RICHARD SMOSNA
Department of Geology and Geography
West Virginia University

CORE DESCRIPTION
MIDDLE ORDOVICIAN TRENTON LIMESTONE
SANDHILL WELL
WOOD COUNTY, WEST VIRGINIA

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MIDDLE ORDOVICIAN TRENTON LIMESTONE

Richard Smosna

Middle Ordovician carbonates of the eastern US are the object of much economic interest. Trenton carbonates, in particular, are known to be oil and gas reservoirs in several parts of the Appalachian and Central Interior provinces. The Trenton yields oil in New York, Michigan, Ontario, Ohio, Kentucky, Tennessee, and Virginia, and natural gas in deep wells of Pennsylvania, Ohio, and West Virginia. In fact, many geologists feel that Trenton limestones have the best petroleum potential of all deep targets in West Virginia. These limestones underlie the Martinsburg-Reedsville Shale and are interbedded with similar black shales, which probably were the hydrocarbon source beds. Furthermore, along the eastern margin of the Appalachian basin, the rocks have been severely fractured, faulted, and locally dolomitized, leading to good secondary porosity. Although only limited data are available for the Trenton in deep parts of the basin, exploration is still taking place, and old fields are being studied for secondary recovery.

The purpose of this report is to offer detailed petrographic information on the Trenton Limestone for a strategic well of West Virginia. The Sandhill well was drilled in Wood County in 1955. It reached a depth of 13,331 feet, of which 2868 feet was cored. The cored interval includes 2000 feet of Middle and Lower Ordovician carbonates: the Trenton, Black River, Chazy, and Beekmantown Formations. The cores were previously described in general terms (WVGS Reports of Investigation 14 and 18), they have been slabled longitudinally, and they are now stored at the West Virginia Geological and Economic Survey's warehouse.

The top of the Trenton Limestone in this core is easily distinguished from the overlying black shales of the Martinsburg-Reedsville Formation. The depth is 9528 feet. The base of the Trenton, however, is gradational with the under-

lying Black River Limestone. In Reports of Investigation 14 and 18 by the West Virginia Geological Survey, the base of the Trenton was picked anywhere from 9730 feet to near 9900 feet. For this study the Trenton is defined as the limestone between 9528 and 9874 feet, for two reasons. (1) The neutron log shows a major deflection at this depth, indicating a significant decrease in interbedded shale below. (2) Two previous authors (Woodward and Prouty) agreed on this interval. Unfortunately, coring through the Trenton was not continuous, and a gap exists from 9665 to 9790. Of the 346 feet of Trenton in the Sandhill well, 221 feet of core is available for this study.

The following core description emphasizes carbonate textures and structures important for paleoenvironmental and diagenetic interpretations. Included is information on lithologies, fossils, non-skeletal grains, bedding structures, diagenetic changes, and porosity types. Lithologically, the Trenton is extremely heterogeneous. It consists of various limestone rock types as well as black calcareous shale, all intimately interbedded. As a consequence, establishing informal units within the formation is quite difficult. Each unit, therefore, generally contains several lithologies, and these are listed in the core description in order of their aggregate thickness. The limestone classification used is that of R.J. Dunham (1962, AAPG Memoir 1, p. 108-121), a classification scheme based on depositional texture. Grainstone refers to a mud-free, grain-supported rock, and packstone to a grain-supported rock that contains some matrix of lime mud. Wackestone is a mud-supported rock with more than 10 percent grains. Lime mudstone has less than 10 percent grains.

It is hoped that the Trenton Limestone of the Sandhill well may now serve as a reference section in any future studies of Middle Ordovician carbonates in the central Appalachians.

CORE DESCRIPTION

MIDDLE ORDOVICIAN TRENTON LIMESTONE

SANDHILL WELL, WOOD COUNTY, WEST VIRGINIA

depth	thickness	description
9526.0-9527.6	1.6	dk gy calc shale, burrows-mostly horiz and compacted, few vert, often bioturb, numerous oblique calcite-filled veins, open horiz fracs
		lam grainstone, f-gr, large brachs on bdg planes, ostra common, horiz veins w/abun pyrite, 2 inches thick
		blk brach packstone, bryo, crin, ostra, trilo, tracks/trails, fossils w/horiz orient, 1 inch thick
9527.6-9532.0	4.4	fossil packstone, crin, brach, bryo, ostra, trilo (pyrite), argill, bioturb
		blk calc shale, becoming less common toward base of unit, open horiz fracs
		partly open, calcite-filled vein at 9527.8', drusy xls
9532.0-9546.0	14.0	lt gy fossil packstone-mudstone, brach, bryo, crin, gastro, coral, ostra, bioturb, nodular bdg
		blk calc shale, bioturb-horiz burrows, floating fossils, or conc in thin lam, flow structure around ls nodules
		vein w/slickensides at 9532
		fossil grainstone at 9545, brach, bryo
9546.0-9555.6	9.6	lt gy fossil packstone-mudstone, bioturb, brach, bryo, crin, ostra, gastro — still some nodular
		blk calc shale, locally fossiliferous, flow structure, horiz fracs and veins
9555.6-9564.0	8.4	blk calc shale, fossils conc in thin lam, brach, bryo, open horiz fracs, flowage, few horiz burrows few fossils pyritized, slickensides at 9563
		lt gy lime mudstone, bioturb, ostra, crin, bryo, rare orig lamination — nodular
		0.7 ft missing at 9557
		fossil grainstone at 9560, interxlline porosity, 1 inch thick

depth	thickness	description
9564.0-9566.0	2.0	blk calc shale, brach, bryo, crin lt gy bioturb lime mudstone fossil grainstone at 9565, bryo, crin, pin-point porosity, loosely packed, 2 inches thick
9566.0-9570.0	4.0	lt gy bioturb lime mudstone, brach, crin, bryo blk calc shale, numerous horiz fracs, flowage grainstone at 9566, no bdg, 3 inches thick
9570.0-9573.0	3.0	fossiliferous blk shale, calc, bryo, brach, crin lt gy bioturb lime mudstone, some floating fossils nodular grainstones at 9572, less than 2 inches thick
9573.0-9574.0	1.0	blk shale with lam of abun fossils, brach, crin, bryo, jumbled-some fossils are edgewise, some burrows brach lime mudstone, crude bdg
9574.0-9576.3	2.3	lt gy fossil grainstone, brach, bryo, crin, bioturb, nodular bdg, few pyrite fossils, blk calc shale, abun fossils, large flat brachs, crin, ostra, gastro, horiz fracs, flowage
9576.3-9583.6	7.3	blk calc shale, mostly unfossiliferous, locally very fossil, brach, ostra, crin, bryo, laminated, fossils come in thin lam, grades into... lt gy brach grainstone, thinly bdd, pele, crin, bryo, small horiz burrows, clasts of blk shale, few brachs edgewise partly open vug at 9579.5
9583.6-9591.0	7.4	blk calc shale, relatively unfossil, fossils conc in thin lam, brach, pele, ostra, bryo, trilo, numerous horiz fracs
9591.0-9593.7	2.7	lt gy brach grainstone, shells tightly packed, parallel to bdg, bryo, clasts of blk shale blk calc shale, interbdd, brach, bryo locally abun; two lithologies gradational in this unit 0.7 ft missing at 9593
9593.7-9602.9	9.2	blk fossil packstone, brach, bryo, intraclasts, bioturb lt gy lime mudstone, nodular, bioturb

missing ?

