STRATIGRAPHIC SECTIONS--
COFFEY COUNTY, KANSAS

Christopher G. Maples

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Aliceville Chris Maples 5-19-89

MAP STA.

1. Exposures along mid-section road from ~300' north of center sec 10, T21S, R17E to ~1/4 mile south of center sec. 10, T21S, R17E. Fair-poor section of Lawrence Shale with ~20' sandstone holding up small ledge at ~1133' (Ireland?); Toronto Limestone at ~1170' (both hand level to topographic line). Leavenworth limestone float at top of hill at ~1191' (hand level from topographic line).

2. Toronto-Lawrence contact at ~1157'; ~6' sandstone in Lawrence at ~1135' (both hand level from spot elevation). Section exposed in road between NE NE NE NE sec. 15, T21S, R17E and SE SE SE SE sec. 10, T21S, R17E, from Coffey-Anderson County line west.

3. Toronto-Lawrence contact (poor exposure) at ~1172' (hand level from topographic line). Exposure in road at midpoint between NE 1/4, sec. 21, T21S, R17E and SE 1/4, sec. 16, T21S, R17E.

4. Exposures along N-S road between NW NW SW sec. 22, T21S, R17E and NE NE SE sec. 21, T21S, R17E. Thin (~2'-3') sandstone at ~1171'; ?Toronto limestone at ~1187' (hand level to spot elevation).

5. Very poor exposure in field-access road (?Toronto) at ~1192' (hand-level/pace from topographic line). Exposure near midpoint on E-W road (not down on map) between NW 1/4 sec. 22, T21S, R17E and SW 1/4 sec. 15, T21S, R17E. Common chert-pebble float in plowed field to north.

6. Sandstone ledge (~6') exposed in creek ~20' south of road in S 1/2, SW 1/4, SE 1/4, SE 1/4, SW 1/4, sec. 9, T21S, R17E at ~1118' (hand level to topographic line).

7. Sandstone (~30') exposed in creek and roadways at about 100'-200' south of corners of secs. 8, 9, 16, and 17, T21S, R17E, exposed at ~1092' (base; hand level to topographic line). Uppermost part of sandstone has deep red float; all in-place sandstone is light yellow.

8. Sandstone outcrop and float (~10') very poorly exposed along E-W road from mid-line to 200' east of mid-line between sec. 22 and sec. 27, T21S, R17E at ~1145' (hand level to topographic line).
9. Small sandstone outcrop on west side of N-S road, 640' south of mid-line between sec. 20 and sec. 20, T21S, R17E, at ~1130' (hand level/pace to spot elevation).

10. Sandstone (5'+ exposure) on north side of creek bank, ~40' west of road (SE NE SE SE sec. 17, T21S, R17E) at ~1110' (estimated from topographic map).

11. Toronto limestone (as a thin veneer - ~1'-2'), thin-bedded (1-3"), slabby, rubbly, with large brachiopods (very poorly preserved and fragmented) on weathered surfaces (wackestone) at ~1149' (hand level from spot elevation) on east side only of N-S road (NW NW NW SW sec. 9, T21S, R17E).

12. Toronto float on top of hill on E-W road at mid-point and up to 200' west of mid-point between sec. 5 and sec. 8, T21S, R17E, at ~1143' (estimated from topographic map). Probably coming from farther upslope.

13. Fair-poor exposure in E-W road between E 3/4, NE 1/4, sec. 7, T21S, R17E and E 3/4, SE 1/4, sec. 6, T21S, R17E of Toronto limestone, only ~1' thick, at ~1145', Leavenworth limestone (on west side of hill) at ~1164', and thin veneer of Plattsmouth limestone capping hill at ~1168' (all hand level to spot elevation).

14. Toronto Limestone exposed in ditch in NE NE NE NE NW sec. 7, T20S, R17E at ~1137' (estimated from spot elevation). Very good section in Lawrence Shale extends for 1/4 mile west of Scott Valley Church.

15. Poor Leavenworth-Plattsmouth exposures at ~1156 and ~1160' (hand level from topographic line), 150'-350' north of the center of sec. 7, T21S, R17E. Chert pebbles common.

16. Exposures along E-W road and in pasture no more than ~200' north, ~300' east and west of Star Cemetery (NE NW NW NW sec. 18, T21S, R17E); sandstone at ~1093', Toronto at ~1122' (hand level to topographic line for both). Chert pebbles everywhere.

