Art. XXXI.—*The Stratigraphic Position of the Hillsboro Sandstone* ;* by Charles S. Prosser.

Historical Review.
Sections on Quaker Hill.
Sections near Hillsboro.
Sections near Turkey.

HISTORICAL REVIEW.

The Hillsboro sandstone was named and described by Dr. Orton in 1871,† who stated that "As a typical example of it occurs so near Hillsboro [top of Lilley's Hill], it may be appropriately designated the Hillsboro sandstone."‡ Dr. Orton called this sandstone the upper and "6th member of the Niagara series in southwestern Ohio," and described the outcrops on Lilley's Hill as "a very fine-grained, purely silicious sandstone, about 30 feet thick, [which] directly overlies the Pentamerus beds at this point. The color of the rock varies from white to yellowish or brown, a small but varying proportion of iron seeming to account for the changes. There is a peculiar glistening appearance to the sandstone which makes it impossible to confound it with any other formation found in this part of the State."§

"The Geology of Highland County," by Dr. Orton, contains the following account of this sandstone:

"At Hillsboro, and on the eastern border of the county generally, a silicious sandstone of a good degree of purity is found terminating the [Niagara] series. Its composition is shown in the following analyses by Dr. Wormley:

Silica	94·10
Iron and alumina	3·60
Lime-carbonate	1·30
Magnesia-carbonate	0·39

The thickness of this sandstone in Lilley's Hill is 30 feet, and no greater thickness has been elsewhere observed. The sand that makes up the rock is fine-grained and but slightly cemented, crumbling easily from exposure to the weather or from mechanical abrasion. In color, it varies from white to deep yellow. There is always a glistening appearance about it which is a distinguishing characteristic of the rock. No fossils but a poorly

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† Geological Survey of Ohio. Report of Progress in 1870, pp. 271, 283–285, 301, 306, 307, 309, and figs. 1, 3, 4, 5 and 6.

‡ Idem, p. 306. § Idem, p. 306.

preserved Halysites or chain-coral, have been discovered in the sandstone. The section at Lilley's Hill shows it in its proper place as crowning the Niagara series, but as it is not covered here by any later formation, the section is not as definite and satisfactory as the section of Grady's Hill, or better still, of the Burying Ground Hill, near Samantha. In the first of these instances, the sandstone is interstratified with the Pentamerus and Megalomus beds. In the second, it is directly overlain by 15 feet of Helderberg [Monroe] limestone, proved to be so by its most characteristic fossil."*

Dr. Orton in his description of "The Geological Scale of Ohio" in 1888 apparently was not absolutely certain that all of the Hillsboro sandstone belonged in the Niagara series, as may be seen from the following quotation:

"The Hillsboro sandstone is the last element in the Niagara group. It is found in but few localities, and its reference to the Niagara series in its entirety is not beyond question. In Highland county it has a thickness of thirty feet in several sections. It is composed of very pure, even-grained, sharp silicious sand. . . . The Hillsboro sandstone is sometimes built up above all the beds of the upper Niagara limestone, but again, it is, at times, interstratified with the beds of the Guelph division. In the latter case it is itself fossiliferous, but when found alone it seems destitute of all traces of life. These sandstones in the limestone formations [Niagara and Monroe] suggest in their peculiarities a common origin."†

The same description was repeated by Dr. Orton in 1890‡ and in 1893 in the last account which he published of the "Geological Scale and Geological Structure of Ohio."§

In 1911 Dr. E. O. Ulrich in the correlation table of the "Neopaleozoic—Silurian and Devonian" in his "Revision of the Paleozoic Systems," gave the Hillsboro sandstone as the basal formation of the Upper Cayugan and equivalent in age to the Sylvania sandstone in the Monroe formation of northwestern Ohio.‖ The writer has found no reference to this formation in the text of Dr. Ulrich's monograph, and does not know the basis for this change in the age of the Hillsboro sandstone.

