

UNITED PRODUCING COMPANY

W. N. Ritter Number 4-V-1557

Topographic Location: 7,000' South of 37°15'; 12,000' West of 81°55'
Richlands Quadrangle (NE), Buchanan County, Virginia.

Elevation: 2258.64' (Derrick).

Total Depth: 4926'.

Interval

- 380-386 Sandstone, very light gray (N8), fine-grained to medium-grained, subangular to subrounded, fairly well sorted, fairly porous, slightly silty, abundant siderite, little green mineral, 90% quartzose.
- 386-391 Like 380-386.
- 391-396 Shale, brownish gray (5YR 4/1) sideritic.
- 396-399 Shale, medium dark gray (N4), slightly micaceous, silty.
- 399-406 Siltstone, medium dark gray (N4), sandy.
- 406-413 Like 399-406.
- 413-420 Like 406-413.
- 420-425 Siltstone, medium light gray (N6) to medium gray (N5), very sandy, calcareous, micaceous.
- 425-431 Like 420-425.
- 431-439 Like 425-431.
- 439-446 Like 431-439.
- 446-454 Sandstone, light gray (N7), very fine-grained, subangular, poorly sorted, silty, calcareous, scattered black mineral.
- 454-459 Sandstone, medium gray (N5), very fine-grained, subangular, very poorly sorted, calcareous, abundant argillaceous material.
- 459-466 Shale, medium dark gray (N4), micaceous, carbonaceous.
- 466-471 Sandstone, light gray (N7), very fine-grained to fine-grained, subangular to subrounded, poorly sorted, slightly porous, silty, abundant green mineral, scattered black mineral, little mica, 3/4 quartzose.
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- 471-472 Like 466-471.
- 478-483 Sandstone, medium light gray (N6), very fine-grained, subangular, silty, calcareous, micaceous, abundant black mineral, 3/4 quartzose.

Ritter #4

Interval

- 483-486 Like 478-483.
- 486-494 Siltstone, medium dark gray (N4), sandy, micaceous.
- 494-502 Like 486-494.
- 502-510 Shale, medium dark gray (N4), silty, calcareous, finely micaceous.
- 510-515 Like 502-510.
- 515-521 Shale, as above, non-calcareous.
- 521-527 Like 515-521.
- 527-535 Like 521-527.
- 535-543 Siltstone, medium dark gray (N4), micaceous.
- 543-550 Shale, dark gray (N3), fissile, carbonaceous.
- 550-557 Ditto.
- 557-567 Sandstone, light gray (N7), very fine-grained to fine-grained, subangular to subrounded, poorly sorted, slightly porous, silty, abundant black mineral, little mica, 3/4 quartzose.
- 567-572 Like 557-567.
- 572-578 Sandstone, light gray, as above, with little green mineral.
- 578-581 Sandstone, very light gray (N8), fine-grained to medium-grained, subangular to subrounded, poorly sorted, slightly porous, slightly silty, micaceous, scattered black mineral, little green mineral, 90% quartzose.
- 581-586 Shale, grayish black (N2), carbonaceous, fissile.
- 586-591 Sandstone, as 578-581.
- 591-595 Like 586-591 with abundant green mineral, slightly calcareous.
- 595-602 Like 591-595.
- 602-607 Like 598-602.
- 607-611 Like 602-607 with abundant black mineral.
- 611-617 Sandstone, light gray (N7), fine-grained to coarse-grained, subangular to rounded, poorly sorted, slightly porous, silty, calcareous, micaceous, sideritic nodules, abundant black mineral, some green mineral, 3/4 quartzose.

Ritter #4

Interval

- 617-621 Sandstone, as above.
- 621-627 Like 617-621.
- 627-632 Like 621-632.
- 632-637 Siltstone, medium dark gray (N4), micaceous.
- 637-645 Shale, medium dark gray (N4), micaceous.
- 645-652 Like 637-645.
- 652-656 Siltstone, medium gray (N5), micaceous.
- 656-660 Like 652-656.
- 660-666 Sandstone, very light gray (N8), to light gray (N7), very fine-grained to fine-grained, subangular to subrounded, poorly sorted, slightly porous, slightly silty, abundant sideritic nodules, abundant black mineral, little green mineral, 3/4 quartzose.
- 666-669 Like 660-666.
- 669-673 Like 666-669.
- 673-677 Like 669-673.
- 677-685 Like 673-677.
- 685-692 Siltstone, medium dark gray (N4), sandy, micaceous and shale, dark gray (N3), carbonaceous.
- 692-697 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular to subrounded, well sorted, fairly porous, friable, little scattered black mineral, 90% quartzose.
- 697-701 Sandstone, light gray (N7), very fine-grained to medium-grained, subangular to subrounded, poorly sorted, slightly porous, silty, micaceous, scattered black mineral, 90% quartzose.
- 701-706 Sandstone, as above, with abundant black argillaceous material.
- 706-713 Sandstone, as 697-701.
- 713-720 Like 706-713.
- 720-725 Like 713-720.
- 725-735 Like 720-735.

Ritter #4

Interval

- 735-745 Like 725-735, conglomeratic, with partings of sideritic shale.
- 745-757 Siltstone, medium dark gray (N4), micaceous, sandy to argillaceous.
- 757-761 Siltstone, medium light gray (N6), very sandy, calcareous.
- 761-766 Sandstone, light gray (N7) to medium gray (N5), very fine-grained to fine-grained, angular to subrounded, poorly sorted, slightly porous, silty, micaceous, calcareous, scattered black mineral, 3/4 quartzose.
- 766-771 Like 761-766 with partings of dark gray (N3) silty shale.
- 771-781 Siltstone, medium dark gray (N4), micaceous.
- 781-788 Sandstone, light gray (N7), as 761-766.
- 788-795 Shale, medium dark gray (N4), silty, micaceous.
- 795-801 Shale, dark gray (N3), carbonaceous, fissile.
- 801-804 Sandstone, very light gray (N8), to light gray (N7), very fine-grained to fine-grained, subangular, with few medium, subrounded grains, fairly porous, with abundant micaceous and dark gray (N3) silty material.
- 804-811 Siltstone, medium gray (N5) to medium dark gray (N4) sandy, micaceous; little shale, dark gray (N3), fissile, and little coal.
- 811-815 Siltstone, as above.
- 815-824 Shale, dark gray (N3), fairly fissile, micaceous.
- 824-830 Shale, as above, with little coal.
- 830-841 Shale, as above.
- 841-850 Siltstone, medium dark gray (N4), slightly micaceous.
- 850-855 Like 841-850.
- 855-865 Shale, dark gray (N3), silty, micaceous.
- 865-873 Like 855-865.
- 873-882 Like 865-873 with some shale, dark gray (N3), fissile, carbonaceous.
- 882-891 Siltstone, medium dark gray (N4), very micaceous.
- 891-899 Siltstone, medium gray (N5), sandy, micaceous.

Ritter #4

Interval

- 899-903 Sandstone, medium light gray (N6), fine-grained to medium-grained, subangular to subrounded, silty, micaceous, scattered black mineral, 3/4 quartzose.
- 903-908 Sandstone, medium gray (N5), as above, with abundant carbonaceous material; and little shale, grayish black (N2), carbonaceous, fissile.
- 908-917 Shale, grayish black (N2), as above, with little coal; and shale, brownish gray (5YR 4/1), sideritic (?).
- 917-922 Shale, medium dark gray (N4), silty, moderately fissile, slightly micaceous.
- 922-933 Shale, dark gray (N3), silty, micaceous, lumpy to fissile, carbonaceous; with trace coal.
- 933-942 Shale, dark gray (N3), fissile, carbonaceous, some contains thin laminae of coal; and little pure coal.
- 942-951 Shale, dark gray (N3), as above.
- 951-959 Shale, medium dark gray (N4), silty, micaceous.
- 959-970 Sandstone, medium light gray (N6) to medium gray (N5), very fine-grained to fine-grained, angular to subrounded, micaceous, scattered black mineral, darker zone contains carbonaceous material, few sideritic nodules, 3/4 quartzose.
- 970-973 Siltstone, medium dark gray (N4), micaceous, with sandy zones.
- 973-978 Sandstone, light gray (N7), very fine-grained to fine-grained, subangular, fairly porous, slightly micaceous, 90% quartzose.
- 978-981 Sandstone, light gray (N7), fine-grained to medium-grained, subangular, to subrounded, fairly well sorted, very porous, scattered black, green, and brown minerals, slightly calcareous, 90% quartzose.
- 981-986 Like 978-981.
- 986-990 Like 981-986.
- 990-993 Siltstone, medium dark gray (N4), sandy, micaceous with sideritic nodules.
- 993-998 Sandstone, very light gray (N8) to light gray (N7), very fine-grained to medium-grained, subangular to subrounded, slightly porous, silty cement, slightly calcareous, some sideritic nodules and scattered black mineral, 90% quartzose.
- 998-1003 Like 993-998 with little green mineral.

