P#11

GEOLOGICAL SURVEY OF OHIO

File No. 562

Sample #970

CORE RECORD

County Ross Twp. Huntington Quad. Roxabel

Lot ..... Quarter ..... Tract ..... Section .....

Measured ..... Ft. From ..... line and ..... Ft. from ..... line of .....

Property owner The well is located on the Hirsch Orchard Farm about two and one-half miles southwest of Chillicothe, Ross County, Ohio. The elevation of the well about 880 feet. A.T. The depth is 577 feet.

Hole No. ..... Purpose of core .....

Driller .....

Drilling company .....

Drilled for .....

Logged by ..... Date .....

Elev. 880' Datum for elevation ..... Diam. of core .....

Direction of hole: Vertical ..... Angle ..... Started ..... Completed .....

Elev. of ground water ..... Samples: Washed ..... Dry ..... Other .....

No. of core boxes 163 Disposition of core Stored by O.G.S.

Remarks Copy of detailed log of Chillicothe test-core on which J. E. Carman based the "Geologic section of the Chillicothe test-core" (Ohio Journal of Science, vol. XLVII, #2, 1947) as an aid for examination of the original core, courtesy of Dr. Carman. MRW

TOP	BOTTOM Ft.	BOTTOM In.	THICKNESS	DESCRIPTION
0	6	6	1	Clay and broken ss. (mantle rock)
	7	6	2	Black fissile sh. (Sunbury shale)
				Lingula and Orbiculoidea which are commonly present at th base of the Sunbury were collected from shale thrown from a reservoir pit.
				Berea Sandstone. 25'6"
	12	6	3	Medium to coarse grained, buff to yellow ss. Much weathered and broken and with a thin vertical ferruginous vein 1/8" thick.
	15	3		4,5,6 Medium grained, blue-gray ss Lower part argillaceous with minute pyrite graine. Upper part weathered buff and laminated, with iron stain.
	17	3	7	Medium grained, buff, laminated ss
	27	3	8	Medium grained, Blue-gray ss., with a few shaly laminae.
	30	0	9	Blue-gray, argillaceous and shaly ss Core badly broken. Shaly parts lost.
	33	0	10	Blue-gray, slightly argillaceous ss. with irregular partings of clay shale.
				The base of No. 10 is the base of Berea sandstone. The base of the sandstone is uneven against blue clay-shale below. The change is abrupt and there is a vertical irregularity of 1-½ to 2" in the width of the 3" core. There is no suggestion of an elasped time interval but the irregular contact and the abrupt change supports placing the contact here.

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TOP	BOTTOM Ft.	BOTTOM In.	THICKNESS	DESCRIPTION
33'0"	36	7	11.	Thin layers and lenses of blue-gray or buff ss. with thinner irregular partings of blue-gray sh.
				The layers are undulating or inclined with cut-and-fill structures. In the shale partings on the face of the core are many small rounded areas of sandstone, apparently rod-like masses parallel with the bedding of the shale and possibly worm- trail fillings. They are present in all the interbedded shale and sandstone zones of the upper part of the Bedford.
	37	9	12.	Medium grained, blue-gray of buff ss.
				The base of zone 12 is an alternative horizon for the base of Berea sandstone. It would place this 14" layer of sandstone in the Berea, but would also include No. 11, consisting of interbedded thin layers and lenses of sandstone and shale, which is characteristic of the zones lower down. It would give 30'3" of Berea for this core. I prefer the base of zone 10 for the base of the Berea. Any horizon chosen is more or less arbitrary.
	39	11	13.	Alternating thin layers and lenses of blue-gray ss. and sh. in proportion of about 2 to 1 with some ss. layers 1" to 2" thick. Rod-shaped masses of sandstone in the shale.
	40	4	14.	Blue argillaceous ss.
	43	4	15.	Interbedded thin layers and lenses of blue-gray ss. and dark blue sh. with many rod-like masses of sand.
	43	8	16.	Blue-gray ss. layer
	55	1	17.	Interbedded thin layers and lenses of blue-gray ss. and dark blue sh. The sh. increases downward and is dominant in the lower half where the ss. is chiefly in lenses.
	55	4	18.	Blue-gray ss. layer
	75	7	19	Interbedded thin layers and lenses of blue-gray ss. and dark blue sh. in about equal amounts or somewhat more sh. Rod-like ss. structures prominent
	75	10	20	Blue-gray ss. layer
	81	1	21	Dark blue sh. with layers or lenses of ss. Sh. dominate about 2 to 1.
	81	4	22	Blue-gray ss. layer.
	82	2	23	Dark blue sh. with thin layers of blue-gray ss.
	82	4	24	Blue-gray ss. layer.
	85	7	25	Dark blue sh. with thin laminae and lenses of blue-gray ss. Rod-like structures of ss. are few.
	85	10	26	Blue-gray ss. layer

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TOP	BOTTOM	THICKNESS	DESCRIPTION
	Ft. In.		
85' 10"	90 3	27	Dark blue shale with thin layers and lenses of ss. Rod-like structures of ss. absent in this and lower zones.
	90 4	28	Blue-gray ss. layer
	90 11	29	Dark blue sh. with laminae and lenses of ss.
	91 0	30	Blue-gray ss. layer.
	97 2	31	Dark blue sh. with thin laminae and lenses of ss. in rat of about 3 to 1
			Sandstone layers ½" thick at 23", 25" and 39" below top.
	97 6	32	Blue-gray ss. layer
	98 0	33	Dark blue, laminated shale with a few thin laminae of ss
	98 3	34	Blue-gray ss. layer
	100 9	35	Dark blue sh. with few thin layers of ss. in upper half. Lower half breaks down to clay shale.
	101 0	36	Blue-gray ss. layer.
	101 11	37	Dark blue laminated shale with thin partings of ss.
	102 1	38	Blue-gray ss. layer
	108 1	39	Dark blue sh. with a few thin laminae of ss. in upper and lower parts. The middle third weathers to clay-sh. and shows folded and contorted structures
	108 2	40	Blue-gray ss. layer
	111 9	41	Dark blue sh. with a few thin laminae of ss. in upper an lower parts and ½" layer of ss. at 1' above base. Middle part without laminae and shows contorted structure.
	111 10	42	Blue-gray ss.
	119 0	43	Dark blue shale
			The upper 15" contains a few thin sandy laminae. The next lower 2' is very dark blue laminated shale. The lower half is more massive and breaks down readily on exposure.
	119 9	44	Blue-gray clay-shale
	124 3	45	Blue-gray sh.
			Upper part check up readily in box.
			This is the basal unit of the Bedford shale. In it were found the fossils, Lingula and Orbiculoidea, and probably other fossils are present as in Franklin Co. Zones 11 to 45 which form the Bedford shale have a total thickness of 91'3" for the bedford. The base is at depth of 124'3".
			Ohio Shale. 376'3"
	128 8	46	Black sh.
			Core firm and smooth but splits along bedding planes on drying.

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TOP	BOTTOM	THICKNESS	DESCRIPTION
	Ft. In.		This zone furnished a number of fossils: Several specimens of a small elongated Lingula. These are small, black, glossy fish plates 1/32" to 1/16" across. Five or six different kinds were recognized by difference in shape and markings. Minute, black, glossy spines, some short and thick, others long and slender. Some of these appear hollow at larger end and may be fish teeth. Several types of conodonts were seen. Sporangia on several surfaces.
128' 8"	129 6	47	Black sh. with good Lingula, Many Conodont fragments, several good fish plates and a few sporangia. Somewhat gray-black on core sides.
	133 9	48	Black sh. in firm core. Contains Lingula, Conodonts, spines, a few fish plates and sporangia.
	134 5	49	Black sh. Somewhat gray on core surface
	149 7	50	Black sh. in firm core with pyrite nodules, 3'4" below top Contains good fish plates, many Lingula, Conodonts, spines and abundant sporangia near middle of zone.
149' 7"	164 1	51	Black or slightly grayish black sh. Core firm and smooth Some slightly arenaceous laminae in top 2" and a few lower in the zone. Pyrite nodules at 3'7" below top. A few Lingula and fish plates seen.
	192 1	52	Black to grayish black shale. Surface of core slightly uneven, shale slightly laminated and slightly arenaceous. Pyrite layer ½" thick at 4'5" below top. Sporangia abundant. Just above Ohio shale level 42 is a very thin, light colored, calcareous parting, the highest one noted. At 44'8", Ohio level, are three closely spaced calcareous partings about 1/32" thick which lie in part on the surfaces of the split shale. They are fillings deposited along the laminae planes of the shale. The calcite is here associated with pyrite concretions, occurs along the contact of the pyrite with the shale and certain calcareous partings abut against and are terminated by the pyrite concretion. Other calcareous partings were noted at 44'10", 45'6", 50'6", 54'3", 55'6", 57', 62' and 63'. At 45'9" is a ¼" thick layer in which little nodules or irregular masses of brownish-gray, highly clacareous material is mixed

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TOP	BOTTOM	THICKNESS	DESCRIPTION
	Ft. In.		
			with the black shale so intimately as to indicate contemporaneous origin. The calcareous nodules have weathered out in part giving a vesicular stone.
192' 1"	192 3	53	Gray, finely laminated, somewhat porous, strongly calcareous layer. This is the thickest of several thin layers of this material.
	195 8	54	Black shale
			At 2' below the top there is a black, glossy carbon film like albertite 1/16" thick and an impression that may be a fish spine. Six inches lower is a thin veritcal pyrite vein with a calcareous film at the border. Six inches above the base is a layer of blue-gray shale andthin calcareous partings. Sporangia present and a conodont seen. Base at end of section 36.
	197 4	55	Black sh. with a 2" layer of blue-gray sh. 6" above base.
	198 9	56	Blue-gray sh.
	206 11	57	Black to grayish-black sh. with 2" layers of blue sh. at 8" below and 1' above base. Two small rectangular fish plates 1/8" across with striated lower edge were seen.
	208 2	58	Blue-gray sh. the basal ½" being gray, laminated, calcareous material, similar to zone 53.
			Several large Lingula 5/8" long and 4/8" broad were found in the upper half of the zone. They are notably larger than those commonly found in the black shale.
	214 7	59-60	Black and grayish-black sh. with a few thin layers of blue-gray sh. A thin ½" layer of gray calcareous material at 4" above base at 90' Ohio shale depth. A few sporangia seen.
	218 3	61	Blue-gray sh. In the upper 6" the large, broad Lingula and the elongat small Lingula were found on the same surface.
	220 8	62	Black to gray-black sh. with ¼" layer of gray calcareous stone at the base.
	226 2	63	Black with some grayish-black sh. Fish plate near middle of zone.
	246 5	63	Black to grayish-black shale

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TOP	BOTTOM	THICKNESS	DESCRIPTION
	Ft. In.		
			Banded, porous, calcareous layer ½" thick at 6'6" below top. Pyrite nodules at 6" and at 7'3" below top. Base at bottom of section 46.
246' 5"	256 11	65	Black and grayish black sh. with a 6" layer of blue-gray sh. 3' below top and four thin, gray, calcareous partings between 9" and 15" below the top. A few sporangia are present.
	257 4	66	Blue-gray sh. with a ¼" gray, calcareous layer at the base.
	258 0	67	Grayish black sh.
	258 5	68	Blue-gray sh. with a gray calcareous parting at base
	266 5	69	Gray-black to black sh. with a 3" layer of blue-gray sh. 2' above base.
			Gray calcareous parting 4'8" below top and pyrite nodules about 2' above the base. Some sporangia were seen.
	267 0	70	Blue-gray sh.
	365 5	71	Gray-black sh. with a few thin layers of blue-gray sh.
			This is a firm, uniform, somewhat banded shale making a core with a smooth surface. The banding is due chiefly to very thin, lighter colored partings that show well on the wall of the core but not on the split bedding surface. At some levels these partings become thicker up to 1/64" to 1/32" and these are calcareous. Marcasite nodules ¼" to ½" across are at intervals of about 10'.
			A few fish plates were found in the upper part of the zone. Sporangia are present throughout the zone and fro 60 to 80' below the top they are locally so abundant as to practically cover certain bedding surfaces giving a brownish color to the shale. In the lower half of the zone there are small rounded or elongate carbonaceous film specimens many of which show finely pitted surfaces.
	376 8	72	Gray-black sh. with sporangia and carbonaceous films
	436 3	73	Gray-black sh. with a very few thin bands of blue-gray sh. Marcasite nodules about 1" across are present at intervals of 5' to 10".
			Two specimens of fish plates were found. Sporangia

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TOP	BOTTOM	THICKNESS	DESCRIPTION
	Ft. In.		
			are present throughout the zone and so abundant locally between 20' and 25' below the top as to almost cover certain bedding planes. Three or four specimens were found showing a film of jet black, vitreous, brittle material of a hardness of 3 to 4 that looks like the anthracolite form of coal. They show a distinctive pattern of pillars and tubes.
436' 3"	449 0	74	Gray-black sh. with ¼ to ½" layers and lenses of blue-gray sh. at intervals of 6" to 12". Sporangia present and abundant at some levels
	449 3	75	Blue-gray sh.
	454 4	76	Gray-black sh. with ¼" to 2" layers of blue-gray sh. at intervals of 6" to 12"
	455 0	77	Gray-black sh. with 2" layers of blue-gray sh. at top and bottom.
	458 3	78	Gray-black sh. with 1'-2" layers of blue-gray sh. at intervals of about 1'. Sporangites present. Base at bottom of section 89.
	464 9	79	Gray-black sh. with thin layers of lenses of blue-gray sh. at intervals of about 1'.
			The layers and laminae are inclined at 15 to 20 degrees in the middle part decreasing toward the top and bottom. Sporangia present.
	490 6	80	Gray-black sh. with blue-gray sh. layers 1" to 3" thick at intervals of 6" to 2'. Some of the blue-gray layers are made up of lenses or rounded masses of shale.
			Marcasite is present as small nodules at intervals of about 1'. An irregular type of a septarium was found about 10' below the top of the zone. The crack-filling material is pyrite and a light colored material that does not effervese and much of the vein filling cuts thru a black carbon material probably of the ozokerite type. The laminae are slightly inclined in the lower half of the zone.
			The larger Lingula was found at 17' to 19' below the top of the zone and the smaller Lingula at 23' to 25' below the top. Neither of these types had been found except at 250' to 275' higher in the formation. Sporangia are present throughout the zone and abundant in the upper 15

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TOP	BOTTOM	THICKNESS	DESCRIPTION
	Ft. In.		
			and the basal 1' of the zone. They are well preserved and would be good for detailed study. Associated with the Sporangia in the upper 10' are some small globular brownish red pellets two to three times th diameter of the Sporangia that are apparently an amber-like material. Base at bottom of tier 95.
490' 6"	500 6		81 Gray-black sh. with a few thin laminae of blue-gray sh. and a 2" layer at 3½' above the base.
			Marcasite is present in small quantitiy as thin partings, disseminated minute crystals, or nodules. Thesmall elongate Lingula was found at 2' and about 6' below the top in mottled or blue-gray shale, Sporangia are abundant in the upper 2' of the zone where several brownish surfaces exist and are rare thru the rest of the zone.
			The base of zone 81 is the base of the Ohio shale at 6" above base of section 97, and at well depth 500'6" Zones 46-81, making up the Ohio sh., total 376'3".
	501 4		82 Blue-gray sh. with a thin 1" layer of black sh. 2" below the top.
			At 5" below the top there is a ½" layer of nodular pyrite with uneven contact with the shale as if the nodules grew in the unconsolidated shale.
	501 9		83 Browwnish-black sh. with a 2" layer of blue-gray sh. below the middle of the zone. Pyrite nodules near Base.
	508 8		84 Blue-gray sh. with a few brownish black layers
	508 10		85 Brownish black sh. grading to blue-gray sh. at top and bottom and with a number of nodules of pyrite.
	512 8		86 Blue-gray sh. interbedded with thin layers of brownish black sh.
	514 9		87 Interbedded laminae of blue-gray sh. and brownish black sh.
	517 0		88 Blue-gray, sh. with a few layers of brownish black sh.
	519 10		89 Interbedded laminae of brownish black and blue-gray sh.
			Pyrite nodule at 7" above base; gray calcareous layer at 13" above base.
	520 7		90 Brownish black sh. grading to blue-gray sh. at top and bottom.
	526 3		91 Blue-gray, slightly calcareous sh. with bands of brownish-black sh.