Later it appears in the same stratigraphic position in Dr. Bassler's "Silurian Correlation Table" in his "Bibliographic Index of American Ordovician and Silurian Fossils."¶ In this table, however, the Sylvania sandstone and the greater part of

* Idem, p. 283.
† Report Geological Survey of Ohio, vol. vi, pp. 14, 15.
‡ Idem, 3d Organization, 1st Annual Report, p. 20.
§ Idem, vol. vii, pp. 12, 13.
‖ Bull. Geol. Soc., America, vol. xxii, September, 1911, pl. 28.
¶ U. S. Nat. Mus., Bull. 92, vol. ii, November, 1915, pl. 3.

the Monroe has been raised from the Cayugan series to the Helderbergian of the Devonian.

SECTIONS ON QUAKER HILL.

It will be recalled that Dr. Orton gave the section on the Burying Ground Hill (Quaker Hill, which is also said to be called High Top), about a mile southwest of Samantha, Highland County. In July, 1915, the road down the southern side of the hill to the farm house of Mr. S. B. Benigar had been freshly graded and the gutters cleaned out so that the rocks were more clearly shown than at any other time when it has been visited by the writer. A section was measured at this time with the assistance of Mr. Kenneth C. Cottingham, which is believed to give the stratigraphic position more accurately than in any other account which is known to the writer. The section begins on top of the hill near the western side of the Cemetery and follows the road south down the hill to the house of Mr. S. B. Benigar.

Section along the highway on the southern side of Quaker Hill.

No.	Thickness Ft.	Thickness In.	Total Thickness Ft.	Total Thickness In.
15. *Ohio shale.*—Specimens of black shale out of hole for telephone pole on highway near the Cemetery. Covered interval for some distance down the highway	17	8	75	1
14. Black, fissile shale weathering to a brownish color. Exposed by roadside below the James Burns house	4	0	57	5
13. Covered interval	2	0	53	5
12. *Monroe formation.*—Brownish to grayish magnesian limestone which is not continuously exposed, since the interval is partly covered. A few fossils were found	12	0	51	5
11. Covered interval	1	0	39	5
10. *Hillsboro sandstone.*—White, fine-grained sandstone, which crushes into a fine sand and weathers on the surface to a brown or rusty color. No effervescence in cold HCl	2	5	38	5
9. Covered interval in road gutter	4	6	36	0
8. Light gray to brownish, porous rock which effervesces in cold HCl, and has a slight bituminous odor	9	0	31	6

No.	Thickness Ft.	Thickness In.	Total Thickness Ft.	Total Thickness In.
7. Light gray, rather porous limestone which effervesces strongly in HCl	11	0	30	9
6. Partly covered interval; but showing some thin-bedded layers and others which are rather thicker with coarser texture and brownish color. The lowest layer has a rather strong effervescence in cold HCl	6	1	29	10
5. Light gray to whitish, quartz sandstone with no effervescence in cold HCl. This sandstone is apparently bedded in the gutter and is the lowest one exposed on the highway. The thickness of the interval from the top of the highest sandstone to the base of the lowest one is 16 feet 8 inches	2	0	23	9
4. Thinner bedded limestone, mottled light to dark gray color, bituminous odor, fairly strong effervescence in cold HCl, and lithologically somewhat similar to the Monroe	2	11	21	9
3. *Cedarville dolomite.*—Buff as weathered, rather porous rock, with scarcely any effervescence in cold HCl, which lithologically is like the Cedarville	5	8	18	10
2. Ledge of rock on road which is obviously Cedarville; but most of the interval is covered	9	2	13	2
1. Gray, glistening dolomite which is very porous, containing holes of some size and is also bituminous. A few specimens of *Trimerella* were found. At the time this section was studied in 1915, four feet of this zone was shown in the eastern wall of the cellar that was being dug for a house on the S. B. Benigar farm	4	0	4	0

Under the lowest layer of sandstone on the western side of the highway is a 17-inch band of black rather gritty shale, and still higher, between the lower sandstone and the porous limestone of zone No. 7, black shale also occurs. This black shale was noted by Dr. Orton, for he stated " that the sandstone frequently contains thin seams of slate, not to be distinguished in any way by its appearance from the great deposit that is shown in such force in the Eastern hills of the County [High-

land] . . The Samantha Hill [Quaker Hill] also shows them in small extent. . . .