depth	thickness	description
		blk calc shale, horiz fracs, gradational with lime mudstone, flowage
		fossil grainstone, brach, bryo, crin, ostra, occasional shale stringers
		box is all mixed up - put away
9602.9-9610.6	7.7	lt gy fossil packstone-grainstone, brach, bryo, gradational with mudstone, load structure at 9610
		lt gy mudstone, bioturb, nodular, floating fossils, brach, bryo 9608
		blk calc shale, laminated, horiz fracs, flowage, brach, crin, bryo, slickensides on vert frac
		sharp contacts between grainstones and shale
9610.6-9611.1	0.5	missing
9611.1-9612.9	1.8	lt gy fossil packstone, brach, bryo, gastro, pellets, laminated-locally bioturb
		blk calc shale, horiz fracs, flowage, horiz burrows
		stylolite at 9612
9612.9-9614.0	1.1	lt gy fossil packstone, brach, bryo, gastro, bioturb
		blk calc shale, horiz fracs
		0.6 ft missing
9614.0-9618.2		lt gy fossil packstone-grainstone, brach, bryo, crin, pellets, clasts of blk shale, burrows, Xbdg at 9617
		blk calc shale, brach, bryo, horiz burrows, flowage, stylolites
		lt gy lime mudstone, bioturb, few orig lam
9618.2-9619.3	1.1	med gy grainstone, brachs, bryo, gastro, intra-clasts, jumbled, blue chert
		blk calc shale, horiz burrows, 1 shell-hash lam
9619.3-9622.0	2.7	fossil packstone, brach, pellets?, pinpoint porosity at 9619
		blk calc shale, bioturb-compacted burrows, laminated elsewhere, brach, bryo, pellets, horiz fracs

depth	thickness	description
9622.0-9623.9	1.9	bioturb lime mudstone, horiz and vert veins, rare pyrite fossils, stylolites
		blk calc shale, horiz fracs
9623.9-9628.0	4.1	brach grainstone-packstone, lt gy gastro, bryo, pellets, jumbled, loosely packed, shale partings, flowage
		blk shale, horiz burrows, brachs in thin lam, stylolites
		lt gy lime mudstone, nodules, stylolites, laminated, few brachs and bryos
9628.0-9629.7	1.7	bioturb lime mudstone, lt gy, brach, bryo, blk shale partings, laminated, nodular bdg, bioturbated to bottom of unit
		blk calc shale, horiz burrows
9629.7-9637.1	7.4	heterogeneous unit
		brach-bryo grainstone, conc of shells at base of beds, shells w/horiz orient, gastro, clasts of blk shale, clay partings common, loadcasts
		blk shale, lam, horiz burrows, horiz vein, rare brach and bryo, flowage
		lam grainstone, f-gr, trough Xbdg
		lt gy wackestone, nodular, stylolites, argill, rare bryo and crin
		0.7 ft missing at 9632
		0.5 ft missing at 9636
9637.1-9640.7	3.6	brach-bryo grainstone, shale clasts, squished shale lam
		chert layer (0.5 inch), abun brachs, numerous vert veins and fracs
		lam lime mudstone, few fossils, few burrows, interbdds of blk shale
		storm layer at 9640
9640.8-9645.0	4.2	unit has notably less shale than units above
		lt gy lam grainstone, f-gr, brach, bryo, cephalopod
		blk shale, laminated, horiz fracs, few open vert veins, rare conc of brachs-bryo in thin lam, flowage, horiz burrows

depth	thickness	description
		nodular lime mudstone, shale partings-stylolites, stylolites invade nodules
9645.0-9648.0	3.0	fossil grainstone-packstone, coarse grained, brach, bryo, gastro, pellets, clasts of blk shale, whispy shale partings, poorly bdd, rare clasts pyritized
		blk calc shale
9648.0-9650.3	2.3	lam calc shale, blk, rare bryo
		fossil packstone, brach, bryo
		lt gy lime mudstone, lam, horiz burrows
9650.3-9652.8	2.5	fossil packstone, gastro, coral, crin, brach, bryo, large intraclasts, intraskeletal porosity
		packstone, f-gr, lam, horiz and vert veins
		blk shale, lam, few horiz burrows, shale partings in adjacent limestones
9652.8-9653.3	0.5	lam argill packstone, f-gr, abun stylolites pass into bdd shale
		blk shale
		fossil packstone, brach, bryo, gastro, crin, large intraclasts
9653.3-9654.0	0.7	blk shale
		0.5 ft missing
9654.0-9656.0	2.0	lam argill lime mudstone, nodular, blk shale partings
		fossil packstone-grainstone, brach, bryo, gastro, large intraclasts
		blk shale, rare bryo
9656.0-9658.9	2.9	blk shale, horiz fracs, vert veins, stylolites mostly horiz-rarely vert, few horiz burrows
		fossil wackestone- packstone, bryo, crin, brach, intraclasts, bioturb
		lime mudstone, nodular bdg, lam, few to abun burrows
		gastro packstone, brach, bryo, crin, shale clasts, geopetal structure in gastros, grading downward into lam, f-gr grainstone w/brach, bryo, gastro

depth	thickness	description
9658.9–9660.5	1.6	blk shale
		bioturb mudstone–wackestone, bryo, brach, trilo, crin
9660.5–9663.7	3.2	lam, f–gr grainstone–packstone, crin, brach, gastro, locally bioturb, horiz veins and fracs
		numerous blk shale partings, rare clasts of blk sh
9663.7–9665.1	1.4	bioturb wackestone–mudstone, gastro, brach, some orig lam
		blk shale, flowage, horiz burrows, horiz fracs, vert veins
		0.5 ft missing at 9664

END OF PART I

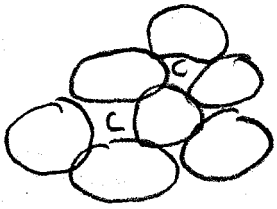
depth	thickness	description
9790.0 9791.6	1.6	mottled mudstone, distinct spar-filled burrows, few large brachs concentrated on bdg planes, also crin, brachs, gastro? in one lam, shale interlaminated, horiz stylolites/clay seams, pellet laminae with upper scoured surface
Units from 9790.0 through 9798.5 are mixed up somewhat.		
9791.6- 9793.0	1.4	fossil packstone, locally grainstone, oncolites, brachs, crin, bryo, ostra, hash, pellets, intraclasts, ooids?, burrowed, horiz stylos, vague thin bdg, rare spar-filled vugs
9793.0- 9794.0	1.0	nodular mudstone, abun stylos, brach, bryo, pellets, burrows, numerous vert veins, shale laminae with flow structure
9794.0- 9795.4	1.4	packstone-grainstone, oncolites, brachs, bryo, crin, ostra, ooids?, vaguely bdd, shale lam pass laterally into stylos
9795.4- 9797.2	1.8	packstone-wackestone, brach, bryo (many are pyrite), oncolites, crin, no bdg, horiz and vert veins, stylos, horiz fracs, passes downward into dk gy lam mudstone
9797.2- 9797.5	0.3	nodular mudstone, brachs, stylos/shale lam, numerous vert veins
9797.5- 9797.6	0.1	brach grainstone, bryo, crin, vague bdg, blk shale lam
9797.6- 9798.5	0.9	nodular mudstone-packstone, brach, crin, bryo, brachs disarticulated and current aligned, horiz burrows, blk shale lam with flow structure, vert frac, horiz styles, grainstone lam with brach, crin, oncolites
9798.5- 9803.8	5.3	gy mudstone, locally packstone, abun stylos/clay seams, brach, crin, bryo, pellets, burrows, numerous horiz veins, horiz fracs, minute spar-filled fenestrae, rare pyrite
9803.8- 9807.5	3.7	tan-lt gy mudstone, abun small spar-filled fenestrae (horiz and vert), undulatory lam, nodular to lumpy bdg, rare soft-sed deformation, pyrite ostra
9807.5- 9808.0	0.5	lt gy lam mudstone, intbdd with blk calc shale, horiz and vert fenestrae, filled with spar and pyrite, vert veins, vert burrows

depth	thickness	description
9808.0–9810.8	2.8	lt gy lam mudstone intbdd with blk calc shale, few fenestrae, one lenticular layer with cross bdg
9810.8–9814.2	3.4	lt gy mudstone, lam often discontinuous, intbdd with blk calc shale, small horiz burrows, fenestrae (few with pyrite), rare ostra, rare shale lam pass laterally into stylos, vert veins, vert fracs, horiz fracs in thicker shales
9814.2–9814.5	0.3	tan to blk mudstone, burrowed
9814.5–9815.3	0.8	blk shale and lt gy mudstone, burrowed, lenticular limestone bds, horiz fracs, vert veins-some partly open
9815.3–9816.8	1.5	lt gy mudstone and blk shale, few lenticular layers, rare pyritized shells, burrowed, horiz and vert fracs
9816.8–9822.7	5.9	lt gy mudstone interlaminated with blk calc shale, rare shells, horiz burrows, few lenticular layers (one with cross bdg), erosinal surfaces, pyrite, horiz fracs, in shale, vert veins
9822.7–9825.3	2.6	skeletal packstone, brach, bryo, crin, gastro, few edgewise, shelter cement beneath brachs, intraclasts of mudstone, few burrows mudstone, bioturbated, pyrite, vert veins blk calc shale, squeezed, pass laterally into stylos, slickensides, horiz fracs
9825.3–9830.0	4.7	mudstone, laminated to bioturbated, shale laminae with flow structure, pass into stylos, nodular bdg, rare brachs, scour surfaces, pyrite, oblique veins, horiz fracs grainstones, brach, crin, coral, bryo, intraclasts of mudstone, 1 inch thick
9830.0–9834.5	4.5	mudstone and interbedded shale, bioturbated, stylos grainstones, bryo, brach, crin, intraclasts, sharp contacts, lenticular
9834.5–9837.5	3.0	interbdd shale and mudstone, mudstone layers tend to be lenticular and contain pellets, abun burrows, mostly horiz, minor discontinuities, stylos, pyrite in burrows, horiz fracs, horiz and vert veins, rare brach, bryo