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TOP	BOTTOM	THICKNESS	DESCRIPTION
	Ft. In.		
526' 3"	526 5	92	Brownish black sh. with small lenticular masses of blue-gray sh.
	532 7	93	Blue-gray slightly calcareous sh. with several units 2" - 3" thick of brownish black sh.
	532 11	94	Brownish-black sh. with some laminae of blue-gray sh. A plant impression, with 1½" wide, with carbon-film crosses the core.
	542 3	95	Blue-gray sh. with several layers 1"-2" thick of brownish black sh.
			At 1'6" below the top is a plant impression that shows very interesting structure. The outer part is jet black anthracolite type of material, probably the bark portion. Within this is a part that is partly replaced with pyrite. It shows fine longitudinal and transverse structure which should belong to the plant. This should be studied in detail. Veins of a light colored mineral cut the anthracolite of part of the specimen similar to the septaria like specimen from the Ohio. This light-colored mineral does not effervesce. Possibly the carbon of the septarium is anthracolite.
	542 10	96	Brownish black sh. with small masses of blue-gray sh. in upper 2".
	548 2	97	Blue-gray, slightly calcareous sh. with a few units 2"-3" thick of brownish black sh. Contains a few pyrite nodules. One plant fragment found
	552 2	98	Blue-gray slightly calcareous sh., with several light gray, calcareous nodules and lenses Contains a few nodules and one thin layer of pyrite
	553 6	99	Interbedded thin layers of blue-gray and brownish-black sh.
	557 1	100	Blue-gray slightly calcareous sh. with a few bands of brownish black sh. and with lenses or nodules 1"-3" across of light gray calcareous material. ~~Contains some pyrite. Base at bottom of section 108.~~
	561 6	101	Blue-gray, slightly calcareous sh. with several 2"-4" layers of brown sh.
			At 9" below the top is a film of black, brittle, carbon material, 1/16" thick, across the core. It shows no definite structure and appears to be compressed material rather than the coalification of on plant stem. There are a few small nodules and several thin laminae of pyrite. About 6" above the base there is an

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TOP	BOTTOM	THICKNESS	DESCRIPTION
	Ft. In.		
			uneven unit 1"-2" thick, with much disseminated pyrite that cuts down across the laminae below as if this represented a slight discomformity. Several show apparent worm trails and winding rod-like masses of blue-gray shale in the black shale may represent worm trails or burrows.
561' 6"	564 6		102 Black and brownish black sh. with a few thin layers of blue-gray sh.
			This is the blackest shale in the Olentangy formation The core is firm and does not split easily. Much of the shale is grainy, even fragmental in certain partings. Lenses and layers rich in disseminated pyrite exist at several levels.
			At about 2' above the base is a film 1/16" thick of jet black, vitreous, anthracolite material complete acro the core. It shows no structure. Fossils were found in the basal 2', chiefly in grainy fragmental material. They include small Lingula, several specimens somewhat twisted and contorted; conodonts, abundant in-fragmental material at 2' above base and several types; sporangites,common. These are the only fossils found in the Olentangy sh., although many cross faces of the core were examined.
			This zone 102 is the base of the Olentangy sh. Zones 88-102 make up the Olentangy and total 64'. The base is at well depth 564'6".
			The shale of 102 rests on and is firmly joined with a crystalline dolo. The contact is uneven, and has a ½" unit of transition, of grainy or fragmental material.
			Niagaran(?) Dolomite. 12'6"
	566 8		103 Gray to bluish gray, finely-crystalline dolo. Certain parts are somewhat porous between loosely joined crystals and with petroliferous staining.
			The upper 2" to 3" looks like detrital material with many coral tubes shown on the core surface and with the upper ½" rich in pyrite. Pyrite is abundant thru the upper part of the zone. Several stylolite partings exist at angles of 20 to 30 degrees.

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TOP	BOTTOM	THICKNESS	DESCRIPTION
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			Corals show in cross section on the core wall in the upper part of the zone and especially the upper 3". There are simple horn corals, simple tubular corals with septa; compound, open colony, tubular corals; and the compound, compact Favosite-like type. Probably the more porous places that have been decayed-out are coral heads of some type. Several such masses show the structure due to radiating filled tubes and tubulae. The side of the core at 8"-10" from the top of the zone looks like an open compound coral colony of tubes with 15 to 20 cross-sections of lighter color all entirely replaced. One specimen looks like the longitudinal section of a tube showing tabulae. The basal 2"-3" of this zone contains quartz sand grains decreasing upward. They are mixed with the small rounded grains of dolo. which may be oolites. Locally the sand grains constitute at least 10% of the whole. A fragment of dolomite was treated with acid and several grains released. Most of the grains are very clear rock-crystal quartz. A few are somewhat stained. They range in size from 1 mm. down to 1/10mm., most of them being ¼ to ½mm. Most of them are well rounded and beautifully pitted or frosted with very minute pits even down to those only ⅛ to 1/5 mm in diameter. Ten to 15% of the grains show secondary enlargement by growth ofpointed ends and a few even show prism faces. A few crystals have very high luster surfaces which I believe is due to enlargement that has buried the pitted surface and formed crystal faces. There are some angular fragments of slivers and these show high luster. There is a lot of finequartz material in grains about 1/25mm across. Many of these particles are elongate quartz crystals; some are aggregates of very minute crystals. This fine material is is probably all secondary.
571' 6"	572 0		107 Brownish gray, fine-grained dolo. with some greenish patches of fine grained pyrite.
	573 0		108 Brownish gray fine-grained dolo. in which there are some open spaces with small pyrite crystals.
			The open spaces are associated with parts that show concentrically laminated masses, 1" to 3" across suggesting stromatoporoids or "biscuit structures".

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TOP	BOTTOM	THICKNESS	DESCRIPTION
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573' 0"	573 10	109	Gray-drab, very porous, irregularly textured dolo.
			This is a very irregularly textured stone made up of angular and plate-like fragments, oolite grains, recemented, powered material and some stromatoporoid-like, laminated material. One of these at the base of the zone is 2-½" by 2". It all appears badly broken possibly brecciated or crushed reef-material. Some spaces may be due to fossils but nothing identifiable.
	576 10	110	Brown, laminated, oolitic dolo.
			Through most of the zone the oolites have dissolved out leaving a porous rock with minute round spaces. Locally the stone is dense and the oolites are hardly recognizable.
	577 0	111	Brown, irregular-textured, porous dolo. made up of angular fragments, oolitic grains and some laminated masses.
			This is the base of the core at well depth 577'. Zones 103 and 110 total 12'6" for the dolomite below the Olentangy sh.
			This dolomite below the Olentangy shale has yielded no identifiable fossils. Fairly certain Favosites-like corals and stromatoporoids are present. In lithology, texture, and general appearance it is more like Niagaran than mid-Devonian or Bass Island. It is thickbedded and rough-textured. Although the lithology, and particularly the oolitic material of zone 110 is not typical Niagaran and the fossils are not conclusive I prefer to assign it to the Niagaran for the present.

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Ohio Geological Survey, 1982, An integrated study of the Devonian-age black shales in Eastern Ohio, 172 p. (Core descriptions by Richard Carlton)

	Interval (feet)
CLEVELAND SHALE MEMBER	123 to 197

OH01: The John Hirsh well no. 1 was completed in 1945 for the Ohio State University Engineering Experiment Station. The drill hole is located in Huntington Township, Ross County (table 4.1). The Ohio Shale portion of this core was not described in detail and no petrographic or XRD data were obtained. The Olentangy Shale is described in detail.

	Interval (feet)
CLEVELAND SHALE MEMBER	123 to 197
Shale, brownish-black (5YR 2/1), silty, contains rare, poorly preserved spores, microcrystalline pyrite, silt-size mica, and organic matter.	
CHAGRIN SHALE MEMBER (THREE LICK BED)	197 to 217
Shale, dark-greenish-gray (5GY 4/1) to olive-black (5Y 2/1), generally containing some very fine silt. Organic matter and microcrystalline pyrite rare, small pyrite nodules up to 0.3 inch numerous. Interbedded olive-gray (5Y 4/1) shale and brownish-black (5YR 2/1) silty shale. The latter contains poorly preserved spores, microcrystalline pyrite, silt-size mica, organic matter, and rarely lenses of pyrite-rich shale. Upper contact gradational.	
HURON SHALE MEMBER	217 to 501.5
Shale (217 to 400 feet), brownish-black (5YR 2/1), silty, with rare, poorly preserved spores, silt-size mica, and microcrystalline pyrite interbedded with olive-black (5Y 2/1) shale.	
Limestone, dark-greenish-gray (5GY 4/1) with cone-in-cone structure at 248 feet; 0.5 to 1.0 inch thick.	
Shale (400 to 501.5 feet), predominantly brownish-black (5YR 2/1), interbedded with dark-greenish-gray (5GY 4/1) silty shale; spores locally common (1 to 10%); conodonts found in nearly every sample below 450 feet. Rare thin lenses of anhydrite and pyrite present. Organic matter rare to absent; (worm?) burrows up to 0.25 inch in cross-sectional diameter, generally filled with pyrite, present; larger burrows up to 0.5 inch in cross-sectional diameter present at contacts between the black and green shales below 435 feet. Latter burrows generally found in the black shales near contacts and filled with green shale.	
"UPPER" OLENTANGY SHALE	501.5 to 561
Shale, olive-gray (5Y 4/1) to olive-black (5Y 2/1) or dark-greenish-gray (5GY 4/1), interbedded or interlaminated with brownish-black (5YR 2/1) shale; carbonate nodules and pyritized (worm?) burrows 0.05 to 0.15 inch in cross-sectional diameter common locally. Horizontal and inclined burrows common at contacts between greenish-gray (5GY 4/1) and brownish-black (5YR 2/1) shales. Burrows generally within black shale and filled with the lighter colored shale. Interbedded brownish-black (5YR 2/1) and olive-black (5Y 2/1) shales in the basal portion of the "upper" Olentangy Shale may be correlative to Rhinestreet Shale Member of the West Falls Formation. Basal contact irregular with pyrite lenses along it.	

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FORM P-504 (GREEN) P-504-B (BUFF) Post-Rite SYSTEMS CELINA, OHIO · DALLAS · LOS ANGELES LITHO IN U.S.A.

	INITIALS	DATE
PREPARED BY		
APPROVED BY		

Very rare = Trace
rare = <1%
common - 1-10%
abund. > 10%

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LINE No.		Chillicothe Test Core	(1)	(2)	(3)	(4)	LINE No.
1–5	000	CTC 123.0'	5YR 2/1	Shale, brnish-blk,	silty, spores(Tas.?) rare; silt-size mica easily observ.; rare coaly organic matter; microcrystalline pyrite rare		1–5
6–10	001	CTC 133.0'	5YR 2/1	Shale, brnish-blk,	silty, spores(Tas.?) rare and poorly preserved; silt-size mica easily observ., rare coaly organics, rare microcrystalline pyrite		6–10
11–14	010	CTC 142.0'	5YR 2/1	Shale, brnish-blk	silty, spores (Tas.?) rare and poorly preserved; silt-size mica easily observed; rare coaly organics		11–14
15–19	020	CTC 163.5'	5YR 2/1	Shale, brnish-blk,	silty, spores(Tas.?) rare, and poorly preserved; silt-size mica easily observed; rare coaly organics, rare microcrystalline pyrite		15–19
20–24	030	CTC 182.0'	5YR 2/1	Shale, brnish-blk,	silty, spores(Tas.) common, poorly preserved - some pyritized; rare coaly organics; microcrystalline pyrite rare, silt size mica		20–24
25–30	040	CTC 202.5'	5YR 2/1	Shale, brnish-black,	silty, spores(Tas.?) rare and poorly preserved, common coaly organics, microcrystalline pyrite rare; one lens of pyrite rich shale observed, silt-size mica.		25–30
31–38	041	CTC 210.0	5GY 4/1 to 5Y 2/1	Shale, Dk grn.gry to ol. blk*	Very fine silt present; rare coaly organics, rare microcrystalline pyrite; pyrite nodules up to 3mm are numerous at least one nodule assoc. with siderite? crystal(subhedral); small orange anhedral crystals (.04mm dia) scattered throughout sample.		31–38
39–43	050	CTC 222.0'	5YR 2/1	Shale, brnish-blk,	Silty, spores(Tas.?) very rare; very rare coaly organics; silt-size mica; microcrystalline pyrite very rare; some yellow earthy grains as described elsewhere		39–43

* ol. = olive

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APPROVED BY		

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LINE No.		(1)	(2)	(3)	(4)
1–5	291	CTC 242.5	5YR 2/1	Shale, brnish-blk,	silty, spores(Tas.?) rare and poorly preserved; silt-size mica; rare coaly organics, rare microcrystalline pyrite
6–10	292	CTC 235.2'	5Y 2/1	Shale, olive-blk	silty, to fine silt; coaly organics common, microcrystalline pyrite rare; pyrite in + (cross-shape) observed; very rare Tas.?
11–15	291	CTC 258.0'	5Y 2/1	shale, olive-blk	fine silt present, spores(Tas.?) rare and well preserved; rare to common coaly organics; silt-size mica; microcrystalline pyrite very rare, some yellow earthy equant grains as described elsewhere
16–19	[illegible]	CTC 259.78'	5GY 4/1	Limest., dk-grnish gry,	aphanitic under binoc.; contains white with red patches of saw-toothed material down center
20–25	290	CTC 259.8'	5YR 2/1	Shale, brnish-blk,	silty, spores(Tas?) rare & well preserved; irregular patches of amber material throughout shale may be poorly preserved Tas?; microcrystalline pyrite rare; rare coaly organics; silt-size mica.
26–30	[illegible]	CTC 279.5'	5Y 2/1	Shale, olive-blk,	silty, spores(Tas.?) very rare; coaly organics common – mostly rod shaped and 0.5 mm long; rare microcrystalline pyrite, fine-silt size mica
31–37	[illegible]	CTC 301.5'	5Y 2/1	Shale, olive-blk	silty, spores (tas?) rare; yellow earthy equant patches may be weathered Tas? (rock is weathered); coaly organics as above common; silt-size mica very rare
38–43	[illegible]	CTC 320.5	5YR 2/1	Shale, brnish-blk,	silty, spores(tas?) rare & well preserved; coaly organics common; microcrystalline pyrite rare; several nodules of pyrite up to 4mm; silt-size mica present; amber patches appear to be poorly preserved spores(Tas.?) on fresh surfaces
			1	2	3	4

	INITIALS	DATE
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APPROVED BY		

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LINE No.	(1)	(2)	(3)	(4)
	CTC 340.5	5YR 2/1	Shale, brnish-blk	same as 320.5 except no nodules
	CTC 362.5'	5YR 2/1	Shale, brnish-blk,	silty to fine-silt; spores (Tas.?) ~~rare~~ common and mostly poorly preserved; microcrystalline pyrite rare; some Tas. spores replaced by pyrite; coaly organics very rare silt-size mica
	CTC 381.0'	5Y 2/1	Shale ~~shale~~, olive-blk,	fine-silt present, spores (Tas.?) very rare; yellow earthy equant grains about .05 to .06 mm dia. common whereas well preserved Tas. are .25 mm dia. coaly organics very rare; microcrystalline pyrite very rare on fresh surfaces & abundant on weath. surfaces, yellow earthy material present only on weath. surfaces & is probably oxidized pyrite? fine-silt-size mica.
	CTC 402.5'	5YR 2/1	Shale, brnish-blk	same as CTC 381.0'
	CTC 420.5'	5YR 2/1	Shale, brnish-blk,	same as above except even fewer Tas., & less ~~silt~~ fine silt (no coarse silt); also thin stringers of white crystalline mineral (anhydrite?)
	CTC 440.5'	5YR 2/1	Shale, brnish-blk,	silty, Tas.? very rare; coaly organics very rare; microcrystalline pyrite very rare; silt-size mica
	CTC 450.6'	5GY 4/1	Shale, dk grnish-gry	fine-silt present; coaly organics rare; microcrystalline pyrite common; pyrite fills short (1mm) cracks; thin stringers or lenses; small nodules .25 mm dia., possibly fills some small burrows.
	1	2	3	4

FORM P-504 (GREEN) P-504-B (BUFF)

Rose-Rite SYSTEMS CELINA, OHIO · DALLAS · LOS ANGELES

LITHO IN U.S.A.