Ritter #4.

Interval

- 1003-1008 Sandstone, light gray (N7), very fine-grained to fine-grained, subangular, very slightly porous, very silty, micaceous, abundant sideritic nodules, scattered black mineral, little green mineral, 3/4 quartzose.
- 1008-1010 Sandstone, as 993-998.
- 1010-1015 Sandstone, as above.
- 1015-1019 Like 1010-1015.
- 1019-1025 Like 1015-1019.
- 1025-1030 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular to subrounded, poorly sorted, few medium grains, slightly porous, slightly calcareous cement, little green mineral, 95% quartzose.
- 1030-1036 Like 1025-1030, some iron stained.
- 1036-1042 Siltstone, medium gray (N5) to medium dark gray (N4), sandy, micaceous, sideritic nodules, with some carbonaceous material.
- 1042-1049 Sandstone, medium light gray (N6) to medium gray (N5), very fine-grained to fine-grained, poorly sorted, very slightly porous, very silty, micaceous, sideritic, abundant black material, 60% quartzose.
- 1049-1052 Like 1042-1049.
- 1052-1060 Siltstone, medium dark gray (N4), micaceous.
- 1060-1065 Like 1052-1060.
- 1065-1073 Sandstone, medium gray (N5), very fine-grained to fine-grained, subangular, poorly sorted, very slightly porous, silty, micaceous, slightly brownish tint, (sideritic?).
- 1073-1081 Shale, dark gray (N3), finely micaceous, carbonaceous.
- 1081-1089 Shale, as 1073-1081, but slightly sandy.
- 1089-1100 Sandstone, very light gray (N8), fine-grained to medium-grained, subangular to subrounded, fairly well sorted, slightly porous, calcareous cement, scattered black mineral, 90% quartzose.
- 1100-1106 Like 1089-1100.
- 1106-1111 Like 1100-1106.
- 1111-1122 Like 1106-1111 with little green mineral and brown mineral, and coarse quartz grains.

Ritter #4

Interval

- 1122-1129 Like 1111-1122.
- 1129-1137 Sandstone, very light gray (N8), very fine-grained to medium-grained, subangular to subrounded, with few rounded pebble chips, poorly sorted, slightly porous, silty, scattered black mineral, scattered mica, few sideritic nodules.
- 1137-1143 Like 1129-1137.
- 1137-1148 Sandstone, light gray (N7) to medium light gray (N6), very fine-grained to medium-grained, subangular to subrounded, very poorly sorted, very slightly porous, very silty, scattered black mineral, little mica, sideritic zone.
- 1148-1154 Sandstone, light gray (N7), fine-grained, subangular, fairly well sorted, very slightly porous, very silty, with abundant black and brown minerals and little mica.
- 1154-1160 Like 1148-1154 with few medium, well rounded grains.
- 1160-1167 Siltstone, medium dark gray (N4), sandy, micaceous.
- 1167-1171 Like 1160-1167.
- 1171-1180 Shale, dark gray (N3), fairly fissile, finely micaceous.
- 1180-1186 Like 1171-1180.
- 1186-1196 Like 1180-1186.
- 1196-1206 Like 1186-1196.
- 1206-1216 Like 1196-1206.
- 1216-1226 Siltstone, medium dark gray (N4), sandy, micaceous, sideritic nodules.
- 1226-1236 Like 1216-1226.
- 1236-1241 Shale, dark gray (N3), as 1206-1216.
- 1241-1250 Shale, as above, and siltstone, brownish gray (5YR 4/1), sideritic, interbedded.
- 1250-1260 Interbedded siltstone and shale as above.
- 1260-1267 Sandstone, light gray (N7), very fine-grained to fine-grained, poorly sorted, slightly porous, silty, micaceous.
- 1267-1271 Sandstone, as above with sideritic zone.

Ritter #4

Interval

- 1271-1280 Shale, grayish black (N2), silty and lumpy to fine, fissile; carbonaceous, finely micaceous.
- 1280-1290 Shale, dark gray (N3), finely micaceous, slightly silty.
- 1290-1300 Shale, dark gray (N3), fissile.
- 1300-1306 Siltstone, medium gray (N5), very micaceous, with sandy zones.
- 1306-1313 Sandstone, medium light gray (N6), very fine-grained, subangular, very silty, micaceous, abundant black mineral and little brown mineral (sideritic?).
- 1313-1324 Like 1306-1313 with abundant siderite nodules.
- 1324-1329 Like 1313-1324.
- 1329-1332 Like 1324-1329 with little siderite and abundant scattered black mineral.
- 1332-1342 Siltstone, medium dark gray (N4), sandy, very micaceous, with partings of black carbonaceous shale.
- 1342-1352 Sandstone, medium gray (N5), very fine-grained to fine-grained, subangular, very poorly sorted, very slightly porous, very silty, micaceous, $\frac{1}{2}$ quartzose.
- 1352-1360 Shale, medium dark gray (N4), finely micaceous.
- 1360-1363 Like 1352-1360 with carbonaceous laminae.
- 1363-1373 Like 1360-1363.
- 1373-1383 Siltstone, very light gray (N8) to medium light gray (N6), very sandy, micaceous, some black material (carbonaceous?); and little shale, brownish gray (5YR 4/1) sideritic.
- 1383-1388 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular, poorly sorted, slightly porous, silty, scattered black mineral.
- 1388-1392 Like 1383-1388.
- 1392-1397 Sandstone, as above, but very fine-grained, very silty.
- 1397-1403 Sandstone, medium light gray (N6), very fine-grained, subangular, poorly sorted, slightly porous, silty, with abundant sideritic nodules.
- 1403-1406 Siltstone, medium gray (N5), micaceous.

Ritter #4

Interval

- 1406-1416 Like 1403-1406.
- 1416-1426 Siltstone, medium dark gray (N4), argillaceous, micaceous.
- 1426-1431 Like 1416-1426.
- 1431-1436 Sandstone, very light gray (N8), very fine-grained to fine-grained, with some medium grains, subangular to subrounded, poorly sorted, fairly porous, silty; and shale, grayish black (N2), carbonaceous, with some coal.
- 1436-1445 Sandstone, like 1431-1436.
- 1445-1451 Like 1436-1445.
- 1451-1457 Like 1445-1451.
- 1457-1462 Sandstone, very light gray (N8), very fine-grained to fine-grained, angular to subangular, fairly well sorted, fairly porous, little scattered black mineral, 90% quartzose.
- 1462-1467 Sandstone, light gray (N7), fine-grained to medium-grained, subangular to subrounded, fairly well sorted, fairly porous, with scattered black mineral, and few sideritic nodules.
- 1467-1475 Sandstone, light gray (N7), very fine-grained to fine-grained, angular to subangular, poorly sorted, slightly porous, silty, scattered black mineral.
- 1475-1483 Sandstone, very light gray (N8), fine-grained to medium-grained, subangular, fairly well sorted, porous, slightly silty.
- 1483-1487 Like 1475-1483.
- 1487-1491 Like 1483-1487.
- 1491-1494 Like 1487-1494 with scattered black mineral and some sideritic nodules.
- 1494-1502 Siltstone, medium dark gray (N4), micaceous, sandy to argillaceous.
- 1502-1511 Siltstone, medium gray (N5), micaceous, sandy.
- 1511-1521 Sandstone, medium light gray (N6), very fine-grained to medium-grained, subangular to subrounded, very poorly sorted, very silty, abundant carbonaceous material, 3/4 quartzose.
- 1521-1525 Sandstone, light gray (N7), very fine-grained to fine-grained, angular to subrounded, poorly sorted, slightly porous, silty, sideritic in zones, 3/4 quartzose.

