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THE LOWER LIMESTONE GROUP COAL SERIES OF  
NORTHEASTERN OHIO.

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BY COL. CHAS. WHITTLESEY.

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The late W. W. MATHER, as chief of the First Geological Survey of 1837-1839, adopted the plan of exact physical profiles—like those of a canal or railroad—with which the strata were to be connected by side levels. He perceived that the universal bearing beds, could not be determined either as to their number or position, by surface explorations only, and the opinion of Geologists based upon them. The topographical part of this system was entrusted to me, acting with himself and his assistants in the field.

By a very simple geometrical calculation, wherever the elevation of these points in any stratum is known, its inclination or dip is determined for all time. Small triangles, show the local undulations, and the larger ones the general dip—whether regular or irregular.

The engineer's level is therefore not only a reliable assistant in the solution of vexed questions, but it is an umpire. For exact work the barometer is not reliable. Its daily and hourly fluctuations are greater than the difference of altitude in many of the strata. To make it reliable requires so much repetition that the expense is greater than that of the spirit level. If precise physical Geology had been put in practice by the late Survey, its errors would not have been so numerous; its reports would have been less voluminous and costly; the confidence of the public in Geological surveys would not have been weakened, and the necessity of an immediate revision avoided.

At Zanesville the typical *Putnam Hill Limestone*, as reported by the late Prof. E. B. ANDREWS, lies 70 to 80 feet below the Upper New Lexington coal seam; also known as the Nelsonville, and

coal No. 6 of the reports. No. 5 coal, lies 31 feet above the Putnam Hill Limestone; and No. 6, 67 feet, which is about 250 feet above Lake Erie.

There are below the two coals three beds of limestone, all of them with their seams of coal directly beneath, which hold good throughout the Northeastern Ohio fields.

Prof. Orton reports a thin, calcareous seam close under No. 6 coal, at Zanesville. This group of limestone beds extends continuously through the series to the Pennsylvania line in Mahoning County, Ohio. There are sometimes *four* beds of lime rock below the pair of coal seams, above referred to, as was 5 and 6; the lowest of the four being the first limestone above coal No. 1. The thickness or vertical space occupied by this group of limestones is somewhat various, ranging from 60 to 130 feet, not depending upon the number of the beds, whether there are three or four. It is universally admitted that the two lower beds, which are generally only 25 or 30 feet apart, are the Upper and Lower Mercer limestones of the Pennsylvania Geologists extending through Ohio, at least as far as the Muskingum River, at Zanesville.

A single seam of coal, or bed of limestone, may not be a reliable horizon for geological classification, but a group of *three* or *four* such strata, of which one or two are always in sight, can be regarded as safe beyond question. By using this group as a guide, Prof. Orton has proceeded to reconstruct the order and nomenclature of the strata throughout the coal series of Northeastern Ohio, left by the late survey in hopeless confusion. The Geologists of the Pennsylvania Survey, particularly Mr. White, in Lawrence and Beaver Counties, had brought their exact work to the Ohio line in Columbiana and Mahoning Counties. They have proven, beyond argument, that the limestone at the mouth of Little Beaver, on the Ohio River, reported by Prof. Newberry to be number one, overlying No 3 coal, in the Ohio system, is the *ferri ferrous* of Pennsylvania, which lies 100 to 130 higher. This result sinks No. 1 limestone, or the lower Mercer and its No 3 coal below the bed of the Ohio and changes not the natural, but the geological position of the strata throughout more than half of Columbiana County.

I propose to go into some detail, in reference to the lower limestones in Stark, Tuscarawas and Coshocton Counties, which will

tend to sustain the innovation of Prof. Orton. In 1877 and 1878 the Cleveland, Canton & Coshocton Railroad Company employed the late Prof. E. B. Andrews and myself to examine its route from Canton to Coshocton, in reference to minerals. Its chief engineer, W. C. Jones, was placed at our disposal, and took side levels to all the exposures which we observed. With these we constructed exact physical profiles along the line, which are probably now in the office of the Connotton Railroad Company. We found the identity of coal No. 6, at the head of Simmons' Creek, about eight miles northwesterly of Coshocton, to be very doubtful, and its reported elevation, near Coshocton, to be (52) fifty-two feet too low. From Coshocton, up the valley to Uhrichsville and New Philadelphia, it was so much misplaced, generally, that I am compelled to recall and repudiate all my calculations for dip, based on the reports, which refer to No. 6 coal. To clear up the complications in that region, there must be more field work and levels, for which it is hoped the State will make provision. The elevations and calculations for dip that I offer in this paper, are confined to the limestone beds of the lower group. In these beds there are local irregularities of deposition, which are embarrassing, but they are more easily discovered than those in seams of coal; besides, in the endeavor to place the coal seams on a safe basis, it is better to use the limestone group, which must be, as a whole, conformable to, and independent of the coal seams.