	INITIALS	DATE
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LINE No.		(1)	(2)	(3)	(4)	LINE No.
1–5	70	CTC 460.5'	5YR 2/1	Shale, brnish-blk,	silty, spores(Tas.?) common, mostly poorly preserved; micro-crystalline pyrite rare; coaly organics very rare; silt-size mica Conodont - bluish gry	1–5
6–8		CTC 468.8'	5Y 4/1 and 5YR 2/1	Shale - Two Litho olive gry & brnish-blk		6–8
9–12			1st Litho. - 5Y 4/1	Shale, olive gry,	fine-silt present; coaly organics very rare, microcrystalline pyrite rare; pyrite occurs also as nodules ~.5mm dia.	9–12
13–20			2nd Lith. 5YR 2/1	Shale, brnish-blk, burrowed	silty, spores(Tas.?) rare; coaly organics very rare; micro-crystalline pyrite very rare; one pyrite nodule 8mm dia. silt-size mica; Conodont 5YR 2/1 lithology extensively burrowed - burrows up to 1cm dia. and filled with 5Y 4/1 shale mostly inclined & vertical burrows.	13–20
21–26	140	CTC ~~470~~ 481.5'	5YR 2/1	Shale, brnish-blk,	silty to fine-silt, spores(Tas.?) very rare, coaly organics very rare; silt-size mica; microcrystalline pyrite very rare; Conodont	21–26
27–33	149	CTC 499.0'	5YR 2/1	Shale, brnish-blk,	silty to fine-silt, spores(Tas.?) ~~very rare~~ absent coaly to common & poorly preserved; microcrystalline pyrite rare; ~~but~~ occurs also as lens or irregular laminae; coaly organics very rare, Conodont	27–33
34–43	14	CTC ~~500.0~~ 503.5' Olentangy Shale	5GY 4/1	Shale, dk grnish-gry,	some fine-silt present; microcrystalline pyrite to subhedral crystals up to .15mm (could be marcasite) organics absent to very rare; several nodules of pyrite up to 2mm.	34–43
			1	2	3	4

Rare - Common - abundant Pyrite
<10% >10% >30%

Chill. Test Core

9-28-77

HUNTINGTON TWP.
ROSS CO.

CTC - 362.50 to 363.00' shale, brnish blk, 5YR 2/1;
fine-silty; micro crystalline pyrite common, white efflor. min. on old surface, minor blk carbonaceous matter usually < .06 mm; Amber SPOR (tasmanites?) .25mm to .06mm (ave. .2mm) many fragments to whole specimens

CTC 499.00' to 499.25', shale, brnish blk, 5YR 2/1;
rare micro. pyrite, Amber SPOR (Tasmanites?) ave. size .15 mm mostly fragments, SD (10-50%)

CTC 259.80 to 260.00 shale, brnish blk, 5YR 2/1
pyrite very rare, rare blk carbonaceous matter usually less than .06mm; Amber SPOR (Tasmanites), whole ones up to .20mm; ave. .15mm; many smaller fragments; SD (10-50%)

CTC 235.20 to 235.70', olive blk 5Y 2/1, shale,
rare micro. pyrite, common rod & equant shaped blk carbonaceous particles; Amber SPOR (Tasmanites?), same size as above; rare fragments, mostly whole FD (<10%)

CTC 340.5 to 341.0 brnish blk, 5YR 2/1, shale,
No pyrite observed; yellow earthy equant grains ~ .06 mm dia. rare; equant & rod shaped blk carbonaceous matter rare; Amber SPOR (Tasmanites?) rare, whole mostly but some fragm. size same as above

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Shale, silty, micropyrite, SPOR-Tas?

CTC 460.5 to 461 Brnish Blk, 5YR 2/1, Shale
pyrite not observed; Bluish gry conodonts (rare)
Amber SPOR (Tasmanites?) ave .25mm, mostly whole
SD (10-50%)

CTC 450.6' to 450.7' Dk grnish gry 5GY 4/1 shale
rare to common microcrystalline pyrite, Amber SPOR (Tasmanites?)
rare and mostly whole, some not flattened. FD (<10%)
Pyrite spheres up to ~ .15mm dia. observed

CTC 381.0 to 381.5 Olive Blk 5Y 2/1 shale,
pyrite not observed; Amber SPOR (Tasmanities) rare
and mostly whole, FD; yellow earthy grains .08mm and less
in size present throughout, common; Blk carbonaceous matter
~~rare~~ common, dessiminated in fine flakes < .08mm dia.

CTC 242.50 to 243.0' Brnish Blk 5YR 2/1 shale,
No pyrite observed; Amber SPOR (tasmanitic) rare
& mostly whole FD; Blk carbonaceous organic matter scattered throughout
most less than .10 mm, white efflor. min. on surface.

CTC 402.5 to 403.0 Brnish Blk 5YR 2/1 shale,
No pyrite observed; Amber SPOR (Tas.?), common SD (10-50%)
& whole & fragments; Blk carb. matter rare - same size as above
yellow earthy grains rare to common. <.04mm

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CTC 222.0 to 222.50 Brnish Blk 5YR 2/1 Shale
Pyrite not observed; yellow earthy grains common, < .05 mm
Rods + equant grains of blk carb. matter, rare & < .05 mm
Amber SPOR very rare only 1 or 2 observed. (Tas?)

CTC 142.0 to 142.5 Brnish Blk 5YR 2/1, Shale
Microcrystalline pyrite rare, Amber SPore (Tas?)
about .2 mm & less dia., usually whole, rare;
Blk carb. matter dessiminated thru out, elongate & equant
grains, most < .10 mm

CTC 301.5' to 302.0' Olive Blk 5Y 2/1 Shale
Microcrystalline pyrite rare, yellow earthy equant grains
< .05 mm dia, common; Amber SPOR, usually whole, rare.
Blk carbonaceous matter, common + in distinct rod & equant
grains usually less than .04 mm.

CTC 210.0 to 210.50 DK grnish gry 5GY 4/1 to Olive Blk 5Y 3/1,
Shale, rare, microcrystalline pyrite seen, Orange-brn grains < .04 mm (solenite?)
dia. scattered thru-out sample, rare (<10%). Small blk flakes < .02 mm
scattered thru-out (rare, <10%)

CTC 259.78 to 259.80' DK grnish gry 5GY 4/1 Carb-ate?
Carbonate (Limestone) with white & red patches of saw tooth
carbonate down center.

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CTC 279.5 to 280.0' Olive Blk 5Y 2/1 Shale, Silty
Rare micro. pyrite, only one or two Amber SPOR (Tas?) .15 mm dia.;
Small blk rods & flakes of carbaceous matter or biotite
rare;

CTC 468.8 to 469.9' Olive gry 5Y 4/1, Shale,
rare micro. pyrite, rare blk flakes of carbonace. or
biotite <.02 mm; 2nd lithol. - Brnish Blk 5YR 2/1
Shale, rare micro. pyrite, burrows (all three types,
incl., horiz. & vert.) x-sect. oval & up to 7 to 8 mm dia.
down to 2 mm, burrows filled with olive gry sh.
Amber SPOR (Tas.?) seen as rare constituent of Brnish Blk
shale. Vertical & inclined burrows most common.

CTC 320.5 to 321.0' Brnish Blk 5YR 2/1 Shale
micro x pyrite rare, also irregular nodular - replacement?;
Amber SPOR (Tas?), common, poorly preserved, SO,
many fragmented; Rods up to 1 mm length & tiny flakes
~~up~~ about .04 mm dia. rare

CTC 503.5 to 504.0' Dk grnish. gry, Shale (Olentangy)
no SPOR, rare micro. pyrite scattered randomly
thru-out shale,

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7

CTC 258.0 to 258.5 Olive Blk 5Y 2/1 ; Shale, 0
some rare u.f.g. sand grains (qtz?), Silty,
rare micro. pyrite, rare Amber SPOR (Tas?);
Filaments & rods usually < .25mm long + flakes of Blk Carb. matter.

CTC 202.5' to 203.0' Brnish Blk 5YR 2/1
one indistinct well area may be decomposed SPOR
Rare Amber SPOR, rare spherules of pyrite, rare Blk carbonaceous
flakes <.2mm

CTC 163.5 to 164.0 Brnish Blk 5YR 2/1, Shale,
rare ~~pyr~~ micro. pyrite, Amber SPOR (Tas.?), rare to common
Blk carbon. matter rare.

CTC 182.0 to 182.50' Brnish Blk 5YR 2/1, Shale,
Micro. pyrite rare, Amber SPOR (Tas.?) common, many
(poorly preserved)
fragmented, rare Blk Carb. matter <.1mm
Clear white effluor. min. on most of these samples. do

133.0 to 133.5 Brnish Blk 5YR 2/1, Shale,
rare micro. pyrite, may have high amount of mica about .04mm
dia., Amber SPOR (Tas?) rare, Rare Blk flakes (carbonaceous
or bentonite?).

CTC 440.5 to 441.0' Brnish Blk 5YR 2/1
Micro. pyrite, rare, Amber SPOR (Tas?) rare, mostly whole,
Blk Carb. matter rare, <

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CTC 123.0 to 123.5 Brnish Blk 5YR 2/1 Shale
Micro. pyrite rare, Blk Carb. matter (rods) up to .5 mm rare
Amber SPOR (Tas?) rare & usually whole

CTC 420.5 to 421.0 Brnish Blk 5YR 2/1 Shale
Micro. pyrite rare, Blk carb. or biotite grains rare,
Amber SPOR (Tas?) rare, only 2 seen

CTC 481.5 to 482.0 Brnish Blk 5YR 2/1 Shale, silty
Micro. pyrite rare, Mica may be abundant,
Blk biotite or carbon. grains < .04 mm rare,
Amber SPOR (Tas.) rare, whole but poorly preserved & difficult to see.

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CTC - 362.50 - 363.00', shale, brnish blk 5YR 2/1,
fine-silty; amber SPOR (Tasmanites?) .25 mm to .06 mm - aver. .20 mm
many fragments, uniform dispersion (all over); SD (10-50%) fossils
parallel to bedding, MS (moderately sorted), MF (>30%
broken frag.
Trace of microcrystalline pyrite < .02 mm

F [Fill out header file card for each sample
For rest of lithology just note type of fossil, abundance
+ size,

Mineralogy - pyrite (habit), any other identifiable mineral

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Petroleum Logging Services

HAMPSTEAD OIL COMPANY & MADISON OHIO OIL COMPANY

R. C. CRYGER NO 1

WILDCAT

POS. SW/4 SW/4 FL 660 WL SW

STATE OHIO

TWP. LIBERTY RGE.

Elev. 631.1 Ft. Above Permanent Datum

KB. 640 Elevations DF. GL. 631.1

1/L-S/P

Other Services

Size	Wgt.	Casing Record From	To
8 5/8"		SURFACE	411

Date	1-22-65
Run	ONE
Log	GGC
Bottom	3503
Top	100
Hour	4 HRS
Recorded By	JONLETZ & STACY
Witnessed By	SHIRLEY
Max. Rec. Temp.	9.4
Type Fluid in Hole	FULL
Level	FRESH MUD

Gamma Ray — Equipment Data — Neutron

Gamma Ray		Neutron	
Run No.	ONE	Run No.	ONE
Tool Model No.	1304	Log Type	GGC
Diam.	3 5/8"	Tool Model No.	22033
Detect. Model No.	G4G1	Diam.	4 1/2"
Type	SCINT	Detect. Model No.	1 G 3
Length	4"	Type	GEIGER
Dist. to N. Source	6"	Length	4"
		Source Model No.	S3E10
		Serial No.	C-4
		Spacing	11"
		Type	CS 137
		Strength	1 CURIE

General

Hoist Truck No.	L 1083
Inst. Truck No.	L 1083
Tool Serial No.	

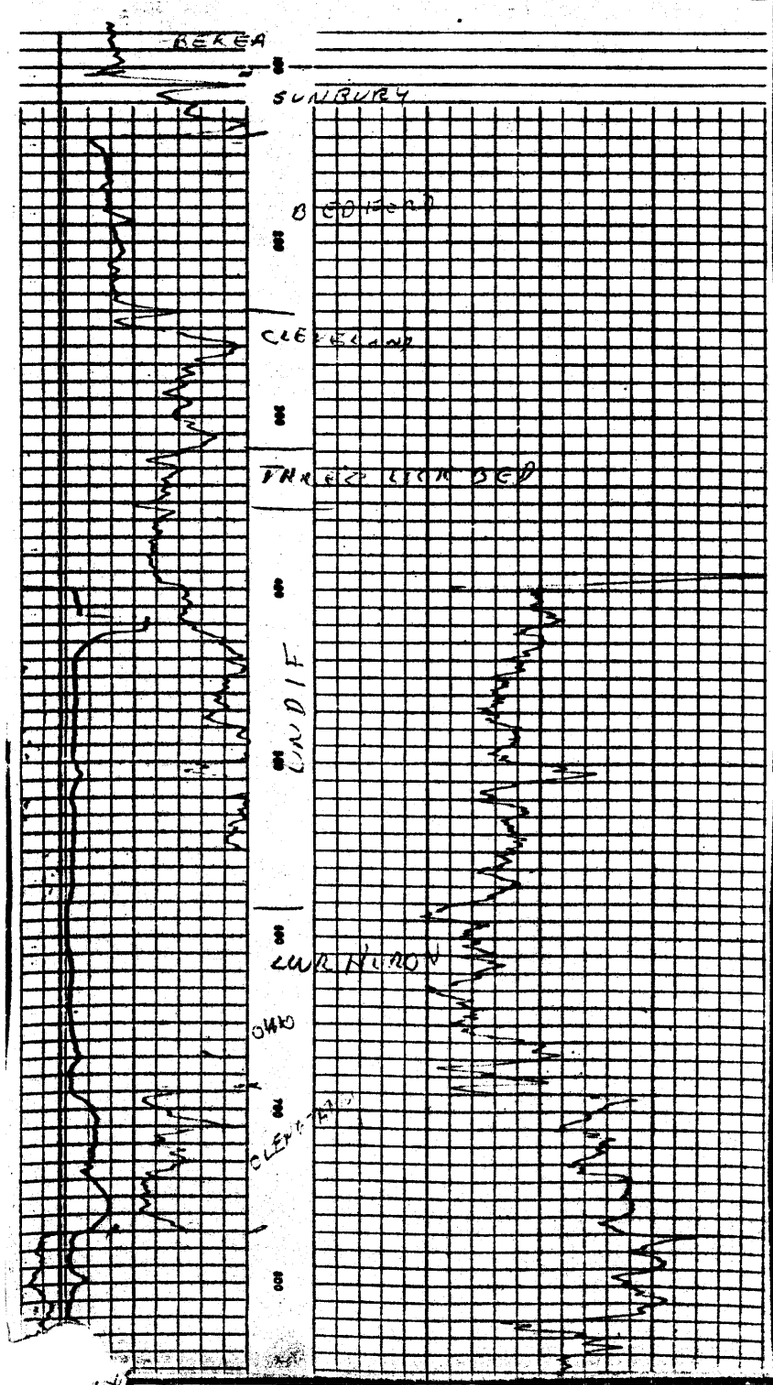
Logging Data

General Run No.	Depths From	To	Speed Ft./Min.	Gamma Ray T.C. Sec.	Sens. Settings	Zero Div. L or R	API G.R. Units Per Log Div	Neutron T.C. Sec.	Sens. Settings	Zero Div. L or R	API N. Units Per Log Div
	3503	100	20	3	620	0	20	4	535	108	10 CO/CAL