Ritter #4

Interval

- 1525-1531 Sandstone, as above, but not sideritic.
- 1531-1539 Sandstone, light gray (N7), very fine-grained to fine-grained, subangular to subrounded, fairly well sorted, porous, slightly micaceous, with abundant black mineral and sideritic nodules.
- 1539-1547 Sandstone, as above.
- 1547-1552 Like 1539-1547.
- 1552-1562 Like 1547-1552.
- 1562-1567 Sandstone, medium light gray (N6), very fine-grained to fine-grained, angular to subangular, very poorly sorted, very slightly porous, silty, micaceous, with abundant black mineral.
- 1567-1576 Like 1562-1567 with little green mineral.
- 1576-1582 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular to subrounded, fairly well sorted, slightly silty, slightly porous, little scattered black mineral.
- 1582-1588 Like 1576-1582.
- 1588-1594 Shale, medium dark gray (N4), micaceous, silty to dark gray (N3), fissile, carbonaceous, with little coal.
- 1594-1600 Shale, medium dark gray (N4), as above.
- 1600-1615 Siltstone, medium dark gray (N4), slightly sandy, micaceous, with abundant coal (cavings?).
- 1615-1624 Like 1600-1615.
- 1624-1636 Siltstone, as above with no coal.
- 1636-1646 Sandstone, light gray (N7), very fine-grained to medium-grained, subangular to subrounded, poorly sorted, slightly porous, slightly silty, abundant black mineral and sideritic nodules.
- 1646-1656 Like 1636-1646.
- 1656-1666 Sandstone, light gray (N7), very fine-grained to fine-grained, subangular, very poorly sorted, very slightly porous, very silty, micaceous, sideritic.
- 1666-1678 Siltstone, light gray (N7), sandy.
- 1678-1688 Siltstone, medium dark gray (N4), micaceous, sandy to argillaceous with little shale, grayish black (N2), carbonaceous.

Ritter #4

Interval

- 1688-1696 Sandstone, very light gray (N8), very fine-grained, angular to subangular, well sorted, fairly porous, little scattered black mineral, appears bedded.
- 1696-1706 Like 1688-1696.
- 1706-1716 Like 1696-1706.
- 1716-1721 Siltstone, medium dark gray (N4), micaceous.
- 1721-1728 Sandstone, medium light gray (N6), very fine-grained to fine-grained, subangular to subrounded, poorly sorted, slightly porous, silty, micaceous, abundant black mineral and siderite.
- 1728-1734 Sandstone, very light gray (N8), very fine-grained to fine-grained, angular to subangular, very poorly sorted, very slightly porous, very silty, slightly micaceous, slightly sideritic.
- 1734-1743 Like 1728-1734.
- 1743-1752 Like 1734-1743.
- 1752-1761 Like 1743-1752.
- 1761-1771 Siltstone, medium gray (N5) to medium dark gray (N4), sandy, micaceous.
- 1771-1776 Siltstone, medium dark gray, micaceous; with partings of carbonaceous shale.
- 1776-1783 Shale, medium dark gray (N4), micaceous, fairly fissile.
- 1783-1790 Siltstone, medium dark gray (N4), sandy, micaceous with some sideritic shale.
- 1790-1805 Siltstone, medium light gray (N6), to medium gray (N5), sandy with micaceous zones.
- 1805-1812 Sandstone, light gray (N7), very fine-grained to fine-grained, subangular to subrounded, poorly sorted, slightly porous, silty, scattered black mineral, micaceous.
- 1812-1820 Like 1805-1812.
- 1820-1827 Like 1812-1820.
- 1827-1833 Sandstone, as above, very silty and with abundant sideritic nodules.
- 1833-1848 Shale, medium dark gray (N4), finely micaceous.

Ritter #4

Interval

- 1848-1855 Sandstone, light gray (N7), medium gray (N5), very fine-grained to medium-grained, angular to subangular, very poorly sorted, slightly porous, very silty, darker zones, micaceous, argillaceous.
- 1855-1862 Shale, dark gray (N3), silty, fairly fissile, little scattered mica.
- 1862-1869 Siltstone, medium dark gray (N4), argillaceous, micaceous.
- 1869-1877 Siltstone, light gray (N7), sandy, micaceous.
- 1877-1885 Shale, medium dark gray (N4), lumpy, silty to dark gray (N3), fissile, carbonaceous.
- 1885-1896 Shale, medium dark gray, as above.
- 1896-1906 Sandstone, very light gray (N8), fine-grained to medium-grained, with some pebble chips, subangular to subrounded, well sorted, fairly porous, silica cement, little green mineral and some iron stain.
- 1906-1916 Sandstone, as above, but finer grained, and not conglomeritic, appears bedded.
- 1916-1921 Sandstone, white (N9), fine-grained to medium-grained, subangular to subrounded, angular to subrounded, well sorted, slightly porous, silica cement, abundant iron stain, 95% quartzose.
- 1921-1924 Like 1916-1921.
- 1924-1928 Like 1921-1924, with no iron stain.
- 1928-1934 Like 1924-1928 with abundant pebble chips.
- 1934-1940 Like 1928-1934.
- 1940-1944 Like 1934-1940.
- 1944-1948 Like 1940-1944.
- 1948-1952 Like 1944-1948.
- 1952-1954 Sandstone, white (N9), very fine-grained to fine-grained, subangular to subrounded, well sorted, slightly porous, silica cement, 90% quartzose.
- 1954-1957 Like 1942-1954 with some iron stain.
- 1957-1960 Like 1954-1957.
- 1960-1963 Like 1957-1960.
- 1963-1965 Like 1960-1965 with few coarse grains.

Ritter #4

Interval

- 1965-1970 Sandstone, as above, with abundant (about 50%) part of sample consisting of pebble chips up to 8 mm. in diameter.
- 1970-1980 Sandstone, white (N9), conglomeratic, sample consists almost entirely of pebble chips as above.
- 1980-1990 Sandstone, white (N9), conglomeratic, medium-grained to coarse-grained, subangular to rounded, with pebble chips as above, well sorted, very porous, silica cement, 95% quartzose.
- 1990-1995 Like 1980-1990.
- 1995-2016 Like 1990-1995.
- 2016-2020 Like 1995-2016.
- 2020-2025 Like 2016-2020.
- 2025-2030 Like 2020-2025.
- 2030-2039 Like 2025-2030.
- 2039-2047 Like 2030-2039.
- 2047-2055 Siltstone, light gray (N7), sandy; and shale, dark gray (N3), carbonaceous.
- 2055-2064 Sandstone, light gray (N7) to medium gray (N5), very fine-grained to medium-grained, subangular to subrounded, very poorly sorted, slightly porous, very silty, micaceous, abundant black material (carbonaceous?), $\frac{1}{2}$ quartzose; with little shale, dark gray (N3), carbonaceous, fissile; and little coal.
- 2064-2070 Sandstone, light gray (N7), very fine-grained to medium-grained, subangular to angular, very poorly sorted, slightly porous, very silty, micaceous, scattered black material (carbonaceous?), $\frac{1}{2}$ quartzose.
- 2070-2080 Sandstone, medium gray (N5), very fine-grained, angular to subrounded, very poorly sorted, very slightly porous, very silty, very micaceous, abundant black (carbonaceous?), $\frac{1}{2}$ quartzose.
- 2080-2090 Sandstone, light gray (N7), very fine-grained to fine-grained, subangular to subrounded, very poorly sorted, very slightly porous, very silty, $\frac{3}{4}$ quartzose.
- 2090-2100 Like 2080-2090.
- 2100-2109 Like 2090-2100.
- 2109-2115 Like 2100-2109.