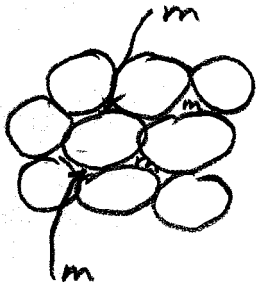
depth	thickness	description
		brach-bryo packstone, less than 1-inch layers, sharp lower contact, gradational upper, one shows grade d bdg
9837.5-9838.1	0.6	brach-bryo packstone, crin, intraclasts, pyritized shells, burrowed, stylos
9838.1-9839.1	1.0	missing core
9839.1-9841.4	2.3	interbdd shale and wackestone/mudstone, burrowed, brach, bryo, ostra, coral?, ripples, vertical spar-filled tubes, shales highly contorted, with pyrite and horiz fracs
9841.4-9845.2	3.8	burrowed shale and pelletal mudstone, rare shells
		intraclast packstone, brachs, cross bdg, 2 inches thick
9845.2-9847.6	2.4	bryo packstone, brach, ostra, crin; burrowed shale, contorted, pyrite; wackestone, bryo, brach, crin, gastro; mudstone, lam, abun spar-filled fenestrae
9847.6-9848.8	1.2	lam mudstone with abun fenestrae
		shale, lam, burrowed, passing into stylos or clay seams
9848.8-9852.0	3.2	intbdd mudstone and shale, spar-filled fenestrae, horiz fracs in shale, vert frac, pyrite
		ostra wackestone
9852.0-9855.5	3.5	intbdd mudstone and shale, horiz burrows, esp at top, few vert spar-filled fenestrae tubes, rare ostra, shales pass laterally into clay seams, horiz fracs, vert veins in limestones, nodular bdg with contorted shale, pyrite, lenticular bdg at base
9855.5-9857.5	2.0	argillaceous mudstone and shale, lam but mostly bioturbated, crin, brach, pellet lenses, pyrite, horiz fracs and veins
9857.5-9860.7	3.2	skeletal packstone, brach, bryo, crin, pyritized shells, pellets, intraclasts of mudstone, burrowed, contorted shale lam, nod bdg where shale is abun, shale passing into stylos, some original lam present
		pelletal mudstone and shale, burrowed, bryo, brach, shale is contorted

depth	thickness	description
9860.7- 9868.1	7.4	argillaceous mudstone and shale, nodular in places, pelletal, few floating fossils-bryo, brach, crin, pyritized shells, stylos, highly burrowed-mostly horiz, horiz fracs, vert vein packstone, gastro, cephalopod, ostra, bryo, crin, brach, lg branching vert burrows
9868.1- 9874.0	5.9	mudstone-packstone, ostra, bryo, brach, cephalopod, crin, gastro, pyrite replacing shells and in burrows, intbdd with blk shale, highly burrowed, pellets, lenticular bdg, rarely lam, stylos, horiz and vert veins, horiz fracs in shale
9874.0- 9876.6	2.6	top of Black River Limestone, skeletal packstone, brach, bryo, crin, ostra, coral?, recrystallized fossils, clay seams, stylos, pyrite, burrowed, notably less shale than in overlying units, vert and horiz veins, fenestrae
9876.6- 9877.7	1.1	mudstone, lam with burrows, mostly horiz, floating fossils-crin, ostra, stylos, horiz and vert veins, small horiz fenestrae
9877.7- 9878.4	0.7	skeletal packstone, crin, bryo, ostra, gastro, lam with burrows, stylos, pyrite