Remarks:

Reference Literature:

GAMMA RAY & CALIPER	DEPTH	DENSITY
0 — 200 RADIATION INTENSITY INCREASES	SCALE 2"=100'	2.10 2.14 2.18 2.24 2.28 2.3 / 2.12 2.16 2.20 2.26 2.31 / 2.34 2.38 2.42 2.50 2.56 2.52 2.68 2.74 2.82 2.90 3.0 / 2.36 2.40 2.46 2.52 2.58 2.64 2.70 2.78 2.86 2.95 / DENSITY IN GM/CM³
HOLE SIZE - INCHES 7 9 11 13 15	LR 100	LOG ZERO 10 CO/R



C#562

Near Chillicothe Cre

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STS Formilog

HAMMERSTONE OIL COMPANY & HAUSON OHIO OIL COMPANY

K. C. CRYDER NO. 1

WILDCAT

ROSS — STATE — OHIO

SW/4 SW/4 SW/4 — 405' FROM SOUTH LINE — 1650' FROM WEST LINE

Elev. 631+1 — Ft. Above Permanent Datum — DF 631.1 — KB 640 — Measurements: RKB

Date: 1-22-65 — Run: ONE — Depth Driller: 3500 — Depth Logger: 3505 — Bottom Log Interval: 3503 — Top Log Interval: 100 — Type Fluid in Hole: FRESH MUD — Max. Rec. Temp.: 100 — Equipment: 6 3/4 FULL — Recorded by: 4 HRS — Witnessed by: JONIETZ & STACY — SHIRLEY

Casing Record: Size 8 5/8" — Wgt. — From SURFACE — To 411

Other Services: 1/1-S/P

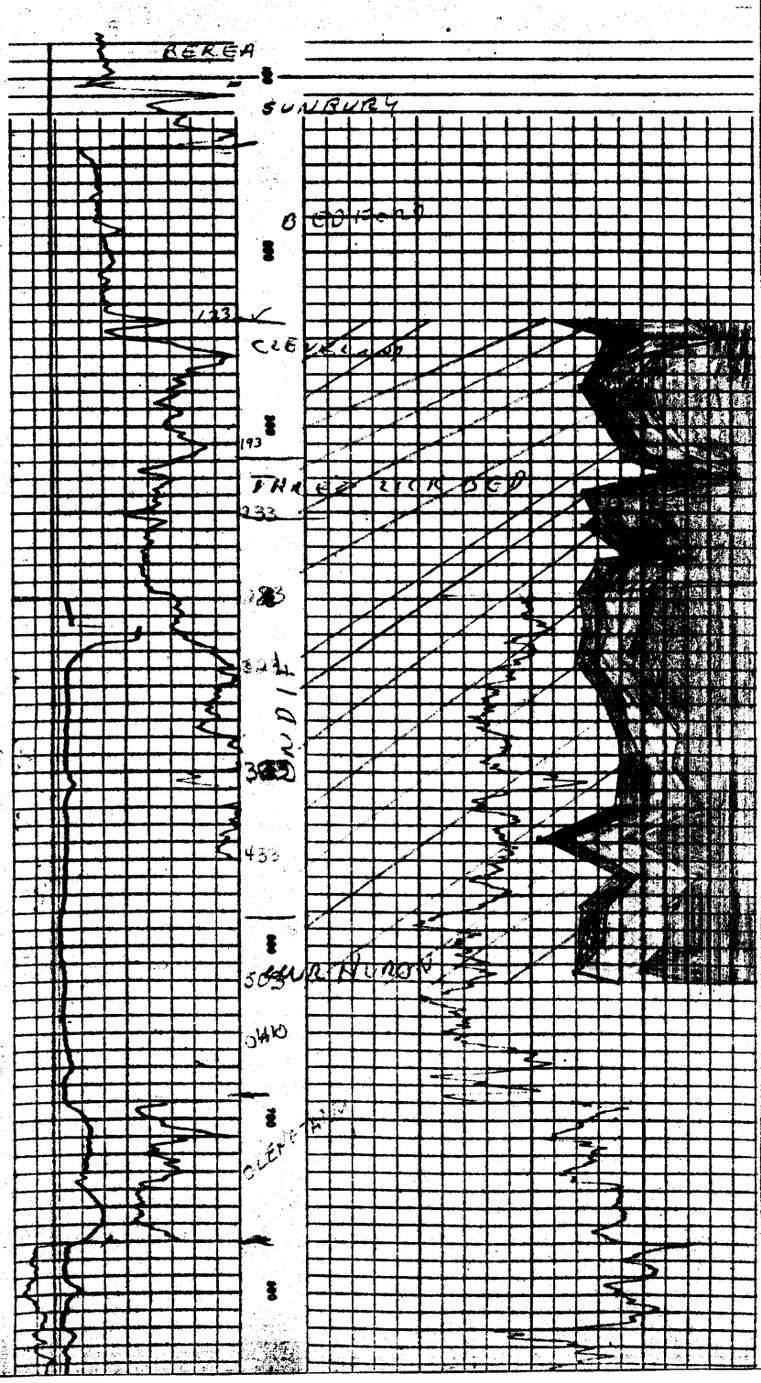
Gamma Ray		Equipment Data	Neutron
Run No.	ONE	Run No.	ONE
Tool Model No.	1304	Log Type	GGC
Diam.	3 5/8"	Tool Model No.	22033
Detect. Model No.	G4G1	Diam.	4 1/2"
Type	SCINT	Detect. Model No.	1 G 4
Length	4"	Type	GEIGER
Dist to N. Source	6"	Length	4"
		Source Model No.	S3E10
General		Serial No.	C-4
Horse Truck No.	L 1083	Spacing	11"
Inst. Truck No.	L 1083	Type	CS 137
Tool Serial No.		Strength	1 CURIE

Logging Data

General: Run No.	Depths From	Depths To	Speed Ft./Min.	T.C. Sec.	Gamma Ray: Sens. Settings	Zero Div. L or R	API G.R. Units Per Log Div.	T.C. Sec.	Neutron: Sens. Settings	Zero Div. L or R	API N. Units Per Log Div.
	3503	100	20	3	620	0	20	4	535	108	10 CD/CAL

Remarks — Reference Literature

GAMMA RAY & CALIPER	DEPTH	DENSITY
0 → 200 RADIATION INTENSITY INCREASES	SCALE 2"=100'	2.10 2.14 2.18 2.24 2.28 2.3 2.12 2.16 2.20 2.26 2.31 2.34 2.38 2.42 2.50 2.56 2.52 2.68 2.74 2.82 2.90 3.0 2.36 2.40 2.46 2.52 2.58 2.64 2.70 2.78 2.86 2.95 DENSITY IN GM/CM³
HOLE SIZE - INCHES 7 9 11 13 15	LR 100	LOG ZERO 10 CD/R



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Ross Co., Huntington Twp. T.D. 577'

Number of boxes: wooden.

Remarks: See log in O.G.S. Rept. Inv. #2.

Status: See Dr. Carman about further procedure.

(No duplicate copy of core record available; see file copy)

This core at Sam Ave 4-11-61

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REVISION OF THE CHILLICOTHE TEST-CORE SECTION

J. ERNEST CARMAN

Department of Geology, The Ohio State University, Columbus 10

This paper presents a correction in the interpretation of the section of the Chillicothe test-core as given by the present writer in an article published in this Journal (Carman, 1947). The core came from a well 3 miles southwest of Chillicothe on the Hirsh fruit farm. The well was drilled by the Engineering Experiment Station, The Ohio State University, to obtain a core for the determination of the petroleum content of the Ohio shale, foot by foot (Kerr, 1948). The entire core was studied by the writer for the determination of the rock units passed through, and discussed in the 1947 paper. The list of rock units penetrated was given in that paper as follows:

Rock Unit	*Thickness*			*Depth to Base*		
	Ft.		*In.*	*Ft.*		*In.*
Mantle rock	6	—	6	6	—	6
Sunbury shale	1	—	0	7	—	6
Berea sandstone	25	—	6	33	—	0
Bedford shale	91	—	0	124	—	0
Ohio shale	376	—	6	500	—	6
Olentangy shale	64	—	0	564	—	6
Niagaran dolomite	12	—	6	577	—	0

The present paper deals only with the basal unit of the above section, 12 ft. 6 in. thick which in the earlier paper was assigned to the Niagaran dolomite and described as follows (Carman, 1947, p. 53). "The dolomite is bluish-gray to brownish-gray and quite variable in texture. In part it is firmly crystalline and compact; in part of very rough texture with open spaces containing petroliferous staining; at places apparently brecciated as if crushed reef material; the basal 4 feet is largely oolitic dolomite. No identifiable fossils were found in the dolomite but in the porous, crushed reef-rock material there are structures that suggest the compound coral *Favosites* and concentrically laminated masses suggesting stromatoporoids, all greatly altered. Although not absolutely conclusive, the evidence indicates that this dolomite is upper Niagaran." This correlation agreed with the fact that in Highland and Adams counties to the southwest, the Ohio shale rests disconformably on a surface of Niagaran and Greenfield dolomites.

In the spring of 1953, in the studies of another geologist on detrital materials at the disconformable contact at the base of the Upper Devonian shale, the piece of the Chillicothe test-core containing the top of the dolomite was sectioned vertically. This section revealed a fossil entirely against the Niagaran age of the dolomite and led to a very thorough restudy of this lower part of the core with sections and polished surfaces at a number of horizons.

The Olentangy shale overlying the calcareous strata is dominantly blue-gray in color, but with many thin layers of brownish-black shale. The lowest 3 ft. is black and brownish-black shale with a few thin layers of blue-gray shale. The restudy of the 12 ft. of calcareous strata next below resulted in the following described section which is also shown graphically in figure 1.

THE OHIO JOURNAL OF SCIENCE 55(2): 65, March, 1955.

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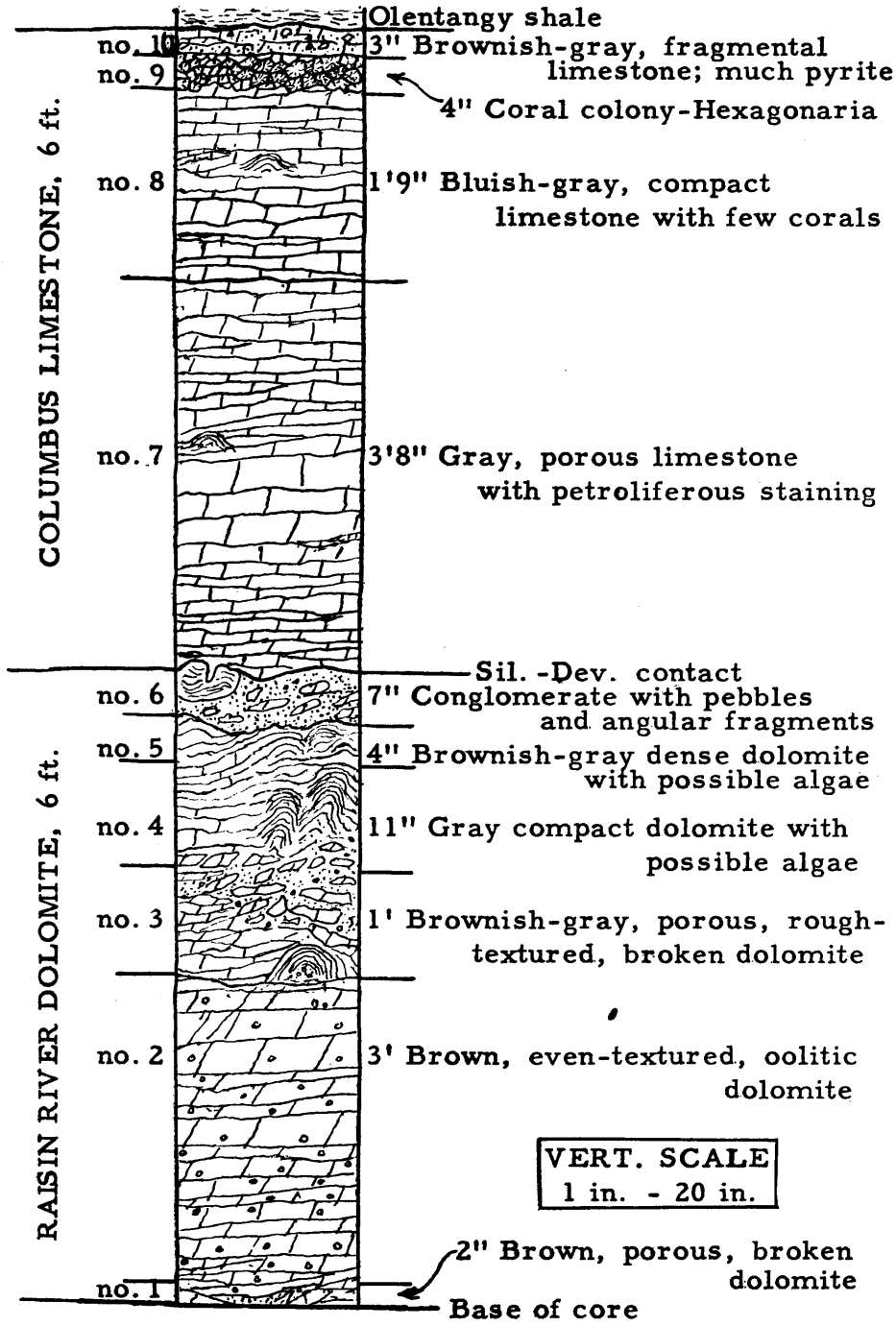


FIGURE 1. Columnar section of calcareous strata below upper Devonian shale

SECTION OF THE CALCAREOUS ROCK STRATA PENETRATED BY THE CHILLICOTHE TEST-CORE BELOW THE UPPER DEVONIAN SHALE

The zones are numbered from the base upward but discussed from above downward.

	Thickness Ft. In.
10. Gray to brownish-gray, compact, fragmental limestone with much pyrite.....	0 — 3

Composed of small calcareous fragments firmly cemented in a matrix of finer grain. The polished section shows small coral tubes, a horn coral, and a compound Favosites-like coral, all pyritized, poorly preserved, and unidentifiable. There are small lenses of pyrite scattered through the mass and the upper ½ in. is dark in color and largely pyrite (fig. 2, middle part).