The occurrence of sandstone and black slate in the Niagara series marks the beginning of a great change in the condition of the seas that prevailed here." * The lower shale zone appears more nearly in place than those above and perhaps they were deposited with the limestone. The writer is not certain that the above explanation is correct and perhaps the black shale has only slumped down the hill, for some was seen still lower in the soil just above the Cedarville dolomite, as shown in the rock wall of Benigar's cellar.

To the east of the highway is the Charles Rogers farm, and in the first gully about opposite the sandstone outcrops in the road gutter, two layers of sandstone are exposed as shown in the following section:

Section in gully on the Charles Rogers farm.

No.		Thickness Ft.	Thickness In.	Total Thickness Ft.	Total Thickness In.
4.	*Hillsboro sandstone.*—Light colored sandstone composed of fine grains of quartz sand. Blocks with a thickness of at least 2 feet 2 inches as shown in small excavation east of old deserted house.	2	2	16	10
3.	Covered interval	11	1	14	8
2.	Layer of quartz sandstone outcropping in gully and on bank to the east, with a thickness of at least 10 inches		10	3	7
1.	Gray magnesian limestone, the top of which is apparently rather sandy	2	9	2	9

The covered interval of 11 feet 1 inch between the two sandstone layers in the above section agrees closely in thickness with that of the interval between the two sandstones on the road (Nos. 5 and 10) which is 12 feet 3 inches.

On the knoll to the east of this gully are fairly large blocks of the Hillsboro sandstone which are apparently from a broken down ledge. From the top to the bottom of these sandstone blocks on the knoll is 7 feet 8 inches; but the thickest individual block is 2 feet 2 inches. In another gully just to the east of the knoll, it is 3 feet 1 inch from the base to the top of the sandstone blocks, or 6 feet 3 inches from the base in the gully to the top of the highest sandstone block on the knoll.

This section may be represented as follows:

* Geol. Surv. Ohio Report of Progress in 1870, pp. 283, 284.

Section on knoll and in gully on the Charles Rogers farm.

No.		Thickness Ft.	In.	Total Thickness Ft.	In.
4.	*Hillsboro sandstone.*—Large blocks of very light gray to white, fine-grained, quartz sandstone. From top to base of sandstone blocks	7	8	20	11
3.	Covered interval of 2 feet 1 inch on knoll; but limestone ledge exposed in gully just to the east with interval of 2 feet 5 inches between the lowest sandstone block in the upper part of the gully and the lower sandstone layer	2	5	13	3
2.	Sandstone layer which is apparently in place	1	3	10	10
1.	Magnesian limestone which effervesces slowly in cold HCl. The rock is hard except where weathered and in lithologic appearance it resembles the Monroe more than the Cedarville. The ledge is rather blocky and rough, more like the thick-bedded Monroe, and does not contain the pores and cavities which are so generally found in the Cedarville dolomite. No fossils were found	9	7	9	7

The sandstone is apparently dipping to the west as shown by the elevation of the highest outcrops. The top of the sandstone layer in the gully as leveled is 1 foot lower than the top of the sandstone block on the knoll to the east, or 5 feet by the barometer; while the top of the highest layer of sandstone in the road gutter is 5 feet lower according to the barometer than the top of the upper sandstone layer in the gully to the east.

In the field to the west of the road on land owned by Mrs. Ellen Burns are outcrops of rocks and three small quarries in the limestone have been worked to some extent. The following section was made in this field:

Section on the Mrs. Ellen Burns farm.