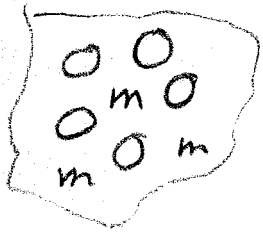
END OF PART II



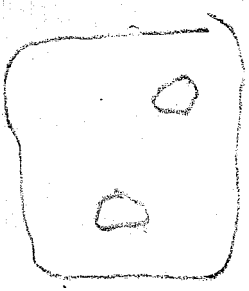
grainstone
cement, no mud



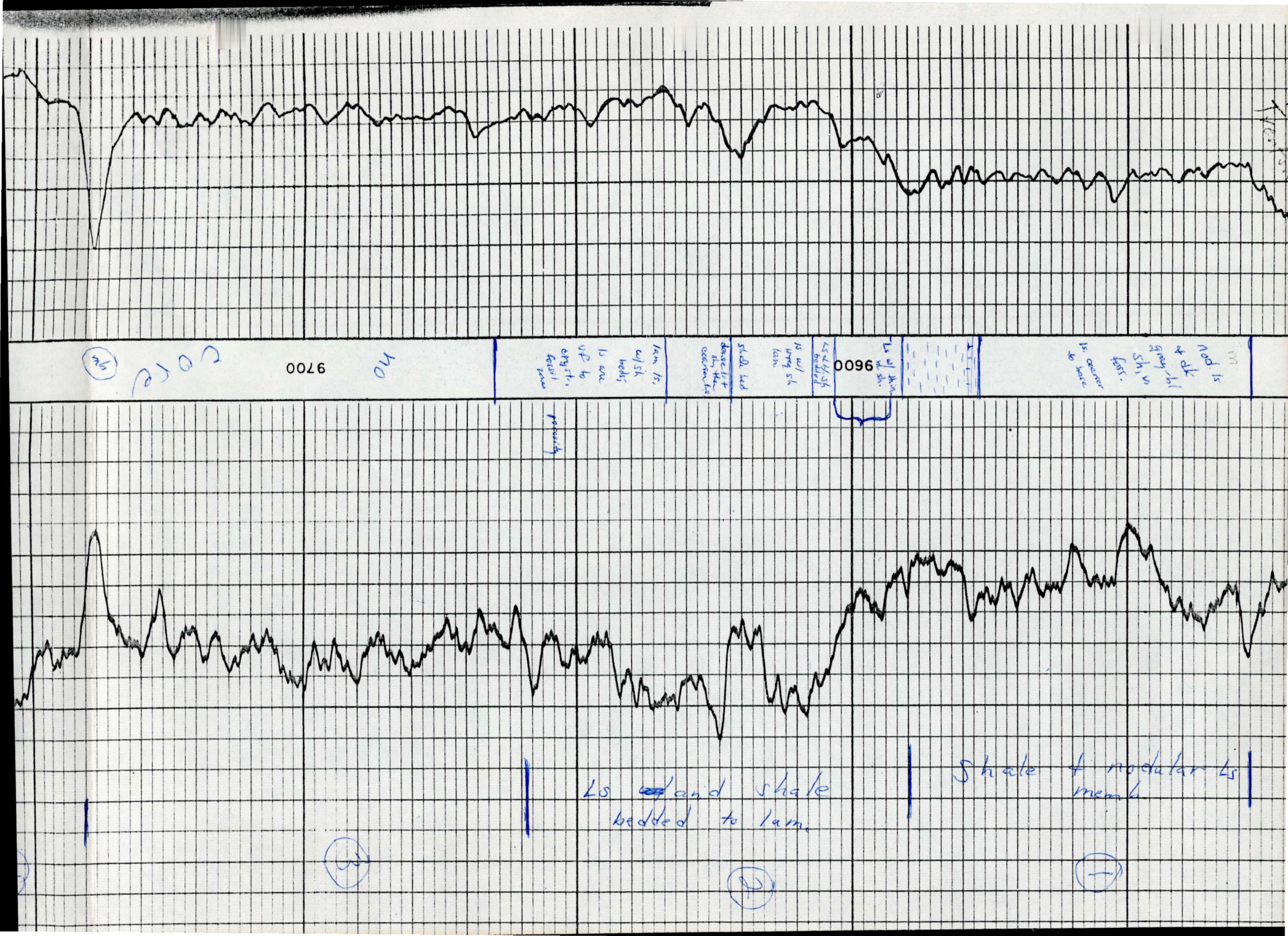
packstone
mud

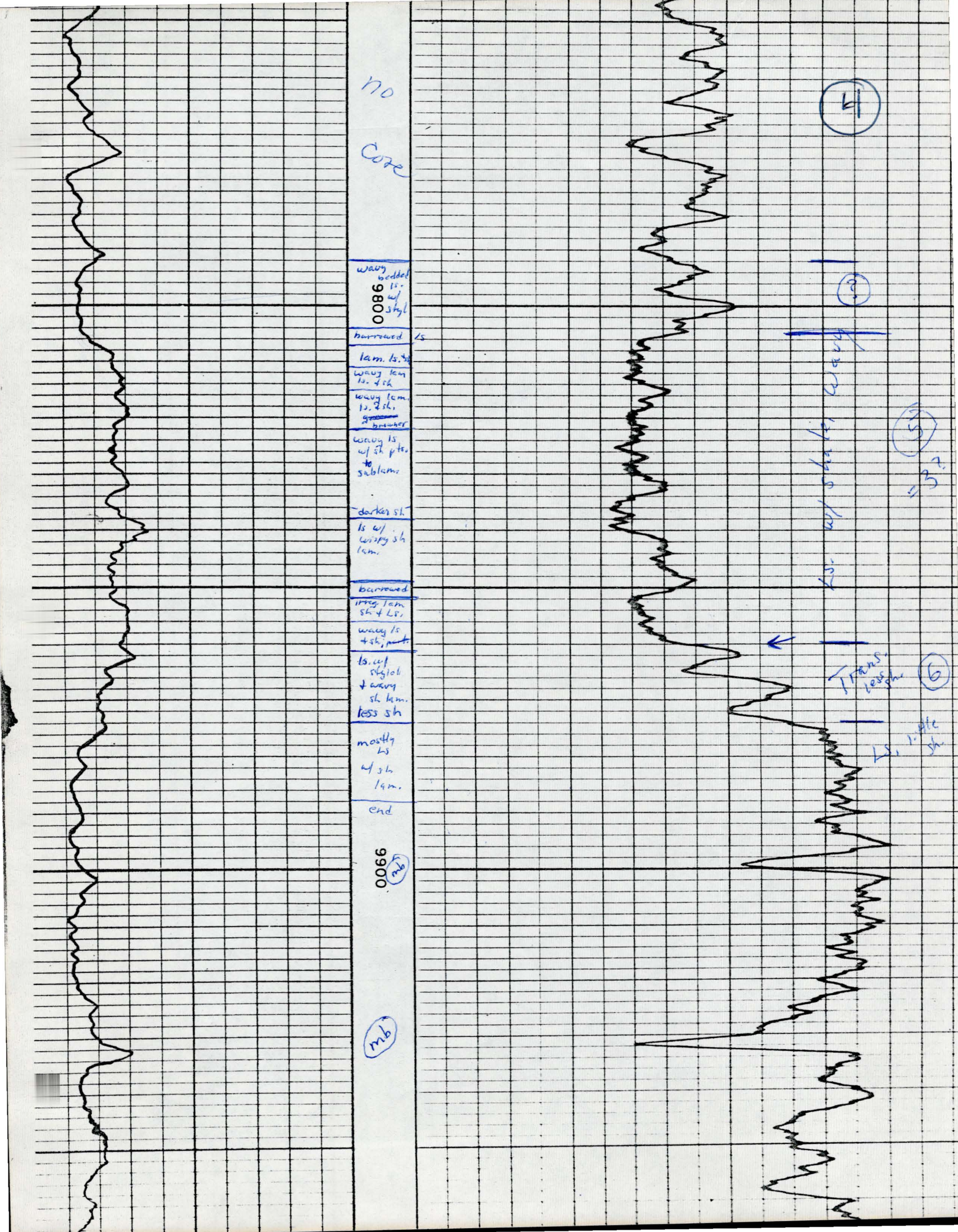


Wackestone
> 10% grains



lime mudstone
< 10% grains


9700
9600
Ls and shale bedded to lam.
Shale & mudstone


no
Coze
4
wavy bedded ls. w/ styl
9800
burrowed ls
lam. ls.
wavy lam ls. + sh
wavy lam. ls. + sh. browner
wavy ls w/ sh pts. to sublam.
darker sh.
ls w/ wispy sh lam.
burrowed
irreg. lam sh + LS.
wavy ls + sh.
ls. w/ styloli + wavy sh lam.
less sh
mostly LS w/ sh lam.
end
9900
mb
mb
?
LS. w/ shale, wavy
5
= 3?
Trans. less sh.
6
LS, little sh.

83. 7760-7765 Very fine grained quartzitic sandstone ---------- 5
84. 7765-7811 Dark shale with numerous sandstone lenses; reworked basal zone at bottom 46

(NOTE: There is a strong regional disconformity below the Tuscarora Sandstone, separating the Silurian and Ordovician Systems. The fact that the Tuscarora here is about 40-50 feet thinner than in near-by wells strongly suggests a local erosional break at its top. This could represent erosion on the anticline itself).

ORDOVICIAN SYSTEM (7,811-11-684') ----------3873

(NOTE: From this point downward, differences of stratigraphic interpretation increase among the various authors who have contributed to this symposium. Thus Woodward and Shearrow place the base of the Ordovician System at depth 11,684'; Prouty et al. use the figure 11,637'; Harris places the boundary at 11,737').

Upper Ordovician Series (7,811-9,065') ----------1254
Juniata Formation (7,811-8,270') ----------459

85. 7811-8270 Reddish-brown siltstone, shale, and thin sandstone interbeds, character generally shaly, gradational boundaries above and below ----------459

(NOTE: The Juniata is more of a facies than a true formation; it is of Richmond age, approximately equivalent to the Sequatchie Formation of the southern outcrops and to the Queenston Red Shale of the Lake Ontario region. The base of the unit is fixed at depth 8,270' because samples in the interval next below contain gray shale alien to the true Juniata. It is possible that Bed 86 and 40' of Bed 87 should be regarded with the Juniata).

Martinsburg, or Cincinnatian, Shales (8,270-9,065') -----795

86. 8270-8330 Greenish-gray shale and siltstone, a little gray shale, and rare limestone fragments ---------- 60
87. 8330-8380 Somewhat calcareous, red-brown to gray, silty shale; the lower 10 feet is fossiliferous ---------- 50

(NOTE: The lower part of this member can almost certainly be identified as the **Orthorhynchula** horizon of the Maysville portion of the upper Martinsburg Shale. It is ubiquitous in the eastern outcrop area.

88. 8380-8425 Essentially the same, considerable red-brown shale ---------- 45
89. 8425-8525 Gray-green shale with some interbedded greenish fossiliferous calcareous siltstone ----------100

NOTE: Beds 86-89 totaling 255 feet, are assigned to the Maysville Division of the Martinsburg).

Woodward RI 18

90. 8525-8760 Slightly calcareous green-gray shale with thin fossiliferous limestone and siltstone interbeds ----------225
91. 8760-9065 Same, somewhat grayer ----------305

NOTE: Beds 90-91, totaling 540 feet, are assigned to the Eden Division of the Martinsburg. Lower shaly beds, although still part of the Martinsburg Shale, are not truly Cincinnatian but are of Trenton age).

Middle Ordovician Shales (9,065-9,265') ---------- 200

NOTE: While there is general agreement that the section from 9,065' to 10,706' represents Trenton, Black River, and Chazyan horizons, the several authors of this symposium do not agree upon the precise boundaries or names of the individual units into which the rocks can be separated. In addition, Prouty places the top of the Beekmantown at depth 10,537').
See also Figure 5.