9. Blue-gray, compact, limestone.....	0 — 4

Composed entirely of part of a colony of the compound, compact coral *Hexagonaria prisma* (Lang and Smith) with the long corralities extending horizontally entirely across the core (fig. 2, basal part and fig. 3). Pyrite has been deposited in porous places and along cracks between or through the corallities.

The contact with the unit above is sharp, with small jagged irregularities which cut across and into the internal structures of the corallites without any distortion. The basal contact of the dense coral mass, with the grainy limestone below, drops two inches in the width of the core and along this surface the limestone forms a sharp contact laterally or vertically with any part of the corallites. These contacts of the coral mass are interpreted as solution contacts. The horizontal position of the corallites and the nature of the contacts indicate that the coral colony must have been overturned, probably moved, and was lying on the surface when buried by the detrital material above. The coral is thus a part of the detrital zone but certainly originated in the limestone unit below.

8. Bluish-gray, fine-grained, compact limestone with some blue streaking and mottling on polished surfaces.....	1 — 9

Locally, slightly porous with petroliferous staining. In the upper part are poorly preserved, unidentifiable, tubular corals and compound Favosite-like corals.

7. Gray to bluish-gray, porous, crystalline limestone with much petroliferous staining.....	3 — 8

Favosite-like, coral structure can be recognized in several of the porous areas and probably most of the porous spaces have originated by the weathering of corals. The basal 9 in. is firmer and more finely crystalline.

6. Dark-gray to brown conglomerate containing a large pebble or cobble, medium-sized pebbles, small slabby fragments, all dolomite and all set in a matrix of medium to small grains (fig. 1, no. 6, and fig. 4).....	0 — 7

A longitudinal, polished section of the entire 7 in. of this zone shows at the top a cobble of dark-brown, dense dolomite over 4 in. across and several pebbles, ½ in. to 1 in. across. The lower part of the zone is made up of sub-angular, lenticular, and slabby particles of the dark-brown and gray dolomite. Finally all of these are enclosed in a matrix consisting of medium to fine grains of dark-brown and gray dolmite, oolites, quartz sand grains and much pyrite. The polished surface of the large cobble shows undulating, more or less contorted, discontinuous, alternating bands or lenses of dark-brown dolomite and less distinct, grayish-brown dolomite. The dark-brown color dominates but the undulating pattern is brought out by the floculent streaks of graysh brown. It is one of the types of structure commonly referred to algae and is so regarded by the writer although no positive algal structures have been found. Between the bands, singly or as thin partings, or in pockets, are small round or oblong dolomite grains 0.2 to 0.3 mm. in diameter, some of which appear to have concentric or radiating structure or appear hollow, and apparently are oolites. Most interesting are the cases where a number of these oolite-like bodies occupy a pocket which must have been at one time a depression in the surface of the algal mass made by the thinning and downfolding of the laminae locally. Such pockets have been figured by authors under the name conceptacles and the oolite-like bodies interpreted as spore cases or some other type of reproductive body (Wieland, 1914).

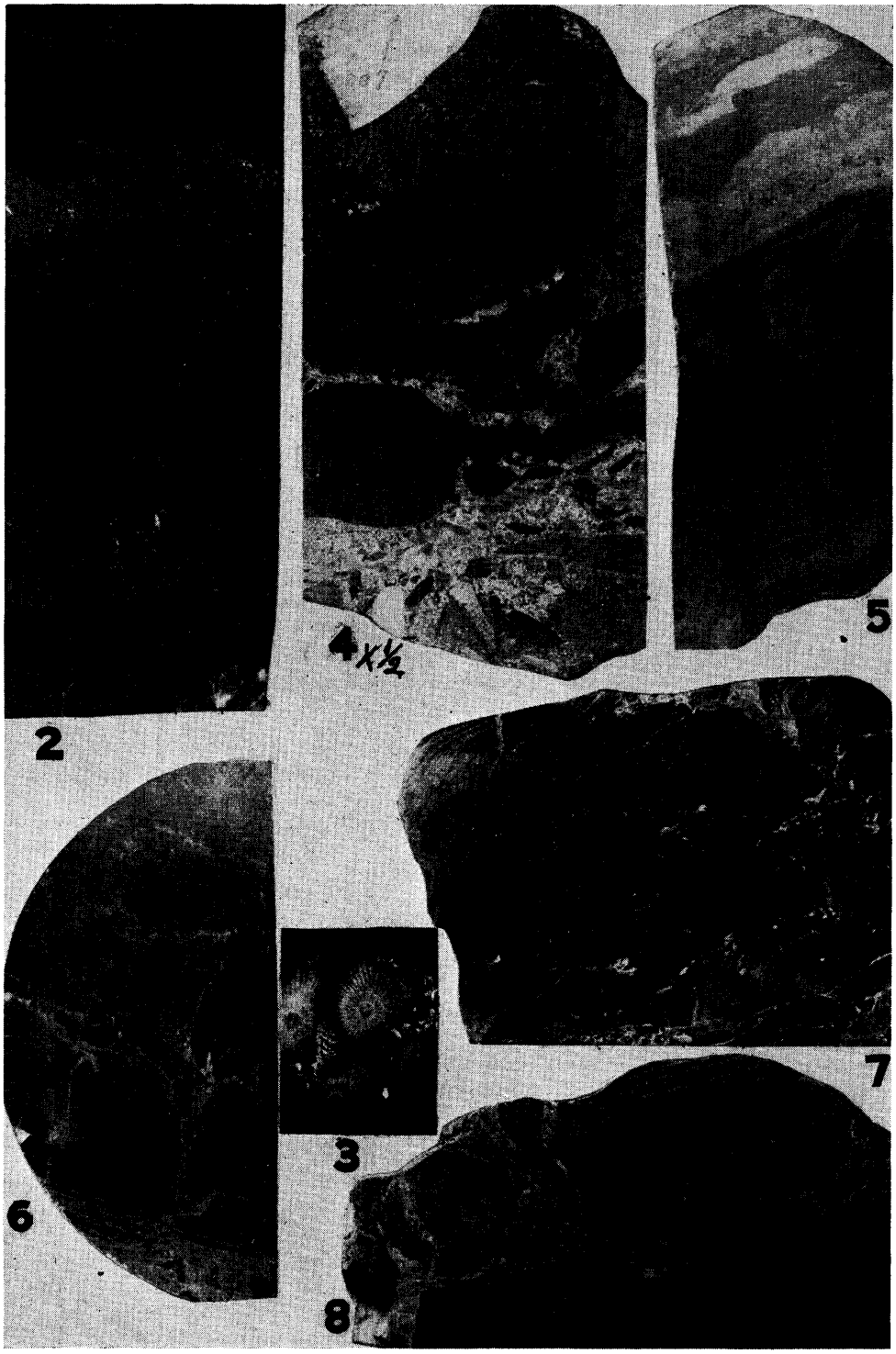
The matrix consists of small sub rounded grains of compact gray dolomite; quartz sand grains; oolites; and fine calcareous sediment and pyrite which form the cementing material. The oolites are most distinct at the basal contact of the zone where the cement has been partly removed allowing each oolite to show its distinct form, and the absence of any interlocking crystalline texture. The upper contact of this zone in the core is a sloping, solution contact with a parting about 1 mm. thick of greenish, argillaceous material with quartz sand grains and

	Thickness Ft. In.
much pyrite. The stone below the parting across most of the core is the brown algal cobble and on one side of the core a stylolite prong of the gray, fine-grained limestone of the zone above, ¼ in. across and ⅞ in. long, extends down into the dense, brown, algal dolomite of the cobble showing the extent to which interlayer solution has taken place (fig. 1, zone 6).	
5. Gray to brownish-gray, dense dolomite	0 — 4
This zone (fig. 5) may be largely of algal origin but is of a different type from the algal mass of zone 6. The lowest one inch is made up of thin laminae which have a broad domal structure ½ in. to 1½ in. across. This grades upward into a part in which the units are ½ in. to ¾ in. across and the laminae are more strongly domed, and this grades back quite abruptly to essentially horizontal laminae. The laminae consist of very thin, at places discontinuous, gray partings alternating with thicker brown units about three times as thick as the gray partings, which indeed appear to be inserted in the denser, brown stone. The upper 1 to 2 in. is light-gray and dark-gray, dense dolomite in alternating, undulating layers ⅛ to ½ in. thick with uneven contacts.	
4. Light-gray to brownish-gray, compact dolomite	0 —11
The core of this zone was sectioned for its full length. The upper 2 to 3 in. is an algal mass composed of brownish-gray, dense dolomite with some irregularly shaped open spaces (figs. 6 and 7). It consists of thicker brown laminae and thin gray partings similar to those in zone 5 above but the mode of growth is quite different. The domed units are quite distinct columns being about ½ in. across and 3 in. long, lying transverse to the vertical of the core. The doming of the laminae is more pronounced. At the base of this algal mass in the core is a ½ in. to 1 in. layer of breccia in which angular fragments of brown algal stone are enclosed in a gray matrix. Farther down through the zone the texture is somewhat irregular and the color mottled as if crushing had taken place, and at the base of the zone much of the width of the core is breccia.	
3. Brown and brownish-gray, vesicular and porous, irregular-textured, broken dolomite	1 — 0
This zone consists of angular fragments of dark-brown, dense dolomite in a matrix of smaller fragments of brown dolomite, oolites, and brownish-gray, finer material. It was apparently formed by the crushing of a vesicular rock, possibly an algal mass with openings. At the base of this zone is a smooth rounded, domed surface 2 by 2½ in. and rising ½ in. above the enclosing stone (fig. 8). A vertical section through this domed mass, plus broken laminae on the upper surface, shows fifteen pairs of the characteristic succession of brown, dense layer and brownish-gray parting. The entire ball-like mass is enclosed in oolites.	
2. Brown, even-textured, oolitic dolomite	3 — 0
The stone is composed almost entirely of small oolites about 0.5 mm. in diameter. They are dominantly round, a few are oblong. On a polished surface of the stone they are shown imbedded in a dense dark-brown matrix.	
1. Brown, irregularly-textured, porous dolomite	0 — 2
Rough-textured dolomite consisting of masses of brown, dense stone, some oolite grains and gray porous matrix. It is somewhat broken or crushed thus resembling the stone of zone 3. This is the base of the core at well-depth 577 ft.	

EXPLANATION OF FIGURES 2–8

2. Upper part, is base of Olentangy shale. Middle part is zone 10, the detrital material on top of Columbus limestone. Basal part is top of coral colony, Hexagonaria.
3. Cross section of corallites of *Hexagonaria prisma* showing diagnostic characteristics. Zone 9, Columbus limestone.
4. (X½) The detrital material at Siluro-Devonian contact, zone 6 entire. The large cobble above may show algal structure.
5. Structure in Raisin River dolomite, zone 5, that may be of algal origin.
6. Structure in Raisin River dolomite, zone 4, that may be of algal origin.
7. Same specimen as in No. 6, sectioned at right angle.
8. Specimen from Raisin River dolomite, zone 3, showing laminated domal mass enclosed in oolitic and detrital material.

Sections and photographs by Richard Bowman.


2
4 X ½
5
6
3
7
8

GEOLOGIC AGE OF THE CALCAREOUS ROCK STRATA

The following is a geologic column of the rock units present along a north-south belt through central Ohio. To this the reader may refer for the stratigraphic position of the unit-names used in the following discussion.

Upper Devonian	Ohio Shale
	Olentangy shale
Erian	Prout limestone } —not known South of Erie Co.
	Plum Brook shale } —not known South of Erie Co.
	Delaware limestone—not known south of Franklin Co.
Ulsterian	Columbus limestone—not known south of Pickaway Co.
	Detroit River dolomite—not known south of Sandusky Co.
	Hillsboro sandstone—locally at Sil.-Dev. contact.
Bass Islands	Raisin River dolomite
	Put-in-Bay dolomite
	Tymochtee shaly dolomite
	Greenfield dolomite
Niagaran	Peebles dolomite } —in Highland and Adams Cos.
	Lilley dolomite } —in Highland and Adams Cos.
	Bisher dolomite } —in Highland and Adams Cos.

In the foregoing section of the calcareous strata below the Upper Devonian shale there are two detrital units; zone 10 and 9 at the top just below the shale where one might expect a stratigraphic break, and zone 6 near the center of the calcareous section where a stratigraphic break would be much less probable.

Zones 8 and 7 above the lower detrital zone consist of gray to bluish-gray, compact to somewhat porous, finely-crystalline dolomitic limestone. Very poorly preserved, unidentifiable corals, including slender tubular types, a small horn coral and compound Favosites-like forms exist in zones 7, 8, and 10. These corals suggest a Devonian age but the one decisive fossil of the entire calcareous section is the colony of the compound, compact coral *Hexagonaria prisma* (Lang and Smith) which forms zone 9 (fig. 1, no. 9; fig. 2, basal part; and fig. 3). The characteristics of the genus are very definite and our specimen is notably well preserved showing on polished sections all the essential internal structures. The genus *Hexagonaria* is known only from the Devonian and *H. prisma* is a species present in the Columbus limestone of central Ohio.

On the basis of this *Hexagonaria prisma* colony, supported by the unidentifiable corals of zones 7 and 8, we must decide that the rock unit which lies disconformably below the Upper Devonian shale is the Columbus limestone down to the lower detrital zone. This includes zones 7 to 10 with a total thickness of 6 ft.

In the Columbus region of central Ohio *Hexagonaria prisma* is known only in zone H at the top of the Columbus limestone, which formation has there a total thickness of about 100 ft. Further, it is believed, on fossil evidence that this upper part of the Columbus continues northward to the Sandusky region but that the lower part of the Columbus of central Ohio is overlapped northward. The presence of *Hexagonaria prisma* in this core suggests that it is the highest part of the Columbus that is represented here. Since the Columbus is only 6 ft. thick in the core and the specimen of *Hexagonaria* is at the top, this interpretation would require that the Columbus sea did not reach this locality until late in Columbus time. It seems improbable that the marine Columbus limestone overlaps eastward away from the Cincinnati anticline. As noted above (zone 9) there is evidence that the Hexagonaria mass is part of the detrital unit resting on the Columbus and therefore may have originated at a higher stratigraphic level and a later time than the limestone layer on which it finally came to rest. However, it is very improbable that a piece of limestone released from its parent ledge in a region of

denudation could remain on or in the mantle rock during the time required for the lowering of the region some 50 to 75 ft. and then become buried beneath the sediments of a new cycle of deposition without complete disintegration or decomposition.

It is noted in the description of the geologic section that the matrix of the lower detrital zone (no. 6) contains quartz grains. In the basal 3 to 4 in. these quartz grains may constitute 10 to 15 percent of the whole, decreasing rapidly upward. When freed from the dolomite by treatment with acid most of the grains are clear rock-crystal quartz between 0.25 and 0.5 mm. diameter, well rounded and pitted or frosted with minute pits. Some of the grains show secondary enlargement by growth of hexagonal pointed ends and high-luster prism faces. The characteristics of these sand grains are identical with those found at the Siluro-Devonian systemic contact from north to south across Ohio; the Sylvania sandstone of Lucas County, the basal zone A of the Columbus limestone of central Ohio, and the Hillsboro sandstone of Highland County in southern Ohio. At all places, this sand or sandy material rests disconformably on the highest Silurian rock unit present at that locality when the sand was deposited. This is commonly on one of the four members of the Bass Islands group but in Highland County where the erosion had been greater, the Hillsboro sandstone at places rests on a still lower unit, the Niagaran dolomite. The sand unit is overlain by the first rock unit deposited at that place by the encroaching Devonian sea. In northern Ohio this is the Detroit River dolomite, the lowest Devonian rock unit in Ohio; in central Ohio the Detroit River is missing and the sand is found in the basal layers of the next overlying unit, the Columbus; and in southern Ohio where the Columbus and Delaware limestones are also absent the Upper Devonian shale rests on the sandstone or in its absence, on Niagaran dolomite.