Ritter #4

Interval

- 2115-2125 Sandstone, as above, with few medium, well rounded quartz grains, and scattered green mineral.
- 2125-2134 Sandstone, light gray (N7), fine-grained to medium-grained, sub-angular to subrounded, fairly well sorted, slightly porous, silty, with little shale, medium dark gray (N4), silty, micaceous.
- 2132-2150 Siltstone, medium dark gray (N4), sandy, and shale, dark gray (N3), lumpy, carbonaceous.
- 2150-2156 Siltstone, medium dark gray (N4) with little fine mica.
- 2156-2166 Like 2150-2156.
- 2166-2171 Siltstone, medium dark gray (N4), very micaceous; and sandstone, medium light gray (N6), very fine-grained, very silty, micaceous, abundant black argillaceous material.
- 2171-2181 Shale, dark gray (N3), fissile, and little coal.
- 2181-2191 Siltstone, medium gray (N5), sandy, micaceous, with some black (carbonaceous?) material.
- 2191-2200 Sandstone, light gray (N7), very fine-grained to fine-grained, silty; siltstone, medium gray (N5), to medium dark gray (N4), argillaceous, some micaceous, and abundant bright coal.
- 2200-2206 No sample.
- 2206-2211 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular to subrounded, poorly sorted, very slightly porous, silty, scattered black mineral, and little green mineral.
- 2211-2220 Sandstone, medium light gray (N6), very fine-grained to medium-grained, angular, to subrounded, very poorly sorted, very silty, abundant argillaceous material, mica.
- 2220-2226 Shale, medium dark gray (N4), fissile, some carbonaceous.
- 2226-2233 Siltstone, medium gray (N5), argillaceous to sandy.
- 2233-2245 Sandstone, very light gray (N8), fine-grained to medium-grained, subangular to subrounded, poorly sorted, slightly porous, friable, silty, micaceous, scattered green mineral, and black mineral, 3/4 quartzose.
- 2245-2251 Like 2233-2245.
- 2251-2262 Like 2245-2251.

Ritter #4.

Interval

- 2262-2267 Siltstone, medium dark gray (N4), argillaceous, micaceous.
- 2267-2272 Sandstone, very light gray (N8), fine-grained to medium-grained, subangular to subrounded, fairly well sorted, slightly porous, slightly silty, scattered green mineral and black mineral.
- 2272-2277 Shale, medium dark gray (N4), micaceous, slightly fissile.
- 2277-2286 Like 2272-2277.
- 2286-2292 Siltstone, medium gray (N5), very micaceous; and sandstone, very light gray (N8), very fine-grained to fine-grained, subangular, well sorted, very slightly porous, slightly silty, silica cement, scattered green mineral.
- 2292-2302 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular to subrounded, poorly sorted, very slightly porous, slightly silty, scattered black mineral; and some coal (cavings?).
- 2302-2307 Sandstone, very light gray (N8), fine-grained to medium-grained, fairly well sorted, slightly porous, silica cement, scattered green mineral and carbonaceous material, 90% quartzose.
- 2307-2312 Sandstone, light gray (N7), very fine-grained to fine-grained, subangular, poorly sorted, very slightly porous, silty, abundant black (carbonaceous?) material, slightly micaceous, 3/4 quartzose.
- 2312-2317 Like 2307-2312.
- 2317-2325 Like 2312-2317.
- 2325-2333 Sandstone, light gray (N7), very fine-grained to medium-grained, subangular to subrounded, poorly sorted, very slightly porous, silty, siliceous cement, abundant black argillaceous material, some mica, little brown mineral (siderite, little green mineral, and little pyrite), 3/4 quartzose.
- 2333-2341 Like 2325-2333.
- 2341-2346 Sandstone, very light gray (N8), very fine-grained to fine-grained, angular, to subangular, poorly sorted, scattered black mineral and green mineral, micaceous, 90% quartzose.
- 2346-2351 Sandstone, as 2341-2351.
- 2351-2356 Sandstone, medium light gray (N6), very fine-grained to fine-grained, subangular, poorly sorted, slightly porous, silty, abundant brown mineral (siderite), and little green mineral.

Ritter #4

Interval

- 2356-2365 Sandstone, very light gray (N8), fine-grained to medium-grained, subangular to subrounded, fairly well sorted, porous, slightly silty, scattered black mineral and green mineral, 90% quartzose.
- 2365-2372 Sandstone, light gray (N7), very fine-grained to medium-grained, subangular to subrounded, very poorly sorted, very slightly porous, very silty, little scattered black mineral, and little pyrite, 3/4 quartzose.
- 2372-2377 Sandstone, very light gray (N8), very fine-grained to fine-grained, angular to subrounded, well sorted, slightly porous, abundant sideritic nodules, 90% quartzose.
- 2377-2382 Like 2372-2377.
- 2382-2387 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular to subrounded, poorly sorted, very slightly porous, silty, scattered black mineral and brown mineral, 90% quartzose.
- 2387-2392 Like 2382-2387.
- 2392-2397 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular, fairly well sorted, slightly porous, scattered siderite nodules, 90% quartzose.
- 2397-2403 Sandstone, very light gray (N8), very fine-grained to fine-grained, angular to subangular, poorly sorted, slightly porous, silty, scattered black mineral, 3/4 quartzose.
- 2403-2410 Sandstone, very light gray (N8), very fine-grained, to fine-grained, subangular to subrounded, poorly sorted, slightly porous, fairly silty, micaceous, scattered black mineral and green mineral.
- 2410-2416 Like 2403-2410.
- 2416-2422 Like 2410-2416, with scattered sideritic nodules.
- 2422-2435 Sandstone, medium light gray (N6), fine-grained to medium-grained, angular to subrounded, very poorly sorted, very silty, abundant, argillaceous material, slightly calcareous, little green mineral and little mica, 3/4 quartzose.
- 2435-2444 Like 2422-2435.
- 2444-2450 Sandstone, very light gray (N8), fine-grained to medium-grained, subangular, fairly well sorted, slightly porous, silty, slightly calcareous, scattered black mineral, little green mineral, 90% quartzose.
- 2450-2456 Like 2444-2450.

Ritter #4

Interval

- 2456-2462 Like 2450-2456.
- 2462-2468 Like 2456-2462.
- 2468-2474 Sandstone, like 2462-2468.
- 2474-2482 Siltstone, medium dark gray (N4), micaceous, argillaceous; and shale, light brownish gray (5YR 6/1), sideritic.
- 2482-2488 Siltstone, medium gray (N5), micaceous, argillaceous.
- 2488-2494 Like 2482-2488.
- 2494-2502 Like 2488-2494.
- 2502-2510 Like 2444-2502, and sh, medium dark gray (N4), fissile.
- 2510-2519 Siltstone, grayish red (5R 4/2), sandy.
- 2519-2525 Shale, dusky red (5R 3/4), silty, slightly micaceous.
- 2525-2529 Siltstone, greenish gray (5G 6/1), sandy; and shale, like 2519-2525.
- 2529-2535 Shale, medium dark gray (N4), lumpy.
- 2535-2541 Shale, as 2529-2535.
- 2541-2546 Sample like 2525-2529.
- 2546-2554 Shale, medium dark gray (N4), silty, micaceous.
- 2554-2559 Siltstone, and shale, as 2541-2546.
- 2559-2564 Sandstone, light greenish gray (5GH 8/1), very fine-grained, angular to subangular, poorly sorted, slightly porous, silty, slightly calcareous, scattered black mineral.
- 2564-2572 Like 2559-2564.
- 2572-2576 Siltstone, medium dark gray (N4), sandy, very micaceous.
- 2578-2584 Like 2572-2578, with little sideritic shale.
- 2584-2590 Sandstone, light gray (N7), to medium light gray (N6), very fine-grained to fine-grained, angular to subangular, poorly sorted, silty, slightly calcareous, 3/4 quartzose.
- 2590-2597 Like 2584-2590.