5-20-89

17. Very nice dam of carefully stacked Toronto Limestone. Overflow gulley at northeast corner of dam exposes excellent ~3'-10' section of soil and Lawrence Shale (highly weathered and root mottled). New dam and pond ~200' south of southwest dam corner has mostly shale and soil, but some slabs of highly weathered Toronto (all probably float); SW 1/4 sec. 18, T21S, R17E. The slabby Toronto may be Amazonia(?) which is beginning to come in below the Toronto now that the Toronto is beginning to thicken.

18. Toronto-abundant float and break in slope at ~1135' (hand level/pace to topographic line). Section is along N-S road ~200' south of mid point between SE 1/4 and SW 1/4 sec. 6, T21S, R17E.

19. Exposures of Toronto(?) Limestone in N-S road north and south of creek crossing ~1/2 mile north of southwest corner sec. 6, T21S, R17E and southeast corner sec. 1, T21S, R16E. Toronto(?)-Lawrence contact at ~1114' north of creek and at ~1110' south of creek (both hand level from spot elevation).

20. Nice exposure of Toronto in pond overflow cut ~40' north of E-W road on southern boundary of SW 1/4, SE 1/4, SE 1/4, SE 1/4, sec. 11, T21S, R16E at ~1081' (hand-level to spot elevation).

8-27-89

21. Sandstone exposed in roadway at top of hill. Toronto Limestone exposed in pasture near tree/bush clump 300' south of road toward top of hill at elevation ~1165' (pace/estimate from topographic map) in NE 1/4, NW 1/4, sec. 14, T21S, R17E. Thin (<4") coaly streak exposed in ditch on south side of road ~150' west of hill crest at elevation ~1145' (hand level/pace from approximated hill-crest elevation).

22. Sandstone in pasture in S 1/2, SE 1/4, SW 1/4, SE 1/4, SE 1/4, sec. 17, T21S, R17E.

23. Sandstone on both sides of road in ditches ~1200' east of northwest corner sec. 20, T21S, R17E at ~1100' (estimated from topographic map).

24. Toronto Limestone at ~1101' (hand level to spot elevation) exposed in ditch on north side of E-W road ~350' west of midline on north edge sec. 24, T21S, R16E.

8-28-89

25. Approximately 15' deep railroad cut through highly weathered Lawrence Shale with thin veneer (<5' thick) of chert and limestone pebbles--many with caliche on various sides. Exposures along both sides of E-W railroad (better on north side) along midline E 1/2, E 1/2, sec. 36, T21S, R16E.

26. Approximately 2-3' of Toronto limestone on north side of E-W road along southern boundary of SE 1/4, SE 1/4, SE 1/4, SE 1/4, sec. 23, T21S, R16E, exposed at ~1099' (hand level to spot elevation).

12-31-89

27. Sandstone exposure in north-south roadway near midpoint, west edge NW 1/4, NW 1/4, sec. 3, T22S, R17E, at ~1175' (hand level from spot elevation).

28. Sandstone, about 10' thick, very poorly exposed along west edge of north-south road on east edge of NE 1/4, NE 1/4, NE 1/4, sec. 33, T21S, R17E, at ~1125' (hand level from spot elevation).

29. Sandstone in east-west roadway near midpoint, southern edge, sec. 27, T21S, R17E, at ~1160' (hand level to spot elevation).

30. Sandstone, about 5' thick, in east-west road near midpoint, south edge SE 1/4, sec. 27, T21S, R17E, at ~1130' (hand level from topographic line).

1-7-90

31. Plattsmouth float in farm fields north and south of subtle break in slope in east-west road about 100' west of midpoint, north edge sec. 14, T21S, R16E, at ~1120' (hand level to spot elevation).

32. Poor exposure of Leavenworth Limestone along north-south road, near center, east edge NE 1/4, SE 1/4, NW 1/4, sec. 14, T21S, R16E, at ~1114' (hand level to topographic line).

33. Poor exposure of Toronto Limestone in east-west road about 200' west of midpoint, south edge SW 1/4, sec. 14, T21S, R16E, at 1084' (hand level from spot elevation).

34. Poor exposure of Toronto Limestone in east-west road about 50' west of midpoint, south edge sec. 14, T21S, R16E, at ~1090' (hand level from spot elevation).