On the basis of the characteristics of the quartz sand in this lower detrital zone and its stratigraphical position below the Columbus limestone in this part of Ohio, this zone 6 must mark the Siluro-Devonian contact horizon.

Zones 1 to 5 below the lower detrital unit consist of gray through brownish-gray to brown, compact to dense, and in part crushed or fractured dolomite. Oolites are present, and in zone 2 they constitute most of the rock material. No animal fossils were found in the 6 ft. of this lower division of the calcareous section but structures which are noted in the foregoing pages as probably fossil algae are present in zones 3, 4, 5, and 6. So far as the writer knows fossil algae have not been previously reported from any Silurian rock unit of Ohio and there are very few references to algae in Silurian or Devonian strata anywhere. Therefore these probable algae may have very little value for correlation purposes even when more thoroughly determined. The writer has long suspected that certain spheroidal and domal, laminated forms in the Bass Islands group might have had an algal origin but has found no conclusive evidence for this interpretation. One such rudely spherical, laminated form from the Greenfield dolomite of the Bass Islands was studied by John W. Wells with a negative conclusion as to having an algal origin (Wells, 1942).

The lithology of this lower unit accords well with that of the upper Bass Islands dolomite and especially with that of the Raisin River formation, the highest unit of the Bass Islands, and of the Silurian system in Ohio. The Raisin River is also suggested by the presence of oolitic dolomite so notably developed in zone 2 of the foregoing section and present also in zones 1, 3, and 6. Oolites are very characteristic of the Raisin River dolomite of Monroe County of southeastern Michigan, the type locality for this member (Grabau and Sherzer, 1910), and they have been seen at a few places in the Raisin River member in Lucas County, Ohio. There are many references in the literature noting the association of oolites and fossil algae in the same formation. Probably both require or are favored by a high percentage of calcium carbonate in the sea water whether they have an organic or a physico-chemical origin.

The Raisin River member has not been positively identified in central Ohio by its type fossils as known in southeastern Michigan and northwestern Ohio. However, the strata directly underlying the Columbus limestone in western Delaware and Franklin counties are certainly Upper Bass Islands (Put-in-Bay or Raisin River) and there, as in this Chillicothe test-core, the lithology indicated Raisin River rather than Put-in-Bay. In neither case does the lithology suggest the Greenfield or the Tymochtee, the two lowest members of the Bass Islands group.

On the bases of 1. stratigraphic position directly below the Columbus limestone; 2. the presence in the detrital zone 6 of the distinctive quartz sand that characterizes the Siluro-Devonian contact widely over Ohio; 3. the similarity of lithology; 4. the presence of oolitic dolomite; we assign zones 1 to 6 of the foregoing section to the Raisin River dolomite here penetrated only 6 ft.

The revision here presented does not effect the areal distribution of the rock formations concerned. There is therefore no change on the areal geologic map. It does however make somewhat more exact our knowledge of the actual distribution of certain formations under cover. Along a north to south course thru central Ohio the Upper Devonian shale (Olentangy and Ohio) overlaps the Prout and Plum Creek units south of Erie County so that in central Ohio the Olentangy rests on the Delaware limestone. Continuing southward it overlaps successively the Delaware and the Columbus and south of Pickaway County, rests on the Bass Islands or the Niagaran. The presence of 6 ft. of Columbus limestone in the test-core indicated that the north-south course of the west edge of the Devonian limestone under cover probably passes just west of Chillicothe.

South of Fayette County the Upper Bass Islands unit is not represented on the outcrop and the Lower Bass Islands unit has only a patchy distribution thence southward to beyond the Ohio River. On this basis it has been natural to assume that probably the Upper Bass Islands unit was never deposited in southern Ohio. The presence of strata here interpreted as Raisin River dolomite, the highest unit of the Bass Islands group, in the base of the test-core section, 18 mi. east of where the Greenfield passes beneath the upper Devonian shale, suggests that the complete section of the Bass Islands is present under cover to the east and southeast under southeastern Ohio.

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GEOLOGICAL SURVEY OF OHIO
COLUMBUS 10
GEORGE W. WHITE, State Geologist

Report of Investigations No. 2

Geologic Section of the Chillicothe Test-Core

By
J. ERNEST CARMAN

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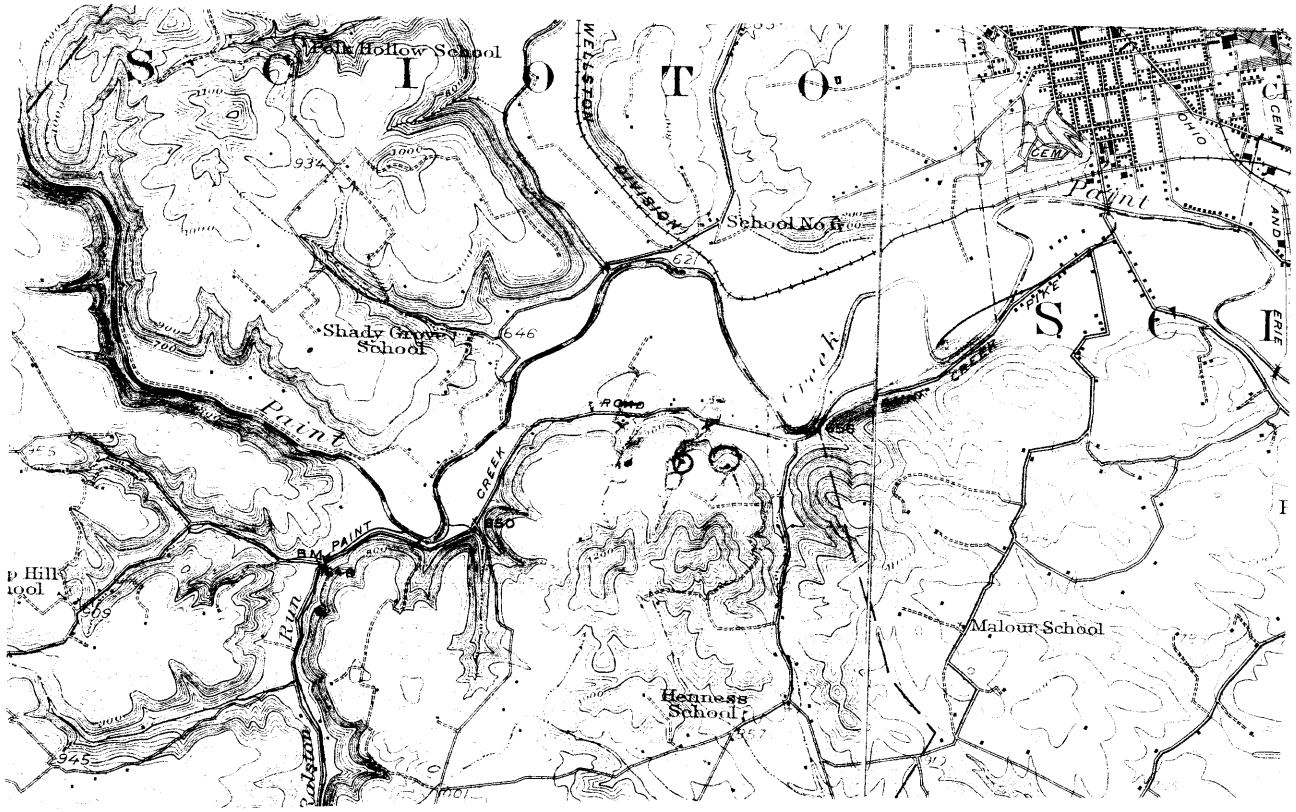
Vol. XLVII, No. 2, pp. 49-54, 1947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Shady Grove School
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Henness School
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OHIO
AND
ERIE
PIKE
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See Ohio Journal of Science
Vol. LV, No. 2, Mar. 1955, p. 65-72
for revision.

GEOLOGIC SECTION OF THE CHILLICOTHE TEST-CORE

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In the autumn of 1944 the Engineering Experiment Station of The Ohio State University put down a test boring southwest of Chillicothe, Ohio, for the purpose of obtaining a drill core for the determination of the petroleum content of the Ohio shale, foot by foot. Mr. L. C. Karrick, formerly of the U. S. Bureau of Mines, where he had had much experience in analyzing oil shale and coal, supervised the taking of the core and made the analyses for petroleum. A report on this study will be published by the Engineering Experiment Station at an early date.

The Experiment Station officials[1] allowed the writer to study the core and after the analyses were made, the unused parts were turned over to the Department of Geology. These include alternate ½-inch sections of the core through the Ohio shale and the complete core through the other formations.

The location of the test well is about three miles southwest of Chillicothe, on the south slope of Paint Creek Valley on the Hirsh Orchard Farm.[2] This is in the edge of the Appalachian Plateau where the surface is rugged and the local relief is 400 to 600 feet. A north-south cross section sketch of Paint Creek Valley is shown in Figure 1. The elevation of Paint Creek is here about 610 feet. The valley is broad with steep slopes which rise to a bench at 880 to 900 feet. Just below the edge of the bench the Berea sandstone commonly crops out in a cliff at the top of the steep valley side where it is undermined by the more rapid weathering and slumping away of the softer Bedford shale below. The lower slopes are at the level of the Ohio shale which is rarely exposed. The bench is at the horizon of the Sunbury shale and the overlying Cuyahoga shale which have been worn away more rapidly than the more resistant Berea sandstone below. The bench on the south is about one-fourth of a mile wide and beyond this the surface rises to a hill capped with a sandstone unit of the Logan formation at an elevation of 1260 feet.

The test boring is located near the edge of the bench at an elevation of about 880 feet. The total depth is 577 feet and the bottom of the well should have an

[1]C. E. MacQuigg, Director; J. R. Shank, Assistant Director; T. H. Kerr, Supervisor of Fuels Research.

[2]From the Hirsch farm house on the south side of Paint Creek Road, a private farm road extends southwest for about one-fourth of a mile, up the slope along the course of a small run to the orchard located on a bench. The test boring is located about 50 yards northeast of where the farm road comes out of the head of the ravine onto the bench. The location of the test boring is in the southeast part of the Roxabell quadrangle, approximately 3300 feet S. 78° W. from the road fork which is just south of Paint Creek and one-eighth of a mile west of the east line of Huntington Township.

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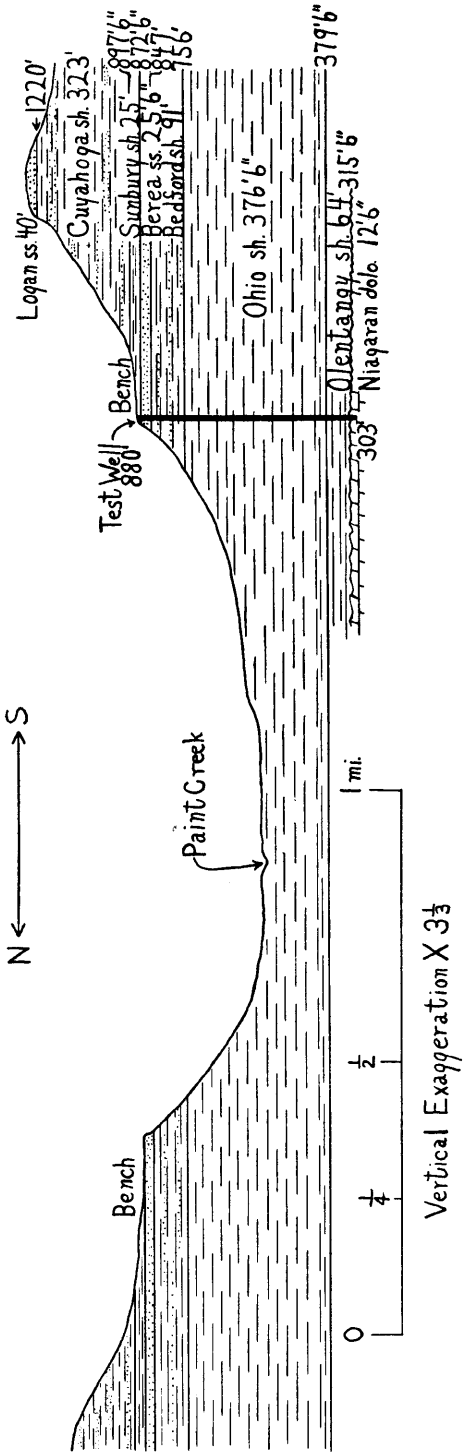

FIG. 1. North-south cross section of Paint Creek Valley about 3 miles southwest of Chillicothe, passing through the Chillicothe test well.

elevation of about 303 feet, at about 300 feet below the level of Paint Creek. The section of rock units penetrated is as follows:

Rock Unit	Thickness Ft.	Thickness In.	Depth to Base Ft.	Depth to Base In.
Mantle rock	6	6	6	6
Sunbury shale	1	0	7	6
Berea sandstone	25	6	33	0
Bedford shale	91	0	124	0
Ohio shale	376	6	500	6
Olentangy shale	64	0	564	6
Niagaran dolomite	12	6	577	0

The first study of the core was very detailed in an attempt to separate every recognizable zone or unit. In this study 114 zones were separated and described. In a later study this was reduced to 35 zones and again to a general section of 16 zones which is given below.

GEOLOGIC SECTION OF THE CHILLICOTHE TEST CORE

	Ft.	In.
Mantle rock. 6 feet, 6 inches.		
1. Clay and fragments of yellow sandstone	6	6
Sunbury shale. 1 foot.		
2. Black, fissile shale with *Lingula melia* and *Orbiculoidea herzeri*	1	0
Berea sandstone. 25 feet, 6 inches.		
3. Medium-grained, blue-gray sandstone with thin shaly partings	25	6
Bedford shale. 91 feet.		
4. Interbedded thin laminae and lenses of blue-gray sandstone and shale, with a few layers of sandstone 2 to 12 inches thick in the upper half and a 3-inch layer of sandstone at the base	22	6
5. Interbedded thin laminae and lenses of blue-gray sandstone and dark-blue shale in about equal amounts	20	0
6. Interbedded thin laminae and lenses of dark-blue shale and blue-gray sandstone with a few layers of sandstone 1 to 4 inches thick	26	6
7. Interbedded dark-blue and blue-gray shale with a few laminae and thin layers of sandstone in the upper half	22	0
Ohio shale. 376 feet, 6 inches.		
8. Black shale with *Lingula*, fishplates, conodonts and macrospores	25	6
9. Black to brownish-black shale with *Lingula*, fishplates and macrospores	44	0
10. Black shale with a few layers of blue shale 2 to 6 inches thick	5	6
11. Brownish-black and blue-gray shale in interbedded thin layers and laminae	21	0
12. Brownish-black shale with a few layers of blue-black and blue-gray shale and with a few gray, calcareous partings in the lower half	48	9
13. Brownish-black shale with thin layers and lenses of blue-black shale	168	6
14. Brownish-black shale with a few 2- to 6-inch layers of blue-gray shale	63	3
Olentangy shale. 64 feet.		
15. Blue-gray shale with layers of brownish-black, especially in basal 5 feet. *Lingula*, conodonts and macrospores in basal 2 feet	64	0
Niagaran dolomite. 12 feet, 6 inches.		
16. Bluish-gray to brownish-gray dolomite with quite variable texture	12	6

The highest bedrock present at the site of the test boring is the basal one foot of the Sunbury shale. Lying just below the mantle rock, this shale was greatly weathered and was not saved in the drill core. It was penetrated also in an excavation for a water-basin just beside the test boring and small fragments from this excavation showed the typical, black, fissile Sunbury shale, as well as the two characteristic fossils *Lingula melia* and *Orbiculoidea herzeri* which are so persistently present in central Ohio in the basal six inches of the Sunbury shale.