Ritter #4

Interval

- 2597-2600 Siltstone, medium light gray (N6) to medium dark gray (N4), sandy.
- 2600-2603 Like 2597-2600.
- 2603-2611 Like 2600-2603.
- 2611-2618 Sandstone, medium light gray (N6), very fine-grained, angular to subangular, poorly sorted, slightly porous, silty, some argillaceous material, little mica, 3/4 quartzose.
- 2618-2621 Sandstone, as 2611-2618, calcareous.
- 2621-2626 Like 2618-2621.
- 2626-2629 Sandstone, as 2621-2629, with partings of shale, dark gray (N3), carbonaceous, micaceous.
- 2629-2639 Siltstone, dark gray (N4), micaceous.
- 2639-2648 Siltstone, medium gray (N5) to medium dark gray (N4), as above.
- 2648-2653 Sandstone, very light gray (N8) to medium light gray (N6), very fine-grained, angular to subangular, poorly sorted, silty, calcareous, abundant carbonaceous material in zones, 3/4 quartzose.
- 2653-2657 Like 2648-2653.
- 2657-2661 Like 2653-2657.
- 2661-2671 Siltstone, medium dark gray (N4), argillaceous, little mica.
- 2671-2678 Shale, medium dark gray (N4), silty.
- 2678-2686 Like 2671-2678.
- 2686-2695 Shale, medium dark gray (N4), fairly fissile, slightly micaceous.
- 2695-2705 Like 2686-2695.
- 2605-2715 Like 2695-2705.
- 2715-2725 Like 2705-2715, with little siltstone, medium dark gray (N4), micaceous.
- 2725-2736 Shale, as above.
- 2736-2742 Siltstone, light greenish gray (5GY 8/1), silty, calcareous, slightly micaceous; and limestone, light brownish gray (5YR 6/1) with fine- to medium-grained, subangular quartz grains.
- 2742-2750 Siltstone, medium gray (N5), sandy, non-calcareous.

Ritter #4

Interval

- 2750-2755 Sandstone, medium light gray (N6), very fine-grained, silty, friable.
- 2755-2761 Sandstone, medium light gray (N6), to medium gray (N5), micaceous.
- 2761-2766 Like 2755-2761.
- 2766-2771 Siltstone, medium dark gray (N4), micaceous, argillaceous.
- 2771-2776 Sandstone, very light gray (N8), very fine-grained, subangular, poorly sorted, very slightly porous, silty, scattered black mineral.
- 2776-2781 Like 2771-2776.
- 2781-2796 Like 2776-2781.
- 2796-2802 Sandstone, grayish orange (10YR 7/4), very fine-grained to fine-grained, angular to subangular, fairly well sorted, fairly porous, slightly silty, 90% quartzose.
- 2802-2810 Like 2796-2802.
- 2810-2818 Siltstone, medium light gray (N6), sandy, calcareous, slightly micaceous.
- 2818-2826 Siltstone, medium dark gray (N4), micaceous.
- 2826-2835 Like 2818-2826.
- 2835-2840 Shale, dark gray (N3), micaceous.
- 2840-2846 Sandstone, very light gray (N8) to light gray (N7), very fine-grained, subangular, fairly well sorted, silty, micaceous, 90% quartzose.
- 2846-2850 Sandstone, as above, and shale, dark gray (N3), carbonaceous, lumpy, micaceous.
- 2850-2853 Sandstone, like 2846-2850.
- 2853-2864 Shale, medium dark gray (N4), silty, lumpy.
- 2864-2875 Siltstone, medium light gray (N6), sandy, slightly micaceous.
- 2875-2886 Shale, medium dark gray (N4).
- 2886-2894 Like 2875-2886.
- 2894-2904 Like 2886-2894.

Ritter #4

Interval

- 2904-2914 Siltstone, medium light gray (N6), to medium gray (N5), sandy, slightly calcareous.
- 2914-2918 Sandstone, light gray (N7), very fine-grained to fine-grained, silty, slightly calcareous; and shale, grayish-black (N2), fissile, carbonaceous, with abundant coal.
- 2918-2925 Sandstone, light brownish gray (5YR 6/1), sideritic to medium gray (N5), calcareous, very fine-grained to fine-grained, subangular to subrounded, fairly well sorted, friable, light black mineral, 3/4 quartzose.
- 2925-2927 Sandstone, very light gray (N8) to medium light gray (N6), very fine-grained, subangular, well sorted, slightly porous, very calcareous, 90% quartzose.
- 2927-2931 Like 2925-2927.
- 2931-2940 Siltstone, medium gray (N5), non-calcareous.
- 2940-2941 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular to subrounded, well sorted, slightly porous, calcareous, 90% quartzose.
- 2941-2947 Limestone, white (N9) to medium gray (N5), very finely crystalline, silty.
- 2947-2951 Like 2941-2947, slightly fossiliferous.
- 2951-2957 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular to subrounded, fairly well sorted, slightly porous, silty, calcareous, 90% quartzose.
- 2957-2961 Sandstone, grayish orange (10YR 7/4), fine-grained to medium-grained, subangular to subrounded, well sorted, porous, fairly clean, calcareous, iron staining, 90% quartzose.
- 2961-2965 Shale, medium dark gray (N4) to dark gray (N3), fissile, carbonaceous.
- 2965-2968 Sandstone, very light gray (N8), very fine-grained, subangular, fairly well sorted, slightly porous, slightly silty, non-calcareous, 90% quartzose.
- 2968-2975 Siltstone, medium dark gray (N4), argillaceous, micaceous.
- 2975-2980 Sandstone, light gray (N7), very fine-grained, angular to subangular, poorly sorted, very slightly porous, silty, slightly micaceous, non-calcareous, 3/4 quartzose.
- 2980-2985 Like 2975-2980.

Ritter #4

Interval

- 2985-2989 Like 2983-2985.
- 2989-2993 Like 2985-2989.
- 2993-2996 Like 2989-2993.
- 2996-2999 Like 2993-2996, with abundant iron stain.
- 2999-3003 Like 2996-2999, with little shale, dark gray (N3), carbonaceous, micaceous.
- 3003-3004 Sandstone, very light gray (N8), very fine-grained, subangular, clean, slightly calcareous, 90% quartzose.
- 3004-3007 Like 3003-3004.
- 3007-3010 Like 3004-3007.
- 3010-3013 Like 3007-3010.
- 3013-3015 Like 3010-3013.
- 3015-3018 Sandstone, light gray (N7), very fine-grained, angular to subangular, silty, non-calcareous, 3/4 quartzose.
- 3018-3021 Like 3015-3018.
- 3021-3024 Like 3018-3021, with partings of dark gray (N3) shale.
- 3024-3027 Like 3021-3024.
- 3027-3029 Like 3024-3027.
- 3029-3032 Like 3027-3029, slightly calcareous.
- 3032-3034 Like 3029-3032.
- 3034-3037 Like 3032-3034.
- 3037-3041 Like 3034-3037.
- 3041-3042 Like 3037-3041.
- 3042-3043 Like 3041-3042.
- 3043-3045 Sandstone, as above, slightly calcareous, scattered black mineral.
- 3045-3048 Sandstone, white (N9), very fine-grained, subangular, well sorted, slightly porous, scattered black mineral, with partings, of dark gray (N3), micaceous shale, 90% quartzose.

Ritter #4

Interval

- 3048-3050 Sandstone, white (N9), fine-grained, subangular to subrounded, fairly well sorted, slightly porous, slightly silty, 90% quartzose.
- 3050-3052 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular, fairly well sorted, slightly porous, iron stain, slightly calcareous, 90% quartzose.
- 3052-3058 Siltstone, medium light gray (N6), sandy, micaceous, non-calcareous.
- 3058-3063 Shale, dark gray (N3), fissile.
- 3063-3072 Shale, medium dark gray (N4), calcareous, silty.
- 3072-3078 Like 3063-3072 with little limestone, medium gray (N5), silty, very finely crystalline to crystalline.
- 3078-3083 Like 3072-3078.
- 3083-3089 Shale, as 3078-3083, fossiliferous, (crinoid and brachiopod).
- 3089-3094 Like 3083-3089.
- 3094-3099 Like 3089-3094.
- 3099-3105 Like 3094-3099.
- 3105-3113 Like 3099-3105.
- 3113-3121 Like 3105-3113.
- 3121-3128 Shale, grayish red (10R 4/2), lumpy; and dark greenish gray (5GY 4/1), slightly calcareous.
- 3128-3135 Shale, grayish red, as 3121-3128.
- 3135-3143 Like 3128-3135.
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- 3143-3148 Shale, as 3135-3143.
- 3148-3153 Like 3143-3148.
- 3153-3158 Like 3148-3153.
- 3158-3161 Like 3153-3158.
- 3161-3166 Like 3158-3161.
- 3166-3172 Shale, dark greenish gray (5GY 4/1).
- 3172-3176 No sample.