To give a clear view of the difference which Prof. Andrews and myself found between the number and the position of the strata, as given in the reports of the late geological survey, for the western parts of Stark and Tuscarawas Counties and their true number and position, require diagrams that cannot here be published. Some of the results appear in a condensed form in the table of elevations for the lower limestones in that region given on the following page:

ELEVATION OF SOME MEMBERS OF THE LOWER LIMESTONE GROUP IN COSHOCTON, TUSCARAWAS AND STARK COUNTIES.

Locality.	No. of known beds.	Thickness of the Group		Upper Mercer.	Putnam Hill.	Ferriferous.	Authority.	Remarks.
		Lower Mercer.	Upper Mercer.					
Simmons Creek, Coshocton County	4	A. L. E. 400	A. L. E. 465	A. L. E. not given	A. L. E. 497	A. L. E. a	Hodges.	(a.) Perhaps Putnam Hill; One flint bed.
Near Coshocton	3	190	252				Andrews.	One flint bed.
Avondale	4	216	384	351		b	Andrews.	(b.) This bed perhaps ferriferous.
Near Steubenville, on Sugar Creek	3	423	485	444			Whittlesey	(c.) Nearly one same level, across the valley heavy bluff limestone, perhaps ferriferous.
Vicinity of Wilmot, Stark co	3	444	610	475			Whittlesey	(d.) Twenty-three feet higher coal, No. 6.
Agnues' Hill, near Forks of Sugar Creek	3	412	551	482			Andrews.	(e.) The Deardoff Limestone and the Stammers Gap Limestone come in between these beds.
Figeon Run, Summit	3	420	514	476			W. C. Jones	Coal No. 1, 318', A. Young's Shaft.
Beach City, near aqueduct.	3	417	553	485			Whittlesey	
Bolivar, northwest	3	386	450	422			"	(f.) There are signs of another bed here.
Zoar Stat'n & Miner's Point	3	300	371	329			Orton.	
Navarre, 2 miles southwest	3	385	578	542			Whittlesey	(g.) This may be ferriferous.
Navarre, 1 1/2 miles east...	3	452		477		565	"	(h) Buff Limestone. Country not high enough for the other bed seen four miles out.
Canton, one and a half miles southwest	.....	441		491			"	Country not as high as the other beds.
Greentown, 8 m's n. Cant'n	.....	450		486			"	

## DIP OF SOME LIMESTONE BEDS IN THE TUSCARAWAS VALLEY.

Triangular Space Embraced.	Strata.	Bearing.	Dip.
1. <i>Local</i> .—Simmons Creek, Morgan's Run and Avondale....	Lower Merc'r	N. 12° East..	S. 18° East, 36 feet per mile.
2. <i>Local</i> .—Morgan's Run, Avondale and Newcomerstown....	Lower Merc'r	S. 87½° East	S. 1° 30' West, 33½ feet per mile.
3. <i>Local</i> .—New Philadelphia and Dover.....	Hydraulic Bluff.	N. 40° East..	S. 86° East, 10 feet per mile.
4. <i>Local</i> .—Navarre.....	Upper Mercer	N. 69° East..	S. 21° E, 11 ft. p. m S. 42° East,
5. Zoar Station, Newcomerstown and Barrs' Mills.....	Lower "	N. 48° East..	13 feet per mile. S. 39° East,
6. Avondale, Zoar Station, and Beach City.....	Lower "	N. 51° East..	13 feet per mile.
7. Bolivar Navarre and Canton....	Lower "	N. 50° East..	S. 40° E. 9 ft. per m.
8. <i>Local</i> .—Bend of the Big Sandy, near the Tunnel.....	Upper "	N. 58° East..	S. 32° East, 16 feet per mile.

When none of the sides of a triangle exceeds ten (10) miles I regard the result as local, and affected by local irregularities. From this to twenty-five (25) miles on a side, the plane of the enclosed space should represent the inclination of the strata very closely. Beyond this the spherical figure of the earth would cause a perceptible variation from a plane. Not having access to maps of a large scale, I offer these calculations, subject to revision. They show in the lower limestone an exceptionally sharp dip to the South, between Coshocton to Newcomerstown. From the valley of Simmons Creek, where it is reported by the late Prof. Hodges to lie about 400 feet A. E. to Zanesville, the course is nearly south about twenty-five (25) miles.

The same bed is seen in the river at that place, at 112 A; having a descent of 288 feet, or about (11½) eleven and a half feet per mile. The general strike of the Limestone is nearly with the course of the Tuscarawas Valley, from Coshocton to the bend, near Trenton. This corresponds very well with the strike of No. 6 coal, which is nearly level along this line.

At Rock Run, about five miles southwesterly of Coshocton, it is about 330' A. At Morgan Run and Coshocton it is somewhat variable from 300 to 350'. At Port Washington it is reported to be 446', and at Wicksville 340.' Here the general course of the valley changes to nearly north, and the strata rises in that direction, but not rapidly. The bearing of the strata becomes more northerly and the dip more easterly, but is everywhere small.