The upper five feet of the Berea sandstone of this core is much broken by weathering, yellow to buff in color, and contains thin partings and veins of ferruginous material. The lower half is argillaceous to shaly sandstone with an increasing number of partings and thin layers of shale downward. In fact the contact between the Berea and the Bedford must be somewhat arbitrarily chosen. There is no suggestion of a break between them.

The distinctive feature of the Bedford is the prominent and persistent alternation of thin layers and lenses of sandstone and shale within which are also a few definite layers of sandstone, increasing in thickness and number upward through the formation. In Franklin and Delaware counties most of the Bedford is soft clay shale with sandy laminae and thin layers in the upper 20 to 30 feet in some exposures. In the test-core section only the basal 10 to 15 feet is clay shale and all the rest contains abundant lenses and thin layers of sandstone The first appearance of arenaceous sediments came earlier in Ross County than in Franklin County. Further, the soft chocolate-brown clay shale that forms the middle part of the Bedford in Franklin and Delaware counties is not present in the test-core section. In the basal few feet of the Bedford of the test-core the fossils *Lingula* and *Orbiculoidea* were seen. They were very poorly preserved impressions, unidentifiable as to species. They were probably *Lingula meeki* and *Orbiculoidea newberryi* which are part of the larger fauna found in the basal two feet of the Bedford shale in Franklin County.[3] The contact of the Bedford with the Ohio shale below is definitely conformable.

The Ohio shale is black to brownish black with thin layers of blue-black to blue-gray shale. It is very uniform in color and texture and the slight differences upon which zones may be based in this test-core section could not be expected to hold laterally over large areas. In general the highest 75 feet is the blackest part and has the fewest bluish layers while the lowest 75 feet has the most bluish shale. That part between 75 and 150 feet below the top of the Ohio shale has a few thin, gray, calcareous partings.

Fossils found in the Ohio shale of this core include conodonts, minute fishplates, macrospores, and the brachiopod, *Lingula*. These fossils have not yet received the detailed microscopic study which most of this material requires and only general statements will be made concerning them.

The only invertebrate found is the brachiopod *Lingula*, of which there are two species: a smaller, elongate, subrectangular form about one-fourth of an inch long, apparently *Lingula spatulata*, and a larger, broader, more oval form about half an inch long. The smaller form was seen in the black shale at a number of levels in the upper 70 feet of the Ohio, at 91 feet below the top in blue shale, and at several levels at 4 to 12 feet above the base in mixed black and blue shale. The larger form was found at 83 and 91 feet below the top and at 18 feet above the base, all in blue-gray shale.

A number of conodonts were found in the upper 12 feet of the Ohio shale where the study was made with the binocular microscope. Below this level the microscope was not used and only a few conodonts were seen but it is probable that an examination with the microscope would reveal them throughout most of the formation. Several types of conodonts were recognized.

Small, black, glossy plates about one-eighth of an inch across, of several shapes and markings, were found at various levels in the Ohio shale. They resemble ganoid fish scales and apparently belong to the Rhadnichthids as figured by Branson from the Ohio shale of northern Ohio.[4]

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[3]Stauffer, C. R., Columbus Folio: U. S. Geol. Survey Folio 197, 1915, p. 7.

[4]Branson, E. B., Notes on the Ohio Shales and their Faunas: The University of Missouri Bulletin, Science Series, Vol. 2, No. 2, 1911, pp. 23-32.

The most abundant fossil of the Ohio shale is the minute, round, amber-colored macrospore, .25 to .5 millimeter in diameter known as *Protosalvinia huronensis*. They are common in the upper 25 feet of the formation and below this to about 200 feet they are present but uncommon. From 200 feet to the base at 376½ feet they are common and at some partings so abundant as to almost cover a bedding surface and give to it a brown color.

A very definite contact can be drawn between the Ohio and the Olentangy shales, but also it is a very definitely conformable contact. The lithologic difference between the two formations is only a matter of percentage of the kind of material making up both formations. The Ohio is dominantly black or brownish-black shale with layers of blue-black or blue-gray shale while the Olentangy is dominantly blue-gray shale with layers of brownish-black shale, which in this test-core section continue to the base of the Olentangy, for here the basal 3 feet is the blackest part of the formation. This section shows a close relation for the two formations, which should mean a close age relation. It supports the conclusions of Lamborn that the Olentangy shale of southern Ohio "is a basal phase of the Ohio shale and therefore Upper Devonian in age."[5]

Parts of the blue shale of the lower two-thirds of the Olentangy are slightly calcareous and the lower one-third contains small nodules or thin layers of calcareous material. Pyrite nodules were found at several horizons and also lenses and layers with much disseminated pyrite. Plant impressions or carbon films were seen at three horizons and a thin layer of grainy, fragmental material at two feet about the base yielded several types of conodonts, macrospores, and a few distorted specimens of a small Lingula.

The base of the Olentangy is firmly joined through a ½-inch, transition unit of grainy or fragmental material, to a crystalline dolomite below. The contact is uneven and it is definitely a disconformable contact. This dolomite was penetrated to a depth of 12 feet 6 inches, the bottom of the test boring. The dolomite is bluish-gray to brownish-gray and quite variable in texture. In part it is firmly crystalline and compact; in part of very rough texture with open spaces containing petroliferous staining; at places apparently brecciated as if crushed reef-material; the basal 4 feet is largely oolitic dolomite. No identifiable fossils were found in the dolomite but in the porous, crushed reef-rock material there are structures that suggest the compound coral *Favosites* and concentrically laminated masses suggesting stromatoporoids, all greatly altered. Although not absolutely conclusive, the evidence indicates that this dolomite is upper Niagaran, probably about the equivalent of the Peebles dolomite of Highland and Adams counties. That is, the Upper Devonian shale rests disconformably on Middle Silurian dolomite.

Passing southward from central Ohio the Olentangy-Ohio unit, overlaps the outcrops of the Delaware and Columbus limestones in Pickaway County and thence southward to the Ohio River rests upon either the Greenfield or Niagaran dolomites. Further, in many of the sections of eastern Highland and Adams counties the Olentangy blue shale unit is missing and the Ohio black shale rests upon the Greenfield or Niagaran. This is readily explained by the interpretation that the Olentangy is merely a non-carbonaceous phase of the greater Ohio shale, a phase which was formed generally, but not everywhere, during the early part of the Ohio shale stage, being contemporaneous with black shale which was forming elsewhere.

The test-core section shows 64 feet of Olentangy shale between the Ohio shale and the dolomite. However, on the outcrop, 20 miles to the west near Greenfield, or 16 miles to the west-southwest near Bainbridge, the Ohio shale rests directly on the dolomites. This may mean that the deposition of the black sediments

[5]Lamborn, Raymond E., The Olentangy Shale in Southern Ohio: Jour. Geol., Vol. 35, 1937, p. 722.

was at a later time and extended farther westward on the old erosion surface than did the blue sediments, or more probably it means that the sediments laid down farther west at Greenfield and Bainbridge contained enough carbonaceous material to make black shale while farther east at the test-core site, contemporaneous deposits without carbonaceous material resulted in blue shale. This accords with the usual interpretation of an eastward source for the Upper Devonian sediments, which were carried westward into a shallow, possibly stagnant, sea area where plant growth furnished the carbonaceous material for making black shale.

The test-core section shows that the west edge of the Columbus-Delaware limestone unit which is overlapped in west central Pickaway County, must run southeast or southeast-by-east in order to pass east of the test-core site which is 16 miles east and about 20 miles south of where the limestones are overlapped. It also shows that the Silurian-Devonian disconformity, which along the outcrop in eastern Highland County is at approximately the contact of the Greenfield dolomite on the Niagaran dolomite does not rise eastward across the dip of the strata, but descends eastward with a somewhat greater dip than the strata in order that the Devonian shales rest on the Niagaran at the test-core site. The base of the Devonian shales, which on the outcrop south of Greenfield has an elevation of about 970 feet, drops to about 315 feet at the test-core site; a drop of about 655 feet in 20 miles to the east, or about 33 feet per mile, which is approximately the regional dip of this part of the state. Assuming that the old erosion surface which truncates the Silurian dolomites was approximately horizontal and that the Upper Devonian shales were laid essentially horizontal, it appears that all the regional dip was produced in post Devonian time.

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REVISION OF THE CHILLICOTHE TEST-CORE SECTION

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This paper presents a correction in the interpretation of the section of the Chillicothe test-core as given by the present writer in an article published in this Journal (Carman, 1947). The core came from a well 3 miles southwest of Chillicothe on the Hirsh fruit farm. The well was drilled by the Engineering Experiment Station, The Ohio State University, to obtain a core for the determination of the petroleum content of the Ohio shale, foot by foot (Kerr, 1948). The entire core was studied by the writer for the determination of the rock units passed through, and discussed in the 1947 paper. The list of rock units penetrated was given in that paper as follows:

Rock Unit	*Thickness*			*Depth to Base*		
	Ft.		*In.*	*Ft.*		*In.*
Mantle rock	6	—	6	6	—	6
Sunbury shale	1	—	0	7	—	6
Berea sandstone	25	—	6	33	—	0
Bedford shale	91	—	0	124	—	0
Ohio shale	376	—	6	500	—	6
Olentangy shale	64	—	0	564		6
Niagaran dolomite	12	—	6	577	—	0

The present paper deals only with the basal unit of the above section, 12 ft. 6 in. thick which in the earlier paper was assigned to the Niagaran dolomite and described as follows (Carman, 1947, p. 53). "The dolomite is bluish-gray to brownish-gray and quite variable in texture. In part it is firmly crystalline and compact; in part of very rough texture with open spaces containing petroliferous staining; at places apparently brecciated as if crushed reef material; the basal 4 feet is largely oolitic dolomite. No identifiable fossils were found in the dolomite but in the porous, crushed reef-rock material there are structures that suggest the compound coral *Favosites* and concentrically laminated masses suggesting stromatoporoids, all greatly altered. Although not absolutely conclusive, the evidence indicates that this dolomite is upper Niagaran." This correlation agreed with the fact that in Highland and Adams counties to the southwest, the Ohio shale rests disconformably on a surface of Niagaran and Greenfield dolomites.

In the spring of 1953, in the studies of another geologist on detrital materials at the disconformable contact at the base of the Upper Devonian shale, the piece of the Chillicothe test-core containing the top of the dolomite was sectioned vertically. This section revealed a fossil entirely against the Niagaran age of the dolomite and led to a very thorough restudy of this lower part of the core with sections and polished surfaces at a number of horizons.

The Olentangy shale overlying the calcareous strata is dominantly blue-gray in color, but with many thin layers of brownish-black shale. The lowest 3 ft. is black and brownish-black shale with a few thin layers of blue-gray shale. The restudy of the 12 ft. of calcareous strata next below resulted in the following described section which is also shown graphically in figure 1.

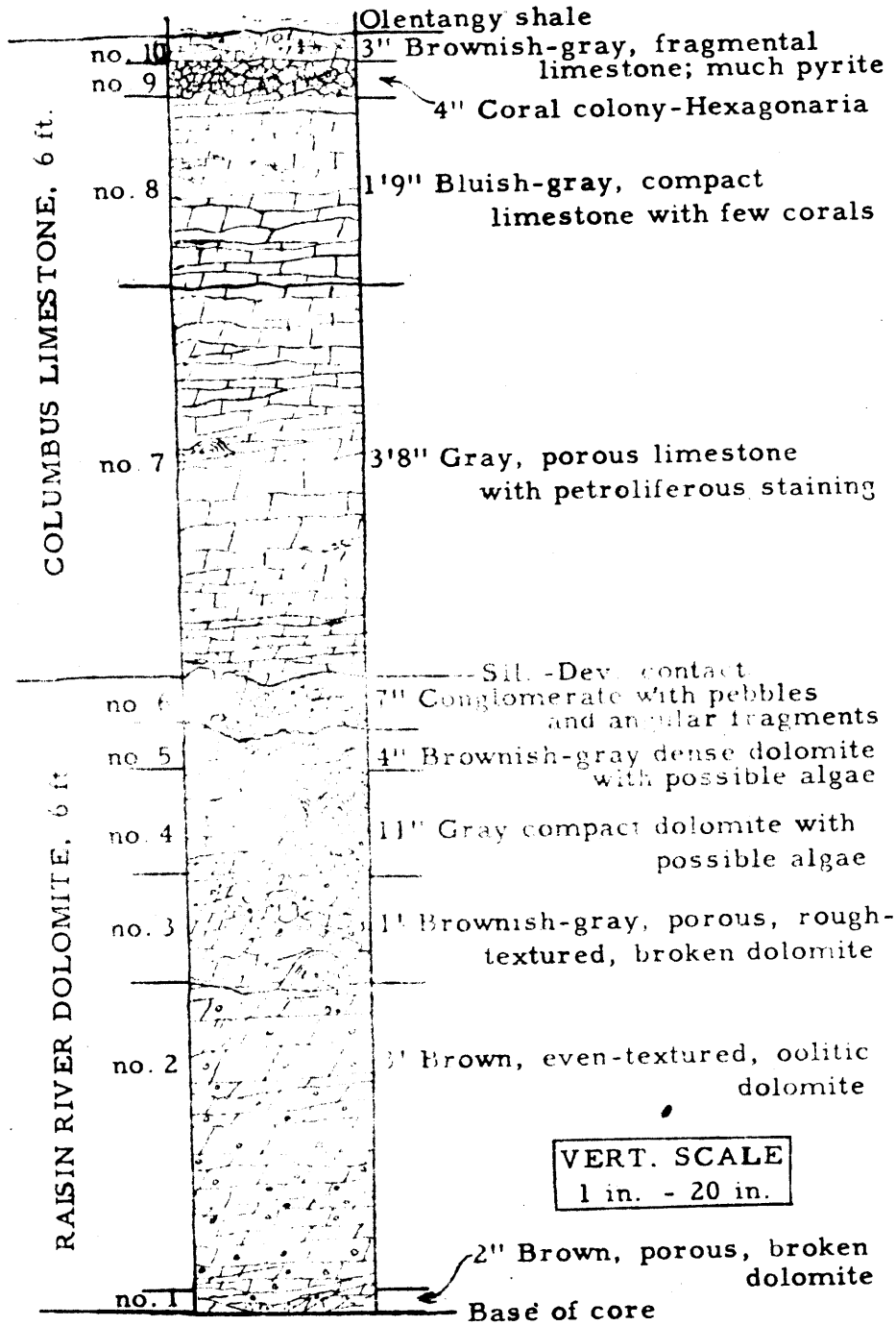

FIGURE 1. Columnar section of calcareous strata below upper Devonian shale

SECTION OF THE CALCAREOUS ROCK STRATA PENETRATED BY THE CHILLICOTHE TEST-CORE BELOW THE UPPER DEVONIAN SHALE

The zones are numbered from the base upward but discussed from above downward.