Ritter #4

Interval

- 3176-3182 Sandstone, medium light gray (N6), very fine-grained to fine-grained, subangular, very poorly sorted, porous, loosely consolidated, calcareous, abundant black mineral, 3/4 quartzose, and limestone, light brownish gray (5YR 6/1), finely crystalline.
- 3182-3188 Shale, grayish red purple (5RP 4/2), calcareous; and limestone, white (N9) to medium light gray (N6), finely crystalline.
- 3188-3194 Siltstone, grayish red (5R 4/2), micaceous, slightly sandy.
- 3194-3199 Siltstone, as above.
- 3199-3204 Siltstone, as 3194-3199, calcareous, very micaceous.
- 3204-3212 Like 3199-3204.
- 3212-3220 Shale, medium dark gray (N4), slightly calcareous.
- 3220-3224 Siltstone, light brownish gray (5YR 6/1), sandy, calcareous.
- 3224-3228 Like 3220-3224.
- 3228-3234 Shale, medium dark gray (N4) to dark gray (N3), fissile, non-calcareous.
- 3234-3240 Shale, medium dark gray (N4), as above, slightly silty.
- 3240-3248 Shale, medium dark gray (N4), lumpy, very calcareous.
- 3248-3256 Shale, dark gray (N3), calcareous with little limestone, medium dark gray (N4), very finely crystalline, silty, thin-bedded.
- 3256-3266 Shale, grayish red (5R 4/2), calcareous.
- 3266-3276 Shale, dark greenish gray (5GY 4/1), silty, non-calcareous.
- 3276-3286 Siltstone, grayish red (10R 4/2), micaceous.
- 3286-3296 Like 3276-3286.
- 3296-3301 Siltstone, greenish gray (5GY 6/1), slightly calcareous, micaceous.
- 3301-3310 Shale, medium dark gray (N4), slightly calcareous; and shale, dark gray (N3), very calcareous.
- 3310-3316 Shale, dark gray (N3), as 3301-3310.
- 3316-3319 Sandstone, light brownish gray (5YR 6/1), very fine-grained, subangular, very poorly sorted, micaceous, scattered black mineral, 1/2 quartzose.

Ritter #4

Interval

- 3319-3322 Sandstone, light gray (N7), very fine-grained, angular to sub-angular, poorly sorted, very slightly porous, scattered black mineral, little green mineral, slightly calcareous, 3/4 quartzose.
- 3322-3324 Like 3319-3322.
- 3324-3327 Like 3322-3324.
- 3327-3331 Sandstone, light greenish gray (5GY 8/1), very fine-grained, silty, abundant green mineral, non-calcareous, 3/4 quartzose.
- 3331-3335 Like 3327-3331.
- 3335-3339 Like 3331-3335.
- 3339-3341 Sandstone, light gray (N7), very fine-grained, angular to subangular, fairly well sorted, slightly porous, scattered green mineral, 90% quartzose.
- 3341-3344 Like 3339-3341.
- 3344-3347 Like 3341-3344.
- 3347-3351 Siltstone, medium dark gray (N4), micaceous.
- 3351-3355 Like 3347-3351.
- 3355-3360 Like 3351-3355.
- 3360-3365 Sandstone, very light gray (N8) to light gray (N7), very fine-grained to fine-grained, subangular to fairly well sorted, slightly porous, slightly silty, little carbonaceous material, scattered green mineral, 90% quartzose.
- 3365-3369 Like 3360-3365.
- 3369-3371 Sandstone, very light gray (N8), very fine-grained, subangular, well sorted, silty, 90% quartzose.
- 3371-3375 Like 3369-3371.
- 3375-3379 Like 3371-3375.
- 3379-3382 Like 3375-3379.
- 3382-3388 Like 3379-3382, with partings of carbonaceous shale.
- 3388-3392 Like 3382-3388.
- 3392-3394 Like 3388-3392.
- 3394-3400 Shale, medium dark gray (N4), silty, with little mica.

Ritter #4

Interval

- 3400-3406 Like 3394-3400.
- 3406-3412 Shale, medium dark gray (N4), calcareous.
- 3412-3417 Like 3406-3412.
- 3417-3423 Siltstone, medium light gray (N6) to medium gray (N5), sandy, to argillaceous.
- 3423-3429 Sandstone, very light gray (N8), very fine-grained, angular, to subangular, silty, scattered black mineral, 90% quartzose.
- 3429-3433 Like 3423-3429.
- 3433-3437 Like 3429-3433.
- 3437-3441 Like 3433-3437.
- 3441-3444 Like 3437-3441.
- 3444-3447 Like 3441-3444.
- 3447-3450 Like 3444-3447.
- 3450-3454 Shale, medium dark gray (N4), to dark gray (N3), calcareous, silty to fine, fissile.
- 3454-3458 Like 3450-3454.
- 3458-3464 Shale, dark greenish gray (5GY 4/1), calcareous.
- 3464-3470 Shale, grayish red (5R 4/2) to very dusky red (10R 2/2) with little shale, grayish black (N2), slightly calcareous; and little sandstone (graywacke), medium gray (N5), abundant black mineral, silt cement, 1/3 quartzose.
- 3470-3471 Sandstone, very light gray (N8), arkosic (?) to graywacke (?), very fine-grained to medium-grained, angular to subrounded, silty, slightly calcareous.
- 3471-3480 Like 3464-3470.
- 3480-3482 Shale, dark gray (N3), fissile; shale, grayish red (5R 4/2), silty, micaceous; and sandstone, as above.
- 3482-3486 Like 3480-3482.
- 3486-3489 Siltstone, medium dark gray (N4), to grayish red (5R 4/2), sandy.
- 3489-3496 Siltstone, medium dark gray (N4), calcareous.

Ritter #4.

Interval

- 3496-3502 Shale, dark gray (N3), fissile, non-calcareous; and limestone, dark gray (N3), very silty.
- 3502-3508 Like 3496-3502, fossiliferous (gastropods).
- 3508-3517 Shale, and limestone, as above with abundant pyrite.
- 3517-3526 Siltstone, medium dark gray (N4), to dark gray (N3), pyritic, abundant calcite seams and little coal.
- 3526-3534 Siltstone, as 3517-3526, with some shale, grayish red (5YR 4/2), silty; and little shale, grayish black (N2), carbonaceous.
- 3534-3542 Like 3526-3534.
- 3542-3550 Like 3534-3542.
- 3550-3554 Sandstone, medium light gray (N6) to very light gray (N8), very fine-grained to fine-grained, angular to subangular, silica cement, fairly friable, abundant green mineral; little red shale as above, and little dark gray (N3) shale and siltstone.
- 3554-3558 Like 3550-3554.
- 3558-3564 Sandstone (graywacke), medium light gray (N6), very fine-grained to fine-grained, and siltstone, medium dark gray (N4), micaceous.
- 3564-3572 Siltstone, like 3558-3564.
- 3572-3580 Siltstone, like 3564-3572, with little shale, grayish black (N2), fossiliferous.
- 3580-3587 Siltstone, grayish red (5R 4/1), micaceous, lumpy.
- 3587-3594 Siltstone, grayish red, as 3580-3587, and sandstone (graywacke), greenish gray (5GY 6/1) to medium dark gray (N4), silty with abundant green and black mineral.
- 3594-3604 Like 3587-3594.
- 3604-3608 Shale, dark gray (N3), lumpy.
- 3608-3612 Siltstone, medium dark gray (N4), micaceous, (muscovite), and little pyrite.
- 3612-3620 Sample dirty, probably like 3608-3612.
- 3620-3629 Siltstone, as 3608-3612.
- 3629-3636 Shale, dark gray (N3), calcareous, fossiliferous?