No.		Thickness Ft.	In.	Total Thickness Ft.	In.
7.	*Ohio shale.*—Base of black shale outcrop on the road.				
6.	Covered interval. As leveled by Mr. Walter A. Verwiebe from the top of the limestone in the third quarry to the				

No.		Thickness Ft.	Thickness In.	Total Thickness Ft.	Total Thickness In.
	base of the outcrop of the Ohio shale on the road is 4 feet 10 inches. From the top of the same limestone to outcrops of Ohio shale in gullys to the northwest is 10 feet by the barometer. On the surface above the top of this quarry are loose blocks of white, fine-grained, quartz sandstone, similar lithologically to the upper layer of sandstone in the road gutter	4	10	35	2
5.	*Monroe dolomite.*—Compact, light to bluish-gray, hard rock, which is somewhat porous, and contains some fossils. The upper part of this zone is shown in the highest or third quarry	8	10	30	4
4.	Rather massive layer, somewhat granular, rather porous and effervescence fairly strong in cold commercial HCl. This layer forms the top of the middle or second quarry and is rather similar lithologically to the porous 11-inch stratum (No. 7) in the road gutter	2	6	21	6
3.	Drab or brownish to gray rock weathering to a very light gray which is fairly compact, lithologically like the Monroe dolomite, and contains a few fossils. In the floor of the quarry are irregular dome-like elevations similar to masses that are not infrequently found in the Monroe. The rock has been quarried and crushed to some extent for highways	6	6	19	0
2.	Covered interval	5	5	12	6
1.	*Cedarville dolomite.*—Porous, buff to gray rock which effervesces strongly in cold commercial HCl. At the bottom of this lowest or third quarry is a heavy layer, and this zone has the lithologic appearance of the Cedarville; although perhaps not all of the upper part of this quarry belongs in the Cedarville. No fossils were found	7	1	7	1

Across the gully to the east of the middle quarry in the above section are loose blocks of light gray, quartz sandstone which are evidently from a broken-down stratum of the Hillsboro sandstone. These loose sandstone blocks occur in a vertical interval of 6 feet and the lowest ones, as leveled across the

gully, lie a little lower than opposite the base of the massive layer (No. 4) at the top of the quarry. The top of the massive layer (No. 4) at the top of the middle quarry, according to one reading of the barometer is 5 feet, and as leveled by Mr. Cottingham 6 feet, lower than the top of the 11-inch porous layer (No. 7) of the road section, which it resembles lithologically. The 9-inch brownish, porous limestone (No. 8) of the road section, perhaps might be united with the underlying 11-inch layer, and then above this limestone zone is a covered interval (No. 9) of 4 feet 6 inches before the base of the exposed upper layer of Hillsboro sandstone (No. 10) is reached. It is very possible that more or less of this covered interval may belong in the sandstone zone. At least it appears probable that the zone of loose blocks of sandstone to the west of the highway represent the continuation of this upper zone of the Hillsboro sandstone, and stratigraphically below it is the middle quarry of limestone containing Monroe fossils.

The fossils collected in the Monroe dolomite of Quaker Hill have been studied and identified by Miss Rose Gormley, who is making a thorough study of the entire Monroe fauna of Ohio, and are concurred in by the writer. On the highway in No. 12 of that section, which is above the Hillsboro sandstone, the following species were found:

1. *Hindella? (Greenfieldia) whitfieldi* Grabau. This species was identified by Whitfield as *Meristella bella** and is reported by Grabau as "Common in the Greenfield dolomite at Greenfield, Ohio." †

2. *Hindella? (Greenfieldia?) rotundata* (Whitfield) Grabau. This is apparently the species that was identified by Whitfield as *Nucleospira rotundata* from Greenfield, Ohio, and is listed by Bassler as *Whitfieldella rotundata.*‡ Grabau states that "The species described by Whitfield occurs in the Greenfield dolomite of Greenfield, Ohio, where it has been obtained as external and internal molds, often indistinguishable from the internal molds of *Hindella (?) whitfieldi*, the originals from which Whitfield's descriptions were made have not been seen, and none of the specimens from Greenfield, Ohio, in the collection of Columbia University show the characters of this species." § The specimens are all in the form of external or internal impressions in which condition it is difficult to separate the two species; but part of the specimens are ventricose with strongly incurved beaks, which are the most important distinguishing characters given for this species.

* Ann. N. Y. Acad. Sci., vol. v, p. 510, pl. V, figs. 8-10, 1891; and Report Geol. Surv. Ohio, vol. vii, p. 412, pl. I, figs. 8-10, 1893.

† Michigan Geol. and Biol. Survey, Pub. 2, Geol. Ser. 1, p. 149, 1910.