92. 9065-9115 Gray to dark-gray calcareous shale, with fossiliferous interbeds of limestone and siltstone ---------- 50
93. 9115-9265 Medium dark-gray calcareous fossiliferous shale; fewer siltstone and more limestone interbeds ----------150

NOTE: Beds 92 and 93, totaling 200 feet, are chronologically assigned to the upper Trenton, but because of their shaly character, they are retained within the Martinsburg Shale. The same can nearly be said for the five next lower members (Beds 94-98), but these are sufficiently calcareous to warrant inclusion in what is here grouped together as "Mid-Ordovician limestone." Probably Beds 92 and 93 correspond to the Coburn Formation of central Pennsylvania, and to the Cynthiana-Million Formations of central Kentucky).

Mid-Ordovician Limestone (9,265-10,706') ----------1441
Mid-Trenton Horizons (9,265-9,528') ---------- 263

94. 9265-9345 Dark fossiliferous shale with limestone interbeds ---------- 80
95. 9345 Trace of metabentonite ---------- 0
96. 9345-9416 Dark fossiliferous shale with limestone lenses ---------- 71
97. 9416-9523 Mainly dark to black calcareous shale ----------107
98. 9523-9528 Transitional to next underlying unit _ 5

(NOTE: These beds pass northeastward into the Salona Limestone of central Pennsylvania, and southwestward into the Lexington Limestone of Kentucky. The horizon is unnamed in most of the Eastern Interior region. Indeed, in many wells, these beds lie above the top of the drillers' "Trenton Limestone." The bentonite bed 80 feet below the top of this unit is matched by a similarly placed zone in the Salona of central Pennsylvania).

Lower Trenton Horizons (9,528-9,899') ---------- 371

99.	9528-9580	Medium-dark, shaly to coarse fossiliferous limestone	62
100.	9580-9608	Essentially as above	18
101.	9608-9670	Dark to dark-brown limestone, some shale	62
102.	9670-9680	Same; trace bentonite at top and bottom	10
103.	9680-9730	Dense dark argillaceous limestone	50
104.	9730-9739	As above; some brown-gray subcrystalline limestone	9
105.	9739-9742	Same; 10-15% soft metabentonite	3
106.	9742-9790	Dense subcrystalline brown - gray limestone	48
107.	9790-9803	Dense medium-dark limestone, wavy bedding	13
108.	9803-9806	Limestone; irregular patches of coarse calcite	3
109.	9806-9873	Fine dense brown-gray styolitic limestone; **Tetradium**	67
110.	9873-9895	Same, lenticular chert in lower 4 feet	22
111.	9895-9899	Same	4

(NOTE: Beds 99-106 represent the "Trenton Limestone" of the driller, but Woodward believes that they are entirely **Lower** Trenton in age. He correlates them with the Oregon-Tyrone Limestone of Kentucky and with the Witten-Nealmont Limestones of central Pennsylvania. Probably they represent the Woodway, Ben Hur, and Hardy Creek sequence of Lee County, Virginia, which became part of the Moccasin Formation of Tazewell County, Virginia).

Black River Horizons (9,899-10,154') ---------- 255

112.	9899-9928	Dark fossil limestone, alternately dense and siltsize	28
113.	9928-10040	Dark stylolitic limestone; **Tetradium**; vertical joints	112
114.	10040-10064	Dense medium to olive-gray partly shaly limestone	24
115.	10064-10154	Dark argillaceous limestone and shale	90

(NOTE: Woodward regards beds 112-115 as of Black River age, approximately equivalent to the Wardell-Gratton-Ben Bolt sequence of Tazewell County, Virginia, and to the Hurricane Bridge Formation of Lee County, Virginia. He also believes that there are regional unconformities at top and bottom of the Black River Series).

Chazy Horizons (10,154-10,706') 552

116.	10154-10218	Dense olive to medium-gray limestone, some shales	64
117.	10218-10278	Onterbedded limestone and shale; some **Tetradium**	60
117.	10218-10278	Interbedded limestone and shale; limestone; some dolomite	113

119.	10391-10429	Dense dark wavy-bedded limestone; some shaly streaks	38
120	10429-10468	Styolitic fine dark dense limestone; some **Tetradium**	37
121.	10468-10490	Dense fine limestone, some shale and dolomitic bands	22
122.	10490-10497	Dark limestone, dense to fragmental	7
123.	10497-10523	Limestone and dark dolomite, intraformational conglomerate at top	26
124.	10523-10537	Same, with gray-black shale partings	14
125.	10537-10541	Dark dolomite, partly argillaceous	4
126.	10541-10552	Same	11
127.	10552-10642	Mainly dark dolomite and shale	90
128.	10642-10673	Same, lighter colored; siltstone at base	31
129	10673-10688	Silty dolomite, partings of dolomite shale	15
130.	10688-10706	Light-colored basal sandstone; interbedded with dolomite and light shale	18

(NOTE: Beds 116-130 comprise the Chazy Group but it seems unwise to attempt its further subdivision. In a general way these beds correspond to the Clifford Formation of Tazewell County, Virginia; to the Martin Creek, Rob Camp, Poteet, and Dot Formations of Lee County, Virginia (in descending order); and to the so-called "Camp Nelson" Formation of the Eastern Interior. The basal units Nos. 129-130 correspond to what is called "St. Peter" Sandstone in eastern Kentucky, and to the conglomerate zone at the base of the Blackford member of the Clifford Formation in the eastern outcrop. Probably they also represent the 22 feet of sand at the base of the Hockenberry well in Butler County, Pennsylvania, and the "Bellefonte" Sandstone that crops out near Bellefonte and Dale Summit, Center County, Pennsylvania. If the latter correlation is valid, then the higher portion of the Bellefonte Dolomite of Pennsylvania is actually Chazyan.

Bed 130 forms the base of the Mid-Ordovician. Note that Prouty regards Beds 125 through 130 as uppermost Beekmantown).

Lower Ordovician Horizons (10,706-11,684') ---------- 978

(NOTE: Despite its unexpected presence, all authors in this symposium unequivocably identified the next 900 feet and more as Beekmantown. There was not agreement, however, where or how it should be divided into units. One suggestion was that an equivalent of the Bellefonte Dolomite of Pennsylvania might extend down to about 11,037', the Nittany equivalent down to about 11,500', and the bottom portion might represent Stonehenge equivalents. Viewed from the Ohio region, the section down to depth 11,319' resembles the Shakopee; the sandstone next below could be the New Richmond; and the beds from 11,328' to the base could be the Oneota Dolomite. Prouty regards the top of the Beekmantown as commencing at depth 10,537'

8430	8470	Shale, light-gray, 10 to 20% red shale
8470	8535	Shale, light-gray, 20 to 40% red shale
8535	8545	Shale, gray, 20% light-gray siltstone, 15% limestone
8545	8600	Shale, medium-gray, 15 to 20% limestone
8600	8640	Shale, medium-gray, 10 to 15½ light-gray siltstone, 20 to 30% limestone
8640	8675	Shale, medium-gray, 20 to 30% limestone
8675	8715	Shale, medium-gray, 10 to 15% light-gray siltstone, 20 to 30% limestone
8715	8750	Shale, medium-gray, 10% light-gray siltstone, 30 to 40% limestone
8750	8855	Shale, medium- to dark-gray, 20 to 25% limestone
8855	8925	Shale, medium- to dark-gray, 10 to 20% limestone
8925	8995	Shale, dark-gray to black, 10 to 20% limestone
8995	9115	Shale, dark-gray to black, 10 to 25% limestone
9115	9120	No sample
9120	9160	Shale, dark-gray to black, 25 to 30% limestone
9160	9275	Shale, medium-gray, 10 to 15% limestone
9275	9345	Shale, medium- to dark-gray, 20 to 25% limestone
9345	9410	Shale, medium- to dark-gray, 10 to 20% limestone
9410	9416	No sample
9416	9480	Shale, dark-gray and brown
9480	9496	Shale, black
9496	9500	Shale, dark-brown
9500	9518	Shale, black
9518	9523	Shale, black and dark-brown