Ritter #4

Interval

- 3636-3640 Sandstone (graywacke), medium light gray (N6) to medium gray (N5), silty, very fine-grained to medium-grained, very micaceous (muscovite), $\frac{1}{2}$ quartzose.
- 3640-3643 Sandstone, very light gray (N8), fine- to coarse-grained, sub-angular, silica cement, quartzitic, 80% quartzose.
- 3643-3662 Missing.
- 3662-3665 Shale, medium dark gray (N4), silty, lumpy, little pyrite.
- 3665-3671 Shale, as 3662-3665.
- 3671-3677 Like 3665-3671.
- 3677-3684 Sandstone, very light gray (N8), quartzitic, fine- to medium-grained, subangular to subrounded, 90% quartzose; and sandstone (graywacke), medium gray (N5), fine- to medium-grained, angular to subangular, abundant pyrite, and black material, $\frac{3}{4}$ quartzose.
- 3684-3686 Sandstone, very light gray (N8), fine- to medium-grained, sub-angular to subrounded, more friable than above, fairly porous, 95% quartzose.
- 3686-3688 Sandstone, very light gray, like 3684-3686.
- 3688-3691 Like 3686-3688.
- 3691-3692 Like 3688-3691.
- 3692-3693 Like 3691-3692.
- 3693-3696 Like 3692-3693.
- 3696-3701 Like 3693-3696.
- 3701-3702 Sandstone, very light gray (N8), fine-grained, subangular to sub-rounded, friable well sorted, porous, 90% quartzose, iron stained.
- 3702-3704 Like 3701-3702.
- 3704-3706 Sandstone, as 3702-3704, but slightly finer grained.
- 3706-3711 Like 3704-3706.
- 3711-3713 Like 3706-3711.
- 3713-3715 Like 3711-3713.
- 3715-3717 Like 3713-3715.

Ritter 4-V-1557

Interval

- 3720-3724 Shale, medium dark gray (N4), micaceous, calcareous, silty.
- 3724-3732 Shale, like 3720-3732.
- 3732-3739 Shale, grayish red (5R 4/2), silty, micaceous, lumpy.
- 3739-3748 Shale, medium dark gray (N4), calcareous, with some siltstone, light brownish gray (5YR 6/1), sandy, very micaceous, (muscovite?).
- 3748-3753 Sandstone, very light gray (N8), very fine-grained to fine-grained, subangular, friable, silty cement, thin-bedded, 90% quartzose.
- 3753-3754 Like 3748-3753.
- 3754-3757 Like 3753-3754.
- 3757-3759 Like 3754-3757.
- 3759-3763 Like 3757-3759.
- 3763-3764 Shale, medium dark gray (N4), micaceous, lumpy.
- 3764-3766 Sandstone, very light gray (N8), as 3759-3763
- 3766-3768 Like 3764-3766.
- 3768-3771 Sandstone, light gray (N7), thin-bedded with partings of dark gray (N3) shale, very fine-grained to fine-grained, subangular to subrounded, very slightly porous, little black material, (carbonaceous?), little muscovite.
- 3771-3779 Sandstone (graywacke), medium light gray (N6), very fine-grained to medium-grained, subangular to subrounded, silty cement, abundant black material (carbonaceous?).
- 3779-3787 Siltstone, medium dark gray (N4), micaceous.
- 3787-3795 Siltstone, as 3779-3787, sand shale, black (N2), carbonaceous.
- 3795-3804 Shale, medium dark gray (N4), fissile, calcareous, fossiliferous (brachiopods), little pyrite.
- 3804-3807 Like 3795-3804.
- 3807-3816 Siltstone, medium gray (N5), fine, fissile, micaceous.
- 3816-3825 Shale, dark gray (N3), calcareous, fissile, fossiliferous (brachiopods).
- 3825-3834 Missing.
- 3834-3843 Like 3816-3825.

Ritter 4-V-1557

Interval

- 3843-3849 Shale, dark gray (N3), very fissile, breaks into thin pencil like chips and limestone, dark gray (N3), medium clastic, nodular, shaly.
- 3849-3854 Limestone, dark gray (N3), as 3843-3849.
- 3854-3858 Limestone, dark gray (N3), as 3849-3854, and limestone, light gray (N7), medium clastic nodular.
- 3858-3865 Limestone, dark gray (N3), finely crystalline, silty.
- 3865-3872 Limestone, dark gray (N3), as 3858-3872.
- 3872-3879 Shale, medium dark gray (N4), lumpy, silty, calcareous.
- 3872-3879 Shale, medium dark gray (N4), silty, non-calcareous.
- 3879-3884 Siltstone, medium gray (N5) to medium dark gray (N4), sandy, micaceous (muscovite), little pyrite.
- 3884-3888 Sandstone, light gray (N7), silty, very fine-grained, micaceous.
- 3888-3894 Siltstone, medium dark gray (N4), micaceous, abundant black material (carbonaceous?).
- 3894-3900 Shale, medium dark gray (N4), silty, lumpy, micaceous, pyrite.
- 3900-3908 Like 3894-3900.
- 3908-3913 Like 3900-3908.
- 3913-3921 Siltstone, medium gray (N5), calcareous, lumpy.
- 3921-3929 Like 3913-3921.
- 3929-3937 Like 3921-3929.
- 3937-3950 Shale, medium dark gray (N4), fissile, little pyrite.
- 3950-3955 Like 3937-3950.
- 3955-3963 Like 3950-3955.
- 3963-3971 Like 3955-3963.
- 3971-3979 Like 3963-3971.
- 3979-3984 Like 3971-3979.
- 3984-3987 Like 3979-3984.

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Interval

- 3987-3999 Shale, dark gray (N3), calcareous, fossiliferous (crinoids).
- 3999-4006 Like 3987-3999.
- 4006-4011 Shale, dark gray (N3), fissile, finely micaceous, with little pyrite.
- 4011-4025 Missing.
- 4025-4031 Shale, dark gray (N3), calcareous, crinoidal.
- 4031-4036 Shale, dark gray (N3), like 4025-4031; and limestone, medium gray (N5), medium crystalline, slightly silty.
- 4036-4041 Like 4031-4036.
- 4041-4043 Shale, dark gray (N3), silty, calcareous, crinoidal; and little limestone, as 4041-4043.
- 4048-4053 Like 4043-4048.
- 4053-4058 Limestone, dark gray (N3), silty, finely clastic with some fine to medium crystals.
- 4058-4063 Limestone, dark gray (N3), crinoidal, nodular (colitic?), medium clastic with some medium crystals; little colitic chert and some subangular to subrounded, medium-grained quartz interbedded with shale, dark gray (N3), calcareous, silty, fossiliferous.
- 4063-4066 Limestone, like 4058-4063.
- 4066-4071 Siltstone, medium dark gray (N4), slightly calcareous, lumpy, little pyrite.
- 4071-4077 Missing.
- 4077-4083 Siltstone, medium dark gray (N4), calcareous, fossiliferous.
- 4083-4090 Limestone, dark gray (N3), colitic, medium clastic to coarsely clastic with some medium crystals.
- 4090-4094 Like 4083-4090.
- 4094-4098 Limestone, dark gray (N3), silty, thin-bedded, finely crystalline, platy.
- 4098-4103 Limestone, dark gray (N3), colitic, finely clastic to medium clastic, with siltstone matrix; little pyrite.
- 4103-4112 Siltstone, medium; dark gray (N4), calcareous, very fossiliferous, (plant).
- 4112-4121 Like 4103-4112.