‡ U. S. National Museum, Bull. 92, vol. ii, p. 1330, 1915.

§ Michigan Geol. and Biol. Survey, Pub. 2, Geol. Ser., 1, p. 151, 1910.

3. *Leperditia ohioensis* Bassler. This is the species which Whitfield identified as *L. alta* from Bellevue, Sandusky County, Ohio, and Grabau in 1910 renamed *L. altoides*, and gave for additional distribution the "Greenfield dolomite of Greenfield and Ballville, Ohio."* The name of *L. altoides*, however, was given by Weller in 1903 to a species in the Decker Ferry formation of New Jersey† and on account of this preoccupation Bassler has renamed the Ohio specimens *L. ohioensis.*‡

In the field on the Mrs. Ellen Burns farm, in No. 5 of that section, a few rods to the west of the road, and apparently stratigraphically above the Hillsboro sandstone, the following species were collected:

1. *Hindella? (Greenfieldia?) rotundata* (Whitfield) Grabau.

2. *Rhynchospira præformosa* Grabau.

These specimens are apparently identical with those from Greenfield, Ohio, which Whitfield identified as *Retzia formosa*, the species that Hall used as the type for his genus *Rhynchospira*. One of the specimens described by Whitfield is in the Geological Museum of Ohio State University, and it is true that it is smaller than the adult forms of *Rhynchospira formosa* Hall; but among the specimens from Quaker Hill are larger ones which it is difficult to separate from medium-sized specimens of *R. formosa*. The type specimens of *Rhynchospira formosa* Hall are from the New Scotland formation of the Helderbergian series in the Helderberg Mountains of Albany County, New York. The species has, however, been identified by Maynard in the Keyser member of the Helderberg formation in Maryland and West Virginia,§ which is the oldest member of the Helderberg formation of those states, underlying the Coeymans member or limestone. Still earlier the species had been identified by Weller in the Decker Ferry formation of New Jersey,‖ which he believed was the southern extension of the Coralline limestone of New York that belongs in the Cayugan series, and has been renamed the Cobleskill limestone. Dr. Swartz of the Maryland Survey, however, correlates the Decker Ferry formation with the lower or *Chonetes jerseyensis* zone of the Keyser member,¶ and this latter correlation is apparently accepted by Bassler.**

* Idem, p. 205.

† Geol. Surv. New Jersey. Report on Paleontology, vol. iii, pp. 63, 252, pl. XXIII, figs. 1, 2.

‡ U. S. National Museum, Bull. 92, vol. 1, p. 704, 1915.

§ Maryland Geol. Survey, Lower Devonian, p. 426, 1913.

‖ Geol. Survey of New Jersey. Report on Paleontology, vol. iii, p. 240, 1903.

¶ Maryland Geol. Survey, Lower Devonian, p. 98, 1913.

** U. S. National Museum, Bull. 92, vol. ii, 1915, pl. 3—Silurian Correlation Table.

3. *Leperditia ohioensis* Bassler.

The four species listed above from the Monroe limestone overlying the Hillsboro sandstone on the southern slope of Quaker Hill all occur in the Greenfield dolomite at Greenfield. The three species of brachiopods were all reported by Whitfield from the hydraulic limestone or waterlime beds of the Lower Helderberg group [Greenfield dolomite] of Greenfield, Ohio, and Grabau in his monograph on the Monroe formation has not increased the range or localities of these species. The *Leperditia ohioensis* is given by Grabau as occurring in the Greenfield dolomite both at Greenfield and Ballville, Ohio, and in addition in the lower Monroe formation of Bellevue, Ohio. So far as the evidence of these fossils goes it shows that the limestone overlying the Hillsboro sandstone on Quaker Hill may be correlated with the Greenfield dolomite of Greenfield.

A few fossils were also found in the middle quarry on the Mrs. Ellen Burns farm, which is apparently stratigraphically below the upper zone of the Hillsboro sandstone. The two following species were collected in this quarry:

1. *Hindella?* (*Greenfieldia?*) *rotundata* (Whitfield) Grabau.
2. *Leperditia ohioensis* Bassler.