Mohawkian Series

Trenton Limestone

9523	9527	Shale, gray and brown finely porous, 30% limestone
9527	9530	Shale, dark-gray to black finely porous, 40% limestone
9530	9534	Limestone, 20% brown finely porous shale
9534	9550	Limestone, 30 to 50% brown finely porous shale
9550	9577	Shale, brown and gray finely porous, 30 to 50% limestone
9577	9590	Shale, black, mostly cavings and 5% limestone
9590	9611	Limestone, 20 to 35% brown finely porous shale.
9611	9618	Limestone, 10% brown finely porous shale, traces of rough chert
9618	9624	Chert, blue and gray mottled and brown rough chert, 25% limestone
9624	9665	Limestone, 15 to 25% brown and gray finely porous shale, traces of very fine grains of sand
9665	9785	Limestone, considerable shale cavings, residues not calculated
9785	9790	No sample
9790	9803	Limestone, 5% brown finely porous shale, trace of brown rough chert and pyrite

Black River Group

9803	9813	Shale, gray finely porous, 40 to 55% lithographic limestone
9813	9834	Limestone, 15 to 35% brown finely porous shale
9834	9838	Shale, brown finely porous, 20% limestone
9838	9848	Limestone, 10 to 35% gray and brown finely porous shale
9848	9857	Shale, brown finely porous, 30 to 50% limestone
9857	9861	Limestone, 10% gray and brown finely porous shale

9861	9865	Limestone, 45% brown finely porous shale
9865	9879	Limestone, 10 to 25% gray shale and brown finely porous shale
9879	9894	Limestone, 5% gray shale and brown finely porous shale
9894	9898	Limestone, 20% brown and gray rough chert
9898	9916	Limestone, 5% gray and brown finely porous shale
9916	9932	Limestone, 20% brown finely porous shale
9932	9946	Limestone, 5% brown finely porous shale
9946	9950	Shale, brown finely porous, 40% limestone
9950	9957	Limestone, 30% brown finely porous shale
9957	10008	Limestone, 5 to 10% brown finely porous shale
10008	10027	Limestone, 5% brown finely porous shale and very fine grained sand
10027	10042	Limestone, 5% brown finely porous shale
10042	10065	Limestone, 5 to 15% gray shale and brown finely porous shale
10065	10067	Shale, brown finely porous, 30% limestone
10067	10102	Limestone, 20 to 50% brown finely porous shale
10102	10108	Limestone, 5% brown finely porous shale
10108	10112	Limestone, 45% brown finely porous shale
10112	10130	Limestone, 10 to 25% brown finely porous shale
10130	10133	Shale, brown finely porous, 20% limestone
10133	10136	Shale, brown finely porous, 50% limestone
10136	10148	Limestone, 20 to 30% brown finely porous shale
10148	10169	Limestone, 5% brown finely porous shale, traces of barite and pyrite
10169	10180	Shale, brown finely porous, 20 to 50% limestone
10180	10187	Limestone, 30 to 40% brown finely porous shale
10187	10191	Shale, brown finely porous, 10% limestone
10191	10208	Limestone, 20% brown finely porous shale
10208	10237	Limestone, 5% brown finely porous shale, traces of pyrite and barite
10237	10242	Shale, white to gray finely porous, 30% limestone
10242	10249	Limestone, 5 to 10% brown finely porous shale
10249	10252	Shale, brown finely porous, 10% limestone
10252	10256	Limestone, 30% brown finely porous shale
10256	10260	Limestone, 5% brown finely porous shale
10260	10267	Shale, brown finely porous, 10 to 30% limestone
10267	10283	Limestone, 5% brown finely porous shale
10283	10287	Shale, brown finely porous, 15% limestone
10287	10307	Limestone, 5 to 15% brown finely porous shale
10307	10312	Shale, brown finely porous, 30% limestone
10312	10315	Limestone, 5% brown finely porous shale
10315	10319	Shale, brown finely porous, 10% limestone
10319	10432	Limestone, 5% gray shale and brown porous shale, traces of barite
10432	10465	Limestone, 5 to 10% brown finely porous shale and brown rough and quartzosed chert.
10465	10469	Limestone, 35% brown rough and quartzosed chert
10469	10477	Limestone, 5 to 10% brown finely porous shale and brown rough and quartzosed chert
10477	10484	Limestone, 25% brown finely porous shale and brown rough quartzosed chert
10484	10487	Limestone, 5% brown finely porous shale
10487	10492	Limestone, 45% brown finely porous shale
10492	10495	Limestone, 5 to 10% brown rough and quartzosed chert
10495	10503	Dolomite, 5 to 10% brown finely porous shale
10503	10507	Shale, brown finely porous, 30% dolomite

Top	Bottom	Thickness	
9477	9508	31	Shale; predominantly grayish black, with some interbedded medium dark gray to dark gray, calcareous shale. Contains bands of fossil fragments. Lower 7.5 feet of unit is highly jointed.
9508	9515	7	Shale; dark gray, slightly calcareous, with some interbedded medium dark gray, calcareous shale. Contains fossils and fossil fragments.
9515	9522	7	Shale; grayish black, with some interbedded medium dark gray calcareous shale.
9522	9528	6	Shale; medium dark gray to dark gray, interbedded. The medium dark gray shale predominates and is highly calcareous.
			Middle Ordovician or Champlainian series, 1179 (?) feet
			Trenton limestone, 214 feet
9528	9615	87	Limestone; very fine textured, medium dark gray, argillaceous, with bands of medium gray, very coarse, coquina limestone. Interbedded with dark gray calcareous shale. Very irregularly bedded. Fossils and bands of fossil fragments occur throughout both limestone and shale, some of which appear to be **Rafinesquina, Dalmanella, Sowerbyella,** gastropods, brachiopods, pelecypods, trilobites, crinoid stems, bryozoa, and ostracods.
			Cores No. 7-10 inclusive, 9416 to 9615 feet, bled gas along entire length of core from bedding planes and stylolites. Gas show recorded throughout in mud analysis. Good shows recorded at 9480 to 9529 feet, 9539 to 9543 feet, 9562 to 9566 feet, and 9571 to 9596 feet.
9615	9665	50	Limestone; very fine textured, dark gray to brownish gray to dark olive black, with bands of gray to light gray, coarse coquina limestone. Contains 20-25% interbedded dark gray to grayish black shale. Irregularly bedded. Fossiliferous throughout.
			Drill stem test from 9571 to 9665 feet: Tool opened with air immediately. Very slight blow in 1 hour. Recovered 30 feet of gas cut mud.

Top	Bottom	Thickness	
9665	9694	29	Limestone; dense to very fine textured, dark gray to gray, slightly fossiliferous, argillaceous, with some interbedded dark gray to black shale. Trace of metabentonite (?) at 9670 and 9680 feet. Trace of chert at 9688 feet. Show of gas recorded at 9670 to 9676 feet.
9694	9724	30	Limestone; medium textured, gray to dark gray, fossiliferous, with a little interbedded gray to black shale. Trace of calcite lined vugs at 9716 to 9718 feet showing oil stail. Trace of metabentonite (?) at base.
9724	9730	6	Limestone; coarsely crystalline, gray, fossiliferous, with a little interbedded gray to black shale. Show of gas recorded at 9724 to 9730 feet.
9730	9742	12	Limestone; as above with an equal amount of brownish gray, dense, subcrystalline limestone. Contains 10-15% soft metabentonite from 9738-9742. Gamma Ray log shows high radioactivity at this same depth. Show of gas recorded at 9730 to 9736 feet.
			Top of Black River limestone
9742	9790	48	Limestone; dense, sub-crystalline, brownish gray, argillaceous. Leaves a very fine clay residue after acid. Sparsely fossiliferous. Trace of chert.
9790	11,684		**Cores No. 12-55 inclusive. Cored 1894 feet, recovered 1892 feet.**
9790	9812	22	Limestone; dense to very fine textured, medium dark gray to brownish gray, with wavy clay partings and numerous stylolites. Lower 8 feet contains minute tubes filled with coarse crystalline calcite. Tubes are generally .10" to .15" in diameter and .50" to .75" long. Orientation is at random, but the majority approach vertical. Vertically jointed. Somewhat fossiliferous. Slight show of gas recorded from 9794 to 9812 feet.
9812	9830	18	Limestone; dense to very fine textured, light brownish gray, with interbedded dark gray, calcareous shale. Limestone contains minute tubes like those described above. Vertically jointed. Only occasional fossils observed.
9830	9840	10	Limestone; dense to very fine textured, medium dark gray to brownish gray, with a little interbedded dark gray calcareous shale. Contains numerous stylolites. Wavy bedded. Limestone contains minute tubes like those described above.

