion channels in the north part of the coal area has been thought to correlate with the Merom sandstone of Sullivan County. In that case this sandstone furnishes the glass sand of Coxville, the building sandstone of Silver Island, Fountain County, and elsewhere.

**TRIASSIC TO TERTIARY, INCLUSIVE.**—The only deposits of these ages known (with the possible exception of the Merom sandstone as noted) are some gravels found on certain high ridges in Martin and Perry\* counties, and possibly elsewhere. These are outside of the drift area, and above any known stream deposits of

\* See Cox, E. T.—Geol. Surv. Ind., 1872, 128.

gravel. Taken in connection with the uniformity of elevation reached by the highest hills, in the Mansfield sandstone area, the Knobstone area and the Silurian area in the southern part of the State, it has been suggested by Mr. Frank Leverett, of the United States Survey, that at least southern Indiana was reduced to base level in Tertiary time. In that case the present and preglacial topography of Indiana would date from some time in the Tertiary. This Tertiary erosion might also account for the absence of Cretaceous deposits, if any such were ever laid down in Indiana. Until more study shall have been given these gravels and their interpretation, the matter of this paragraph must be considered more as a suggestion than as a demonstrated fact.

**RECENT AND GLACIAL.**—The present surface of Indiana is a gently sloping plain, whose extremes of level are 313 and 1,285 feet above tide. More than three-fourths of the area of the State is covered with glacial drift deposited by several successive invasions of the great Laurentide glacier. The known thickness of this drift ranges from 0 to 485 feet. Its materials are, for the most part, foreign and derived from the vast area of crystalline rocks which occupy the region in which the glacier had its source. The sedimentary rocks of the northern part of Indiana were, of course, ground down by the overriding ice, the shales being reduced to clays, the sandstones to fine sand and the limestones to drift marl. These resulting materials were thoroughly mingled, not only together, but with those from the north, and spread out in a gradually thinning mass to the southward. The soils of this glaciated area of the State are, therefore, rich in the various elements which comprise the food of plants, and require a much less outlay for artificial fertilizers than the residual soils of the unglaciated portion of southern Indiana.

This driftless area comprises all or a large portion of each of the following counties: Posey, Vanderburgh, Warrick, Dubois, Spencer, Perry, Crawford, Orange, Martin, Lawrence, Monroe, Brown, Jackson, Washington, Floyd and Harrison. In addition, small portions of Gibson, Greene, Morgan, Bartholomew and Clark are included in its bounds. The greater portion of the driftless area "and the southeastern part of the drift plain is a region of deep, narrow valleys, bounded by precipitous bluffs, and separated by sharp, irregular divides. Isolated knobs and buttes are numerous; their crests and summits being from 300 to 500 feet above the valley bottoms. The streams are rapid and broken by frequent cataracts. All open into the Ohio Valley, a trench from one to six miles wide, 400 feet deep and bounded by steep bluffs."\*

\*Dryer.—Stud. in Ind. Geog., 1897, 19.