The specimens of *Leperditia* are the more abundant and both of the above species occur in the Greenfield dolomite, as has already been stated. It is also to be noted that both species, so far as known, are restricted to the Monroe formation, and this together with the lithologic appearance of the rock seems to prove conclusively that the upper zone of the Hillsboro sandstone on Quaker Hill occurs in the Monroe formation in the Cayugan series instead of at the top of the Niagaran series.

In the highway section is a lower zone of sandstone (No. 5), the top of which is 12¼ feet below the lowest exposure of the upper sandstone stratum (No. 10). All of this intervening rock has the lithologic appearance of the Monroe and although fossils were not found in the exposures along the highway, still it is believed to belong in the Monroe. Also below the lower sandstone stratum is a zone of thin-bedded limestone, 2 feet 11 inches thick, which lithologically is fairly similar to the Monroe; before the buff, porous rock is reached which is considered as belonging in the Cedarville dolomite. Fossils were not found in the upper two zones (Nos. 2 and 3) of the Cedarville, which have a thickness of 14 feet 10 inches; but about two-thirds of this interval is covered and the opportunity for hunting fossils along the road is not good. In the next lower zone (No. 1), 4 feet of which was shown in the excavation for

the Benigar house, specimens of *Trimerella* (a genus that according to Schuchert is confined to the Guelph and Niagara of the United States and Canada and the Upper Silurian of the Baltic region in Europe) were found, and the lithologic appearance of the rock is that of the typical Cedarville dolomite, so that apparently there is no question as to this rock belonging in that formation.

SECTIONS NEAR HILLSBORO.

It is, of course, possible that the sandstones described by Dr. Orton at several localities in Highland County may occur at more than one horizon. This apparently is true if Dr. Orton's statement is correct that "the sandstone is interstratified with the Pentamerus and Megalomus beds"* in the Grady's Hill section, four miles north of Hillsboro. The outcrops along the pike from Hillsboro to Samantha were carefully examined, and rock with the lithologic characters of the Cedarville dolomite was found to within 15 feet of the top of the hill at the four corners near the house of Charles F. Chaplin. Mr. Chaplin stated that he had never seen sandstone on his farm, and the nearest outcrop he knew is on Lilley's Hill, to the east of Hillsboro.

The top of Lilley's Hill, about one mile east of the Parker Hotel in Hillsboro, is the locality from which Dr. Orton named the sandstone. The pike from Hillsboro to Marshall crosses this hill and gives the best outcrops to be found on it; but they are not continuous and the sandstone occurs in loose blocks, apparently from a broken down ledge.

Section of upper part of Lilley's Hill.

No.	Thickness Ft.	Thickness In.	Total Thickness Ft.	Total Thickness In.
3. Top of hill in field above highway. Covered. Seven feet as leveled by Mr. Wendell Z. Miller	7	0	31	6
2. *Hillsboro sandstone.*—Loose blocks of fairly massive, light gray to brownish-gray, friable, quartz sandstone, near the summit of the hill, on the northern side of the highway, opposite the house of Lea Williams. Lower part of zone mostly covered. Ten feet according to the barometer, and 9½ feet as leveled by Mr. Miller	9	6	24	6

* Geol. Survey Ohio, Report Progress in 1870, 1871, p. 283.

No.	Thickness Ft.	Thickness In.	Total Thickness Ft.	Total Thickness In.
1. *Cedarville dolomite.*—Light gray to buff, porous rock, part of which contains numerous large specimens of *Pentamerus oblongus* Sowb. Fifteen feet exposed according to the barometer ----	15	0	15	0

Dr. Orton stated that the sandstone is shown at this locality "in its proper place as crowning the Niagara series,"* with a thickness of 30 feet. It appears at present impossible to say whether all the summit of the hill above the top of the exposed Cedarville dolomite (No. 1) is sandstone or not. If it is, however, then as leveled by Mr. Miller it is only 16½ feet from the top of the outcropping Cedarville dolomite containing numerous specimens of *Pentamerus oblongus* Sowb., to the summit of the hill.

SECTIONS NEAR TURKEY.