	Thickness Ft. In.
10. Gray to brownish-gray, compact, fragmental limestone with much pyrite	0 — 3
Composed of small calcareous fragments firmly cemented in a matrix of finer grain. The polished section shows small coral tubes, a horn coral, and a compound Favosites-like coral, all pyritized, poorly preserved, and unidentifiable. There are small lenses of pyrite scattered through the mass and the upper ½ in. is dark in color and largely pyrite (fig. 2, middle part).	
9. Blue-gray, compact, limestone	0 — 4
Composed entirely of part of a colony of the compound, compact coral *Hexagonaria prisma* (Lang and Smith) with the long corralities extending horizontally entirely across the core (fig. 2, basal part and fig. 3). Pyrite has been deposited in porous places and along cracks between or through the corallities. The contact with the unit above is sharp, with small jagged irregularities which cut across and into the internal structures of the corallites without any distortion. The basal contact of the dense coral mass, with the grainy limestone below, drops two inches in the width of the core and along this surface the limestone forms a sharp contact laterally or vertically with any part of the corallites. These contacts of the coral mass are interpreted as solution contacts. The horizontal position of the corallites and the nature of the contacts indicate that the coral colony must have been overturned, probably moved, and was lying on the surface when buried by the detrital material above. The coral is thus a part of the detrital zone but certainly originated in the limestone unit below.	
8. Bluish-gray, fine-grained, compact limestone with some blue streaking and mottling on polished surfaces	1 — 9
Locally, slightly porous with petroliferous staining. In the upper part are poorly preserved, unidentifiable, tubular corals and compound Favosite-like corals.	
7. Gray to bluish-gray, porous, crystalline limestone with much petroliferous staining	3 — 8
Favosite-like, coral structure can be recognized in several of the porous areas and probably most of the porous spaces have originated by the weathering of corals. The basal 9 in. is firmer and more finely crystalline.	
6. Dark-gray to brown conglomerate containing a large pebble or cobble, medium-sized pebbles, small slabby fragments, all dolomite and all set in a matrix of medium to small grains (fig. 1, no. 6 and fig. 4)	0 — 7
A longitudinal, polished section of the entire 7 in. of this zone shows at the top a cobble of dark-brown, dense dolomite over 4 in. across and several pebbles, ½ in. to 1 in. across. The lower part of the zone is made up of sub-angular, lenticular, and slabby particles of the dark-brown and gray dolomite. Finally all of these are enclosed in a matrix consisting of medium to fine grains of dark-brown and gray dolmite, oolites, quartz sand grains and much pyrite. The polished surface of the large cobble shows undulating, more or less contorted, discontinuous, alternating bands or lenses of dark-brown dolomite and less distinct, grayish-brown dolomite. The dark-brown color dominates but the undulating pattern is brought out by the floculent streaks of graysh brown. It is one of the types of structure commonly referred to algae and is so regarded by the writer although no positive algal structures have been found. Between the bands, singly or as thin partings, or in pockets, are small round or oblong dolomite grains 0.2 to 0.3 mm. in diameter, some of which appear to have concentric or radiating structure or appear hollow, and apparently are oolites. Most interesting are the cases where a number of these oolite-like bodies occupy a pocket which must have been at one time a depression in the surface of the algal mass made by the thinning and downfolding of the laminae locally. Such pockets have been figured by authors under the name conceptacles and the oolite-like bodies interpreted as spore cases or some other type of reproductive body (Wieland, 1914).	
The matrix consists of small sub rounded grains of compact gray dolomite; quartz sand grains; oolites; and fine calcareous sediment and pyrite which form the cementing material. The oolites are most distinct at the basal contact of the zone where the cement has been partly removed allowing each oolite to show its distinct form, and the absence of any interlocking crystalline texture. The upper contact of this zone in the core is a sloping, solution contact with a parting about 1 mm. thick of greenish, argillaceous material with quartz sand grains and	

	Thickness Ft.	In.
much pyrite. The stone below the parting across most of the core is the brown algal cobble and on one side of the core a stylolite prong of the gray, fine-grained limestone of the zone above, ¼ in. across and ⅞ in. long, extends down into the dense, brown, algal dolomite of the cobble showing the extent to which interlayer solution has taken place (fig. 1, zone 6).	0	4
5. Gray to brownish-gray, dense dolomite. This zone (fig. 5) may be largely of algal origin but is of a different type from the algal mass of zone 6. The lowest one inch is made up of thin laminae which have a broad domal structure ½ in. to 1½ in. across. This grades upward into a part in which the units are ½ in. to ¾ in. across and the laminae are more strongly domed, and this grades back quite abruptly to essentially horizontal laminae. The laminae consist of very thin, at places discontinuous, gray partings alternating with thicker brown units about three times as thick as the gray partings, which indeed appear to be inserted in the denser, brown stone. The upper 1 to 2 in. is light-gray and dark-gray, dense dolomite in alternating, undulating layers ⅛ to ½ in. thick with uneven contacts.	0	11
4. Light-gray to brownish-gray, compact dolomite. The core of this zone was sectioned for its full length. The upper 2 to 3 in. is an algal mass composed of brownish-gray, dense dolomite with some irregularly shaped open spaces (figs. 6 and 7). It consists of thicker brown laminae and thin gray partings similar to those in zone 5 above but the mode of growth is quite different. The domed units are quite distinct columns being about ½ in. across and 3 in. long, lying transverse to the vertical of the core. The doming of the laminae is more pronounced. At the base of this algal mass in the core is a ½ in. to 1 in. layer of breccia in which angular fragments of brown algal stone are enclosed in a gray matrix. Farther down through the zone the texture is somewhat irregular and the color mottled as if crushing had taken place, and at the base of the zone much of the width of the core is breccia.	1	0
3. Brown and brownish-gray, vesicular and porous, irregular-textured, broken dolomite. This zone consists of angular fragments of dark-brown, dense dolomite in a matrix of smaller fragments of brown dolomite, oolites, and brownish-gray, finer material. It was apparently formed by the crushing of a vesicular rock, possibly an algal mass with openings. At the base of this zone is a smooth rounded, domed surface 2 by 2½ in. and rising ½ in. above the enclosing stone (fig. 8). A vertical section through this domed mass, plus broken laminae on the upper surface, shows fifteen pairs of the characteristic succession of brown, dense layer and brownish-gray parting. The entire ball-like mass is enclosed in oolites.	3	0
2. Brown, even-textured, oolitic dolomite. The stone is composed almost entirely of small oolites about 0.5 mm. in diameter. They are dominantly round, a few are oblong. On a polished surface of the stone they are shown imbedded in a dense dark-brown matrix.	0	2
1. Brown, irregularly-textured, porous dolomite. Rough-textured dolomite consisting of masses of brown, dense stone, some oolite grains and gray porous matrix. It is somewhat broken or crushed thus resembling the stone of zone 3. This is the base of the core at well-depth 577 ft.		

EXPLANATION OF FIGURES 2–8

2. Upper part, is base of Olentangy shale. Middle part is zone 10, the detrital material on top of Columbus limestone. Basal part is top of coral colony, Hexagonaria.
3. Cross section of corallites of *Hexagonaria prisma* showing diagnostic characteristics. Zone 9, Columbus limestone.
4. (X½) The detrital material at Siluro-Devonian contact, zone 6 entire. The large cobble above may show algal structure.
5. Structure in Raisin River dolomite, zone 5, that may be of algal origin.
6. Structure in Raisin River dolomite, zone 4, that may be of algal origin.
7. Same specimen as in No. 6, sectioned at right angle.
8. Specimen from Raisin River dolomite, zone 3, showing laminated domal mass enclosed in oolitic and detrital material.

Sections and photographs by Richard Bowman.

No. 2 CHILLICOTHE TEST-CORE SECTION

GEOLOGIC AGE OF THE CALCAREOUS ROCK STRATA

The following is a geologic column of the rock units present along a north-south belt through central Ohio. To this the reader may refer for the stratigraphic position of the unit-names used in the following discussion.

Upper Devonian	Ohio Shale
	Olentangy shale
Erian	Prout limestone, Plum Brook shale—not known South of Erie Co.
	Delaware limestone—not known south of Franklin Co.
Ulsterian	Columbus limestone—not known south of Pickaway Co.
	Detroit River dolomite—not known south of Sandusky Co.
	Hillsboro sandstone—locally at Sil.-Dev. contact.
Bass Islands	Raisin River dolomite
	Put-in-Bay dolomite
	Tymochtee shaly dolomite
	Greenfield dolomite
Niagaran	Peebles dolomite, Lilley dolomite, Bisher dolomite—in Highland and Adams Cos.

In the foregoing section of the calcareous strata below the Upper Devonian shale there are two detrital units; zone 10 and 9 at the top just below the shale where one might expect a stratigraphic break, and zone 6 near the center of the calcareous section where a stratigraphic break would be much less probable.

Zones 8 and 7 above the lower detrital zone consist of gray to bluish-gray, compact to somewhat porous, finely-crystalline dolomitic limestone. Very poorly preserved, unidentifiable corals, including slender tubular types, a small horn coral and compound Favosites-like forms exist in zones 7, 8, and 10. These corals suggest a Devonian age but the one decisive fossil of the entire calcareous section is the colony of the compound, compact coral *Hexagonaria prisma* (Lang and Smith) which forms zone 9 (fig. 1, no. 9; fig. 2, basal part; and fig. 3). The characteristics of the genus are very definite and our specimen is notably well preserved showing on polished sections all the essential internal structures. The genus *Hexagonaria* is known only from the Devonian and *H. prisma* is a species present in the Columbus limestone of central Ohio.

On the basis of this *Hexagonaria prisma* colony, supported by the unidentifiable corals of zones 7 and 8, we must decide that the rock unit which lies disconformably below the Upper Devonian shale is the Columbus limestone down to the lower detrital zone. This includes zones 7 to 10 with a total thickness of 6 ft.

In the Columbus region of central Ohio *Hexagonaria prisma* is known only in zone H at the top of the Columbus limestone, which formation has there a total thickness of about 100 ft. Further, it is believed, on fossil evidence that this upper part of the Columbus continues northward to the Sandusky region but that the lower part of the Columbus of central Ohio is overlapped northward. The presence of *Hexagonaria prisma* in this core suggests that it is the highest part of the Columbus that is represented here. Since the Columbus is only 6 ft. thick in the core and the specimen of *Hexagonaria* is at the top, this interpretation would require that the Columbus sea did not reach this locality until late in Columbus time. It seems improbable that the marine Columbus limestone overlaps eastward away from the Cincinnati anticline. As noted above (zone 9) there is evidence that the Hexagonaria mass is part of the detrital unit resting on the Columbus and therefore may have originated at a higher stratigraphic level and a later time than the limestone layer on which it finally came to rest. However, it is very improbable that a piece of limestone released from its parent ledge in a region of

denudation could remain on or in the mantle rock during the time required for the lowering of the region some 50 to 75 ft. and then become buried beneath the sediments of a new cycle of deposition without complete disintegration or decomposition.

It is noted in the description of the geologic section that the matrix of the lower detrital zone (no. 6) contains quartz grains. In the basal 3 to 4 in. these quartz grains may constitute 10 to 15 percent of the whole, decreasing rapidly upward. When freed from the dolomite by treatment with acid most of the grains are clear rock-crystal quartz between 0.25 and 0.5 mm. diameter, well rounded and pitted or frosted with minute pits. Some of the grains show secondary enlargement by growth of hexagonal pointed ends and high-luster prism faces. The characteristics of these sand grains are identical with those found at the Siluro-Devonian systemic contact from north to south across Ohio; the Sylvania sandstone of Lucas County, the basal zone A of the Columbus limestone of central Ohio, and the Hillsboro sandstone of Highland County in southern Ohio. At all places, this sand or sandy material rests disconformably on the highest Silurian rock unit present at that locality when the sand was deposited. This is commonly on one of the four members of the Bass Islands group but in Highland County where the erosion had been greater, the Hillsboro sandstone at places rests on a still lower unit, the Niagaran dolomite. The sand unit is overlain by the first rock unit deposited at that place by the encroaching Devonian sea. In northern Ohio this is the Detroit River dolomite, the lowest Devonian rock unit in Ohio; in central Ohio the Detroit River is missing and the sand is found in the basal layers of the next overlying unit, the Columbus; and in southern Ohio where the Columbus and Delaware limestones are also absent the Upper Devonian shale rests on the sandstone or in its absence, on Niagaran dolomite.

On the basis of the characteristics of the quartz sand in this lower detrital zone and its stratigraphical position below the Columbus limestone in this part of Ohio, this zone 6 must mark the Siluro-Devonian contact horizon.

Zones 1 to 5 below the lower detrital unit consist of gray through brownish-gray to brown, compact to dense, and in part crushed or fractured dolomite. Oolites are present, and in zone 2 they constitute most of the rock material. No animal fossils were found in the 6 ft. of this lower division of the calcareous section but structures which are noted in the foregoing pages as probably fossil algae are present in zones 3, 4, 5, and 6. So far as the writer knows fossil algae have not been previously reported from any Silurian rock unit of Ohio and there are very few references to algae in Silurian or Devonian strata anywhere. Therefore these probable algae may have very little value for correlation purposes even when more thoroughly determined. The writer has long suspected that certain spheroidal and domal, laminated forms in the Bass Islands group might have had an algal origin but has found no conclusive evidence for this interpretation. One such rudely spherical, laminated form from the Greenfield dolomite of the Bass Islands was studied by John W. Wells with a negative conclusion as to having an algal origin (Wells, 1942).

The lithology of this lower unit accords well with that of the upper Bass Islands dolomite and especially with that of the Raisin River formation, the highest unit of the Bass Islands, and of the Silurian system in Ohio. The Raisin River is also suggested by the presence of oolitic dolomite so notably developed in zone 2 of the foregoing section and present also in zones 1, 3, and 6. Oolites are very characteristic of the Raisin River dolomite of Monroe County of southeastern Michigan, the type locality for this member (Grabau and Sherzer, 1910), and they have been seen at a few places in the Raisin River member in Lucas County, Ohio. There are many references in the literature noting the association of oolites and fossil algae in the same formation. Probably both require or are favored by a high percentage of calcium carbonate in the sea water whether they have an organic or a physico-chemical origin.

The Raisin River member has not been positively identified in central Ohio by its type fossils as known in southeastern Michigan and northwestern Ohio. However, the strata directly underlying the Columbus limestone in western Delaware and Franklin counties are certainly Upper Bass Islands (Put-in-Bay or Raisin River) and there, as in this Chillicothe test-core, the lithology indicated Raisin River rather than Put-in-Bay. In neither case does the lithology suggest the Greenfield or the Tymochtee, the two lowest members of the Bass Islands group.

On the bases of 1. stratigraphic position directly below the Columbus limestone; 2. the presence in the detrital zone 6 of the distinctive quartz sand that characterizes the Siluro-Devonian contact widely over Ohio; 3. the similarity of lithology; 4. the presence of oolitic dolomite; we assign zones 1 to 6 of the foregoing section to the Raisin River dolomite here penetrated only 6 ft.

The revision here presented does not effect the areal distribution of the rock formations concerned. There is therefore no change on the areal geologic map. It does however make somewhat more exact our knowledge of the actual distribution of certain formations under cover. Along a north to south course thru central Ohio the Upper Devonian shale (Olentangy and Ohio) overlaps the Prout and Plum Creek units south of Erie County so that in central Ohio the Olentangy rests on the Delaware limestone. Continuing southward it overlaps successively the Delaware and the Columbus and south of Pickaway County, rests on the Bass Islands or the Niagaran. The presence of 6 ft. of Columbus limestone in the test-core indicated that the north-south course of the west edge of the Devonian limestone under cover probably passes just west of Chillicothe.

South of Fayette County the Upper Bass Islands unit is not represented on the outcrop and the Lower Bass Islands unit has only a patchy distribution thence southward to beyond the Ohio River. On this basis it has been natural to assume that probably the Upper Bass Islands unit was never deposited in southern Ohio. The presence of strata here interpreted as Raisin River dolomite, the highest unit of the Bass Islands group, in the base of the test-core section, 18 mi. east of where the Greenfield passes beneath the upper Devonian shale, suggests that the complete section of the Bass Islands is present under cover to the east and southeast under southeastern Ohio.

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