Between New Philadelphia, Dover and Zoar, there is a hitch that requires more examination. About two miles south of the square on the east side of the valley, the so-called No. 6 coal is very irregular, varying from about 350 to 400 feet above the lake. Nearly opposite, on the west side, are old mines at 365 A. On the east side the sharpest rise is to the north, and beneath both No. 6 and No. 5 coals is the bluff or hydraulic limestone. Not far north of New Philadelphia, on the west side, this limestone is 25 feet higher than the old entries to which I have referred. If it shall be found that there is also a sharp rise in the coal on the west side, to the north, it will remove the difficulty and assist the connection with Zoar Station. In that case the Bluff Limestone fits better with the Putnam Hill. If it overlies No. 6 coal on the west side, that seam must be at least 50 feet below the No. 6 of the east side, and the old works should be on No. 4a.

After examining the above tables, the student of Ohio Geology may turn to the reports of 1870 and of 1878, where detailed sections are published at Zoar Station, Mineral Point, and Tunnel Hill. In the report of 1870 three sections are given on pages 21, 22 and 23, as the type, and guide or key, to the Geology of Northeastern Ohio. Only two beds of limestone are shown in any of them below No. 5 coal. Prof. Orton, Prof. Andrews and myself, find that there are well exposed in the same hills, and for many miles in all directions, *always three*, and sometimes *four*, beds of limestone below Nos. 5 and 6 coal, of which I have above given some of the elevations.

About fifteen to twenty feet above the second or Upper Mercer limestone, is a valuable seam of coal opened and worked at numerous places, which is also ignored.

Seven years later, after a long period of more, and as it is claimed closer, observation, the strict accuracy of these guide sections is reiterated in the following words, which may be found on page 81 of the final report, vol. 3, issued in 1878: "*At Zoar Station we have one of the most comprehensive sections in the county and one so complete and so well exposed that it has been given as a typical illustration of the Geological Structure.*" An engraved section faces the above page, representing the theory of the text, and the abstract of the printed sections of 1870. Without any hesitation, the

Upper Mercer limestone is made to play also the part of the Putnam Hill of Zanesville.

From the bend in Big Sandy, near the tunnel, its general course to Bogard is nearly with the strike of the strata, or about North-east. This line prolonged Southeasterly, passes near Zoar Station and about three miles north of Canal Dover. From the bend down Big Sandy to Bolivar, its course is nearly Northwest, or at right angles and against the dip of the beds.

In this distance of about eight miles the rise of the valley is not far from ten (10) feet per mile and the dip of the strata in the opposite direction still more, which accounts for their rapid disappearance below drainage in this space. (See table of Dips.)

Between two and three miles Southwest of Millersburg, Holmes County, at Landus & Armor's mines, are two seams of coal classed as Nos. 5 and 6. Twenty-five feet above the uppermost one, is a bed of limestone at 595 A. The elevation of the Grey limestone of Prof. Read is not so well known, but the blue or Lower Mercer is 199 feet below the one I have just referred to. This indicates that those coals belong to the Limestone Group; and, if so, should correspond to 4a or 4b, of the Ohio nomenclature.

At Rowville coals 5 and 6 are respectively 511 and 531 A, less than 50 feet below the Millersburg seams. The direction is nearly S. 75° E, and the distance about 16 miles. Unless the theory of undulations can be established, the Millersburg seams should be here about 100 feet lower.

At Shanesville near Rowville, No. 4a, or the Fisher Seam, is 107 feet below the reputed No. 6 at Landus.

Looking in the other direction, at the source of the Big Sandy, Prof. Orton has shown that the old mines at Rochester, Lynchburg, and Hanover, in Columbiana County, are not No. 6, but 7 coal. In that case the limestone, which lies about 30 feet beneath it around Hanover, and which crops out beyond the Summit, in the valleys, at the sources of the west fork of the Little Beaver, does not belong to the lower limestone group. In the same valley, up to the Yellow Creek summit, there are two more beds of lime rock at greater elevations.

Many interesting questions arise in regard to the reappearance of the Lower Limestone Group in the Yellow Creek Valley after



it disappears beneath the uplands of Carroll County, in the valley of the Big Sandy. Messrs. White and Orton have brought the Ferriferous Limestone down the Ohio from Industry to and beyond Yellow Creek. They make it correspond to the position of creek vein or seam, which the Ohio reports rated as No. 3 coal, and therefore went beneath No. 1 Limestone, or the Lower Mercer.

If Messrs. White and Orton are correct, the Ohio No. 3 lies at least 100 feet lower, and about the same distance below water level. It also follows that we have here the upper member of the limestone group of the Sandy and Tuscarawas Valley. It is refreshing to find this horizon firmly established in the Yellow Creek Valley, and on the Ohio as far as Elliottsville.

PROFESSOR ORTON: The paper is full of interest to me. Some of the anomalies suggested it is possible to unravel. The Holmes County series will come out in such shape as to satisfy Colonel Whittlesey of its continuity. There seems to be a shortening of the series in this vicinity, No. 2 here forms the upper horizon of the Mercer series. This accounts for fifty or sixty feet of shortening, No. 5 drops out, leaving No. 6 predominant. Professor A. A. White is now preparing a report of this region, and I believe that all anomalies will disappear by comparison. I think the points need study before they can be comprehended.

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