Dr. Orton stated that "other localities at which it [Hillsboro sandstone] occurs are principally to be found at the foot of the slate hills on the eastern side of the county. The following named points give good exposures: The Marshall and Sinking Spring road near the house of John Bell, Esq.; the farm of Hon. J. L. Hughes; the foot of Stult's Mountain; the Caves of Rocky Fork."† All of these localities, with the exception of the Hughes farm, were located, and the outcrops on and near the farm formerly owned by John Bell, now owned by D. E. Stewart, were found to be the best. This locality is about 5 miles southeast of Marshall and 1 mile southeast of Turkey on the pike from Marshall to Sinking Spring, and 3 miles northwest of the last-named place, in Brush Creek Township. At the first four corners southeast of Turkey is the house of A. L. Rhoads, and on the eastern side of the north and south road on the Stewart farm, a short distance south of the Rhoads house, is a small quarry in the so-called "marl" of this region, which has been worked for the highway. In this quarry is a sandstone which is lithologically like the Sylvania sandstone; but apparently does not extend entirely across the quarry. The following section of this outcrop was made:

Section on the D. E. Stewart farm.

No.	Thickness Feet	Total Thickness Feet
3. Drab limestone lithologically like the Monroe and rather harder than the lowest zone in the quarry. No fossils were seen ----------	5±	9±

* Idem, p. 283. † Idem, p. 283.

No.	Thickness Feet	Total Thickness Feet
2. *Hillsboro sandstone.*—Light to darkish gray, very friable sandstone composed of grains of quartz sand	1±	4±
1. Drab, porous limestone; but no fossils were seen	3±	3±

On the other side of the north and south road in the field, a few rods below the house of Mr. Rhoads, is the thickest ledge of the Hillsboro sandstone that was found in this region.

Section on the A. L. Rhoads farm.

No.	Thickness Ft.	Thickness In.	Total Thickness Ft.	Total Thickness In.
3. *Hillsboro sandstone.*—Dark gray sandstone composed of quartz grains and much of it is friable although some of it is harder	3	2	6	8
2. Perhaps covered interval		6±	3	6
1. The so-called "marl" which is a drab, rather soft limestone that crumbles on weathering	3	0	3	0

On the pike just northeast of the A. L. Rhoads' house, and by the barometer 5 feet lower than the quarry on the Stewart farm, is an outcrop of about 8 feet of black, bituminous shale, which evidently is the Ohio shale.

Another outcrop of the sandstone is shown on the north and south road a few rods north of the four-corners and house of Mr. A. L. Rhoads, where the following section was measured:

Section on road north of Mr. A. L. Rhoads' house.

No.	Thickness Feet	Total Thickness Feet
3. *Hillsboro sandstone.*—Dark gray, friable sandstone composed of grains of quartz sand	1½±	18
2. The so-called "marl" which is used for highways. Drab colored, rather granular limestone in which no fossils were found, that is supposed to be Monroe	14+	16½
1. Massive drab-colored limestone at base of road section, which contains *Favosites*, and possibly belongs in the Cedarville dolomite	2½	2½

On the A. L. Rhoads' farm to the west of the north and south road is a ledge of dark gray, friable sandstone composed of grains of quartz sand, with a thickness of 1½ feet.

The sandstone is also shown on the northern side of the Marshall-Sinking Spring Pike, northwest of the house of Mr. D. E. Stewart, which is the one formerly occupied by Mr. John Bell.

Section on Pike northeast of the D. E. Stewart house.

No.	Thickness Ft.	In.	Total Thickness Ft.	In.
3. *Hillsboro sandstone.*—A ledge by the side of the highway, which is more or less broken down, of light to dark colored, friable sandstone, composed of grains of quartz sand. Mr. Stewart stated that this sandstone caps most of the knolls in this locality	2	10	15	10
2. Covered interval	10	0	13	0
1. The so-called "marl," drab limestone which crumbles on weathering	3	0	3	0

It is not certain that all of these outcrops of sandstone near Turkey occur at the same stratigraphic position; but lack of time prevented the writer from carefully investigating this point. It is not improbable that they belong in two horizons similar to the outcrops already described on Quaker Hill.

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