Top	Bottom	Thickness	
9840	10,040	200	Limestone, dense to very fine textured, light gray to dark gray to brownish gray. Contains occasional dark gray, calcareous, shale partings and numerous stylolites, also occasional zones of tubular structures described previously. Somewhat fossiliferous throughout with occasional coquina zones. Lenses and irregular masses of olive black chert occur from 9891 to 9895 feet. Some vertical jointing.
10,040	10,439	399	Limestone; dense to very fine textured, gray to olive dark gray to dark gray. Contains occasional zones of lighter gray, medium textured limestone and many partings or laminations of dark gray to black, calcareous shale. Two thin bands of medium textured, brownish gray dolomite occur at 10,278 to 10,279 feet. Bedding, for the most part, is irregular. Contains minute tubular structures filled with coarsely crystalline calcite and many stylolites. Olive black nodular chert zones occur at 10,41, 10,043 and 10,391 feet.
10,439	10,469	30	Limestone; dense to very fine textured, dark gray to olive gray. Irregularly bedded with numerous stylolites. Contains minute tubular structures filled with coarsely crystalline calcite. Wavy clay partings throughout. Gas show recorded throughout this unit.
10,469	10,487	18	Limestone; dense to very fine textured, dark gray to olive black, with interbedded dark gray to black shale in upper part. Contains occasional bands of dolomitic limestone. Disseminated pyrite throughout. Stylolites. Gas show recorded at 10,472 to 10,480 feet.
10,487	10,497	10	Limestone; interbedded, dense and fine to medium fragmental, dark gray to olive black. Gas show recorded 10,490 to 10,496 feet.
10,497	10,523	26	Dolomite; very fine textured, dark gray to olive black, argillaceous, with interbedded dark gray to olive black, dense to finely textured, pyritic limestone. Contains a few stylolites and a little interbedded dark gray, pyritic shale. Thin intraformational conglomerate zone near top of this unit. Angular dolomite pebbles up to 2 inches in length embedded in limestone.
10,523	10,568	45	Dolomite; very fine textured, olive gray to dark gray, argillaceous, with occasional anhydrite patches. Contains occasional thin interbeds of dark gray, pyritic shale.

Top	Bottom	Thickness	
10,568	10,587	19	As above; dolomite contains occasional very fine to fine quartz sand grains and silt particles.
10,587	10,592	5	Dolomite; very fine textured, dark gray to olive gray, argillaceous, with occasional thin interbeds of dark gray, pyritic shale.
10,592	10,673	81	Dolomite; very fine textured, gray to dark gray, argillaceous, with a very little interbedded, dark gray, pyritic shale. Irregular patches of anhydrite. Scattered zones of very fine to fine quartz sand grains and silt particles.
10,673	10,674	1	Sandstone; fine to medium grained, light gray.
10,674	10,687	13	Dolomite; very fine textured, gray to light brownish gray, argillaceous, with a very little interbedded medium gray, dolomitic, shale.
10,687	10,694	7	Sandstone; fine to medium grained, gray to light gray to white. Upper portion is highly dolomitic and somewhat finer than lower. Grains are rounded and frosted. Occasional coarse to granule size grains at base.
10,694	10,695	1	Dolomite; dense, gray, very sandy. Sand grains range from very fine to fine and are rounded and frosted. Thin dark gray shaly zone near middle.
10,695	10,707	12	Sandstone; mostly medium grained, but ranges from silt to granule size, light greenish gray with streaks of white, dolomitic. Coarse and granule size grains are concentrated in lower 4 feet. Basal contact is irregular with silt and sand filling joints in underlying dolomite.
			Unconformity
			Base of Middle Ordovician rocks is tentatively placed at 10,707 feet. However, there is some evidence of an unconformity at 10,497 feet and the definite placement of the base of the Middle Ordovician must await the identification of fossils within the intervening dolomite section.
			No attempt will be made to subdivide the remaining sedimentary section at this time. Paleontological studies are now being made and it is considered wise to await the results of these studies before further subdivisions are attempted.
10,707	10,819	112	Dolomite; fine to medium textured, medium dark gray to gray to olive gray, with greenish gray shale partings. Vertical and 40° joints filled with floating quartz silt and sand grains in a greenish gray shale matrix. Contains many vugs, most of which are filled

DESCRIPTION OF CORES

By Leonard D. Harris and Russell R. Flowers

(All thicknesses stated in feet)

	Depth in feet
Core 7 (49')	9,419-9,465
Unit 1 (38.9')	9,416-9,454.9

Shale. Slightly calcareous dark-gray shale interbedded with medium-dark-gray calcareous shale. The slightly calcareous shale predominates. Bands of fossil fragments from 0.01 to 0.1 thick scattered throughout. Fragments of brachiopods, bryozoa, and crinoid stems.

Unit 2 (10.1')	9,454.9-9,465

Shale. Predominantly medium-dark-gray calcareous shale with interbeds of grayish-black fissile shale and dark-gray shale. The grayish-black shale in units from 0.05 to 0.2 thick. Bands of fossil fragments scattered, averaging 0.01 thick.

Core 8 (50.0')	9,465-9,515
Unit 3 (12.1')	9,465-9,477.1

Predominantly calcareous medium-dark-gray shale with some grayish-black shale. Fossil fragments in zones. The grayish-black shale is in units from 0.01 to 0.2 and the calcareous medium-dark-gray shale is in units from 0.2 to 0.9 thick.

Unit 4 (4.0')	9,477.1-9,481.1

Shale. 50-50 grayish-black shale and medium-dark-gray to dark-gray interbedded shale. Units from 0.4 to 1.0. The grayish-black shale has bedding plane calcite from 0.01 and less thick.

Unit 5 (15.1')	9,481.1-9,496.2

Shale. Predominantly grayish-black shale with interbeds of medium-dark to dark-gray calcareous shale. The grayish-black shale occurs in units from 0.2 to 2.0 thick and the medium-gray shale in units from 0.1 to 0.4. Fossil fragments in bands.

Unit 6 (3.1')	9,496.2-9,499.3

Shale. 50-50 interbedded grayish-black and medium-dark-gray and dark-gray calcareous shale. Units from 0.2 to 0.4 thick—slickensided.

Break in core 0.2'	9,499.3-9,499.5
Unit 7 (7.5')	9,499.5-9,507

Shale. Predominantly grayish-black shale. The unit is highly jointed with the joints trending 20 to 40 degrees to the horizontal plane of the core. This part of the core seems to be jumbled, as if some of the pieces are not in place. The upper two feet is more calcareous with calcite veins mostly in joints, some along bedding surfaces.

Break in core 1.0'	9,507-9,508
Unit 8 (7.0')	9,508-9,515

Shale. Interbedded 60-40 dark-gray shale, slightly calcareous, and medium-dark-gray calcareous shale. Bedding plane calcite in veins about 0.01 and some fossil fragments. Dark-gray shale is in units from 1 to 2 feet and calcareous shale is in units of 0.6.

	Depth in feet
Core 9 (50.0')	9,515-9,565
Unit 9 (7.3')	9,515-9,522.3

Shale. Predominantly grayish-black in units from 0.6 to 1.5. There are calcite stringers along the bedding surfaces. There is some medium-dark-gray calcareous shale in units 0.3 to 0.6.

Unit 10 (6.1')	9,522.3-9,528.4

Shale. Predominantly calcareous medium-dark to dark-gray shale. In units from 0.2 to 0.5. Some calcite veins along bedding surface of the dark-gray shale.