Interval

- 4121-4127 Like 4112-4121.
- 4127-4137 Like 4121-4127 with abundant pyrite.
- 4137-4148 Missing.
- 4147-4151 Shale, dark gray (N3), silty, slightly micaceous (muscovite?).
- 4151-4156 Like 4147-4151.
- 4156-4169 Missing.
- 4169-4173 Shale, dark gray (N3), like 4156-4169, with some shale, dark gray (N3), very calcareous, and little limestone, brownish black (5YR 2/1), medium crystalline, fossiliferous.
- 4173-4177 Like 4169-4173.
- 4177-4180 Like 4173-4177.
- 4180-4182 Like 41-7-4180.
- 4183-4189 Shale, dark gray (N3), non-calcareous, like 4180-4182, 50%; and limestone, medium, medium dark gray (N4), colitic, medium crystalline to coarsely crystalline, crinoidal.
- 4189-4193 Limestone, very light gray (N8), to dark gray (N3), nodular (some colitic?) probably mottled, medium crystalline to coarsely crystalline, dark phases, silty and very slightly sandy, fossiliferous.
- 4193-4196 Limestone, very light gray (N8), to dark gray (N3), mottled, medium crystalline to very coarsely crystalline, fossiliferous; with some shale, grayish black (N2), silty, calcareous.
- 4196-4201 Like 4193-4196.
- 4201-4210 Shale, medium dark gray (N4), calcareous, mica-eous (muscovite?).
- 4210-4223 Mottled siltstone, medium dark gray (N4), like 4201-4210; and limestone, light gray (N8), medium crystalline to coarsely crystalline, fossiliferous, little pyrite.
- 4223-4230 Like 4210-4223.
- 4230-4238 Siltstone, medium dark gray (N4), calcareous, little pyrite; and little light gray (N8), mottled limestone, as above.
- 4238-4250 Like 4230-4238.
- 4250-4257 Sample dirty, probably same as 4238-4250.
- 4257-4262 Siltstone, medium dark gray (N4), calcareous; and limestone, very light gray (N8) to medium gray (N5), pure to silty, medium crystalline.

Interval

- 4262-4268 Limestone, medium dark gray (N4) to dark gray (N3), oolitic, finely crystalline, slightly silty.
- 4268-4275 Limestone, medium dark gray (N4), very finely crystalline, platy.
- 4275-4279 Limestone, medium light gray (N6), finely crystalline, grainy; and limestone, medium dark gray (N4), silty; few subrounded quartz grains.
- 4279-4282 Like 4275-4279, with little white chert (fresh).
- 4282-4289 Limestone, medium dark gray (N4), nodular with some ooliths, nodules from grayish black (N2) to very light gray (N8), very finely crystalline matrix.
- 4289-4300 Like 4282-4289.
- 4300-4307 Missing.
- 4307-4310 Limestone, dark gray (N3), slightly silty, very finely crystalline; and limestone, very light gray (N8), oolitic with finely clastic matrix (?).
- 4310-4314 Limestone, medium dark gray (N4), nodular (probably oolitic), dark gray (N3), nodules with medium light gray (N6), medium crystalline matrix; few subangular medium quartz grains.
- 4314-4321 Limestone, medium gray (N5) to medium dark gray (N4), oolitic, very silty matrix, finely crystalline to medium crystalline with some siltstone, medium dark gray (N4), calcareous, fossiliferous.
- 4321-4330 Siltstone, medium dark gray (N4), like 4314-4321; and limestone medium gray (N5), to medium dark gray (N4), as 4314-4321.
- 4330-4338 Limestone, mottled light gray (N7) and dark gray (N3), oolitic, finely crystalline to coarsely crystalline, few crinoid buttons.
- 4338-4343 Like 4330-4338.
- 4343-4351 Limestone, dark gray (N3) silty, finely crystalline to medium crystalline; and little limestone, medium light gray (N6), medium crystalline.
- 4351-4356 Like 4330-4338.
- 4356-4361 Like 4351-4356.
- 4361-4366 Like 4356-4361.

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- 4366-4369 Like 4361-4366.
- 4369-4379 Siltstone, dark gray (N3), calcareous, fossiliferous.
- 4379-4385 Like 4369-4379.
- 4385-4392 Limestone, dark gray (N3), nodular, finely crystalline; and siltstone, dark gray (N3), as 4379-4385.
- 4392-4397 Like 4385-4392 with some limestone, medium light gray (N6), colitic, finely crystalline.
- 4397-4406 Like 4392-4397.
- 4406-4414 Siltstone, medium light gray (N6), calcareous; and limestone, dark gray (N3), as 4397-4406.
- 4414-4423 Siltstone, dark gray (N3), calcareous; siltstone, medium light gray (N6), like 4406-4414; little limestone, like 4406-4414; and little sandstone, medium gray (N5), calcareous, very fine-grained, silty, 3/4 quartzose.
- 4423-4429 Limestone, very light gray (N8) and dark gray (N3) mottled, very oolitic, medium crystalline with some very coarsely crystalline, white (N9), and brownish gray (5YR 4/1) limestone.
- 4429-4439 Like 4423-4429.
- 4439-4445 Limestone, dark gray (N3), nodular (probably oolitic), finely crystalline; siltstone, medium light gray (N6), calcareous; and little limestone light gray (N7), medium crystalline, crinoidal.
- 4445-4450 Limestone, light gray (N7) and dark gray (N3) mottled, oolitic, with little siltstone, medium light gray (N6), as 4439-4445.
- 4450-4455 Like 4445-4455.
- 4455-4463 Like 4450-4455.
- 4463-4469 Limestone, medium gray (N5), colitic, medium crystalline to coarsely crystalline, with little white very coarsely crystalline limestone.
- 4469-4475 Limestone, medium dark gray (N4), finely crystalline to medium crystalline; and limestone, very light gray (N8), chalky.
- 4475-4482 Like 4469-4475.
- 4482-4491 Like 4475-4482.
- 4491-4499 Limestone, dark gray (N3), silty, medium crystalline, fossiliferous.

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Interval

- 4499-4507 Limestone, dark gray (N3), finely crystalline to medium crystalline, platy; limestone, dark gray (N3), as 4491-4499; and limestone, very light gray (N8), colitic, medium crystalline.
- 4507-4515 Limestone, dark gray (N3), silty, platy; and limestone, very light gray (N8), as 4499-4507.
- 4515-4524 Missing.
- 4524-4533 Limestone, dark gray (N3), as 4507-4515; and siltstone, dark gray (N3), calcareous.
- 4533-4548 Missing.
- 4548-4551 Like 4507-4515.
- 4551-4561 Like 4548-4551.
- 4561-4563 Limestone, medium dark gray (N4), finely crystalline; and siltstone, medium gray (N5), calcareous.
- 4563-4568 Limestone, medium dark gray (N4), finely crystalline; and limestone, light gray (N7), medium crystalline, fossiliferous, mottled; with little siltstone, medium gray (N5), like 4561-4563.
- 4568-4575 Limestone, dark gray (N3), silty, medium crystalline; limestone, medium dark gray (N4), colitic, finely crystalline matrix; and little siltstone, dark gray (N3), slightly calcareous.
- 4575-4582 Limestone, medium dark gray (N4), very colitic, slightly silty; and little limestone, light gray (N7), colitic, chalky to medium crystalline.
- 4582-4589 Missing.
- 4589-4596 Like 4575-4582, 50%; and limestone, medium dark gray (N4), finely crystalline, silty, 50%.
- 4596-4606 Limestone, medium dark gray (N4), silty, like 4589-4596; and limestone, medium light gray (N6) to medium gray (N5), colitic, very finely crystalline to coarsely crystalline.
- 4606-4613 Siltstone, medium light gray (N6), calcareous; and siltstone, grayish black (N2), calcareous.
- 4613-4625 Siltstone, medium dark gray (N4), calcareous.
- 4625-4633 Limestone, dark gray (N3) and very light gray (N8), mottled, very finely crystalline to medium crystalline.

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- 4633-4642 Limestone, like 4625-4633; limestone, medium dark gray (N4), oolitic, finely crystalline matrix; and siltstone, light gray (N7), calcareous, some sandy, few pyrite crystals.
- 4642-4649 Limestone, brownish gray (5YR 4/1), very finely crystalline, platy; and limestone, very light gray (N8), chalky.
- 4649-4662 Missing.
- 4662-4669 Limestone, medium light gray (N6) to medium dark gray (N4), very oolitic with chalky to medium crystalline matrix.
- 4689-4675 Like 4662-4669.

Samples examined by Allen D. Williamson
Geologist, U.S.G.S.
Lexington, Kentucky.
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