Unit 11 (36.6')	9,528.4-9,565

Limestone and shale. Interbedded nodular limestone and shale. The limestone varies from silt size to very coarse coquina, but it is mostly silt size. The silt size limestone is medium dark gray and the coarser material is medium gray. The limestone is argillaceous in wavy beds from 0.2" to 0.5" thick. There are some discontinued blebs of the lime in the shale and the shale seems to lap over the lime masses. The coquina is more predominant in the upper two feet but occurs in scattered zones throughout the shale. The shale is dark gray and carries abundant fossils concentrated in stringers. Some of the fossils appear to be **Rafinesquina, Dalmanella, Sowerbyella,** gastropods, pelecypods, crinoid stems, bryozoa, and ostracods.

Core 10 (50.0')	9,565-9,615
Unit 12 (5.6')	9,565-9,570.6

Limestone and shale. 50-50 interbedded nodular limestone and calcareous shale. The shale is dark-gray to medium dark gray, highly fossiliferous with coquina zones. It is irregular in units from 0.2 to 0.5" thick. There are some blebs of limestone 0.2 x 0.1" scattered in the shale. The limestone is dark gray to olive black, silt size to coarse size, with the silt size lime predominating.

Unit 13 (7.1')	9,570.6-9,577.7

Limestone and shale. 50-50 interbedded coquinoid limestone and shale. There are two types of limestone: one is silt size, dark-gray to olive-gray, and the other is coquinoid, which is predominant. The limestone beds are irregular but not as nodular as above. They occur in units from 0.2 to 0.4 thick. The shale is calcareous and has many stringers and zones of fossil fragments. In some places the shale has as much as 50% coquinoid stringers. It is in units from 0.05 to 0.8 thick. At 2.2 from the top, graptolites occur. Fossils include **Cornularia,** trilobites, brachiopods, and bryozoa.

Unit 14 (3.8')	9,577.7-9,581.5

Shale and limestone. 60-40 interbedded shale and limestone, mostly shale. Two types of limestone; the silt size lime and the coquinoid lime, dark-gray to olive-black. The shale is dark-gray with a few scattered zones of fossil fragments. There seem to be many pelecypods and some gastropods, trilobites, and brachiopods.

Unit 15 (10.8')	9,581.5-9,592.3

Shale. Dark-gray, slightly calcareous, with some grayish-black shale. There are laminae and zones of

Depth in feet

fossil fragments. It contains many pelecypods, some brachiopods, trilobites, cephalopods, and gastropods.

Unit 16 (3.3′) 9,592.3-9,595.6

Limestone and shale. 50-50 interbedded limestone and shale. The limestone is mostly coquinoid with some silt size in beds from 0.2 to 1.0 thick, more regularly bedded than before. The dark-gray to grayish-black shale has laminae and 0.5 zones of coquina, very fossiliferous.

Unit 17 (19.4′) 9,595.6-9,615

Limestone and shale. Interbedded limestone and shale, mostly limestone, 70-30. The limestone is predominantly coquinoid, dark-gray to olive-black, in beds from 0.1 to 0.8 thick, wavy to nodular, becoming more even in the lower part. The shale has stringers and zones of fossils and is dark-gray. Trilobites, pelecypods and many brachiopods.

Core 11 (50.0′) 9,615-9,665

Unit 18 (4.2′) 9,615-9,619.2

Limestone and shale. Mostly limestone, 80-20. Limestone dark-gray to brownish gray with a very few beds of medium-light-gray. Most of the lime is very fine to silt size with some coquina in beds from 0.2 to 0.5. The limestone has wisps of shale and is irregularly bedded. The shale is dark-gray in units averaging 0.1 thick.

Unit 19 (4.5′) 9,619.2-9,623.7

Limestone and shale. Limestone predominating, 80-20. The limestone is silt size, brownish-black, sparsely fossiliferous. The beds average 0.4. Wavy bedded. The shale is dark-gray with very few fossils.

Unit 20 (22.5′) 9,623.7-9,646.2

Limestone and shale. Limestone predominating 90-10. The limestone is coquinoid and mostly fine grained. Some of the beds appear to grade upward from coarse to fine. The beds average 0.5 but are from 0.1 to 1.0 thick. This unit is rather even bedded but there are some wavy beds with clay wisps. Brownish-gray to dark-olive-black with some medium-gray beds. The limestone is fossiliferous but the fossils are not well preserved, mostly fragmental.

Unit 21 (18.8′) 9,646.2-9,665

Limestone and shale. Mostly limestone 85-15. The limestone is interbedded, fine, and coquinoid—about 30% coquina. It is brownish-gray to dark-gray, olive-black and the beds average 0.6; they are even to irregular. The shale is dark-gray to grayish-black and the lower 5 feet has some blebs of limestone 0.05 to 0.02. It appears to be interformational conglomerate. Sparsely fossiliferous, gastropods occur at 7.5 feet from the base with clay filling the test.

Drilled 125.0′ 9,665-9,790

Core 12 (49.0′) 9,790-9,839

Unit 22 (1.3′) 9,790-9,791.3

Limestone. The limestone is dense, medium-dark-gray to olive-gray, has wavy clay partings that are about 0.001 thick. Brachiopods occur along the partings and the partings are from 0.01 to 0.2 apart.

Unit 23 (3.3′) 9,791.3-9,794.6

Limestone. The limestone is fine grained with some dense. Some of the denser material seems to be disturbed and has rounded masses that resemble

Depth in feet

oolitic structures. A few wavy partings of clay and some fossil fragments. The color is medium-dark-gray.

Unit 24 (1.0′) 9,794.6-9,795.6

Limestone. The limestone is dense, medium-dark-gray, to olive-gray, wavy bedding, partings about 0.5 apart, wavy partings are dark-gray shale.

Unit 25 (5.3′) 9,795.6-9,800.9

Limestone. Limestone is dense to fine, meduim-dark-gray to olive-gray. The dense material has wavy partings about 0.5 apart. It is about 50-50 dense and fine lime interbedded.

Unit 26 (2.6′) 9,800.9-9,803.5

Limestone. The limestone is dense, olive-gray, stylolitic, with a few wavy, dark-gray shale partings.

Unit 27 (4.0′) 9,803.5-9,807.5

Limestone. Silt size with irregular patches of calcite crystals that are coarse. These crystals seem to fill tubular structures or circular areas, mostly parallel to the bedding. The color is olive-gray to medium-dark-gray. Some pyrite blebs, and the beds are somewhat laminated.

Unit 28 (4.6′) 9,807.5-9,812.1

Limestone. The limestone is dense, olive- gray to dark-gray. The beds have vertical tubes about 0.02 long filled with coarse crystals of calcite. Vertical jointing about 0.3 apart. The beds seem to be laminated and slightly pyritic.

Unit 29 (17.3′) 9,812.1-9,829.4

Limestone and shale. 50-50 interbedded limestone and shale. The limestone is medium-dark-gray to olive-gray, very fine silt size. There are some circular areas and tubular structures with coarse crystalline calcite filling. Vertical jointing evident. Some fossil brachiopods along the bedding surfaces. The shale is dark-gray, calcareous.

Unit 30 (5.9′) 9,829.4-9,835.3

Limestone. Dense, medium-dark-gray to olive-gray, wavy bedded 0.05 to 0.2 thick. The wavy bedding is due to argillaceous partings that are dark-gray.

Unit 31 (2.5′) 9,835.3-9,837.8

Limestone. Very fine silt size, olive-gray to medium-dark-gray with a few partings of argillaceous limestone or calcareous shale. Not wavy bedded. Some blebs of coarsely crystalline calcite. Vertical jointing.

Unit 32 (1.2′) 9,837.8-9,839

Limestone. Olive-gray to medium-dark-gray, silt size, wavy bedded. Some bryozoa stems and brachiopods. Vertical jointing.

Core 13 (50.0′) 9,839-9,889

Unit 33 (8.5′) 9,839-9,847.5

Limestone and calcareous shale. The limestone is silt size with some fine grained material, olive-gray to medium-dark-gray, wavy bedded. The wavy bedding is due to calcareous shale partings. The shale contains some blebs of limestone and is medium-dark-gray. Vertical jointing evident.

Unit 34 (4.2′) 9,847.5-9,851.7

Limestone. Dense to silt size, dark-gray to olive-gray. There are some circular to tubular areas throughout that are filled with coarsely crystalline calcite, they average about 0.1 long and 0.02 to 0.8 across. Some argillaceous partings and films.