35. Fair-poor Plattsmouth exposure (<3') in north-south roadway, on north and south sides of creek crossing, near midpoint of east edge, NE 1/4, NE 1/4, sec. 11, T21S, R16E, at ~1113' (hand level to spot elevation).

36. Sandstone, yellowish-brown with reddish-brown spots, weathers dark reddish-brown, medium-grained, exposed on south side of hill in S 1/2, SE 1/4, sec. 2, T21S, R16E, at ~1148' (hand level from topographic line); exposure very poor, but sandstone estimated to be at least 5' thick.

37. Fair Leavenworth exposure in east-west road, about 500' east of creek crossing, near midpoint, south edge, SW 1/4, sec. 2, T21S, R16E, at ~1097' (hand level from spot elevation).

38. Fair exposure of thin (about 3' thick) Toronto Limestone in east-west road near midpoint, north edge, NE 1/4, NW 1/4, sec. 12, T21S, R16E, at ~1093' (hand level to topographic line).

39. Fair exposure of thin (about 3' thick) Toronto Limestone in north-south field-access road near midpoint, east edge NE 1/4, sec. 12, T21S, R16E, at ~1119' (hand level from spot elevation).

40. Poor exposure of Toronto Limestone in north-south roadway, about 200 north of southeast corner of sec. 1, T21S, R16E, at ~1109' (hand level from spot elevation).

41. Fair exposure of thin Toronto Limestone (about 2' thick) in ditch on west side of north-south road about 200' north of midpoint, east edge, sec. 5, T21S, R17E, at ~1160' (hand level from spot elevation).

42. Excellent stream-cut exposure of Westphalia Limestone (about 2' thick, nodular, fusulinid profuse), Haskell Limestone (about 2 1/2' thick, massive, dark red zone at top), and thin (<6") myalinid- and gastropod-rich limestone in basal Robbins Shale Member. Exposure along southeast tributary of stream in SE 1/4, SW 1/4, sec. 2, T20S, R17E. Limestone in Robbins Shale at ~1048'; Haskell at ~1042'; Westphalia at ~1036' (all hand level to spot elevation). Joint directions in Haskell: N45°W, N5°E, N55°E.

43. Yellowish- to brownish-orange, medium-grained sandstone in ditch on north side of east-west road, near midpoint, south edge SE 1/4, SE 1/4, sec. 20, T21S, R17E, at ~1120' (estimated from topographic map).

44. Medium-grained, yellowish-red to reddish-brown sandstone exposed at southeast corner sec. 29, southwest corner sec. 28, and northeast corner sec. 32, T21S, R17E, at ~1095' (hand level to spot elevation).

45. Medium-grained, yellowish-brown to reddish-brown sandstone beds, each about 2' thick, separated by about 6' of covered interval; basal sandstone at ~1160' (hand level to spot elevation). Sandstones exposed in north-south roadway along eastern edge of NE 1/4, NE 1/4, NE 1/4, sec. 28, T21S, R17E.

46. Medium-grained, yellowish-brown sandstone exposed in gulley on east side of north-south road near midpoint, west edge, SW 1/4, SW 1/4, sec. 34, T21S, R17E, at ~1142' (hand level to topographic line).

47. Fine- to medium-grained, yellowish-brown to brownish-yellow, sandstone exposed in east-west roadway, near midpoint, north edge NW 1/4, NW 1/4, sec. 10, T22S, R17E, at ~1174' (hand level from spot elevation). Sandstone is about 5' thick at this locality; fair exposure.

48. Sandstone caps hill (very poor exposure) near center, east edge, SE 1/4, NE 1/4, sec. 15, T22S, R17E.

49. Fine-grained sandstone, about 3' thick; one thick (about 1'-1.5'), convoluted bed; the rest thin (<2"), laminated, ripple-marked beds. Exposure on west side of stream, south of east-west road, in NE 1/4, NW 1/4, NW 1/4, NW 1/4, sec. 16, T22S, R17E, at ~1058" 9hand level to topographic line).

50. Thin (<4"), argillaceous, yellowish, brachiopod-crinoid-fusulinid-coated grain packstone in ditch on south side of east-west road across from Quisling Cemetery, near midpoint, north edge, NW 1/4, NW 1/4, sec. 18, T22S, R17E, at ~1026' (hand level to topographic line). This may be Westphalia, or just a limestone in the lower part of the Lawrence Shale.

    (Revisited - 1-8-90) - Common Haskell float, 10'-14' above the Westphalia, at ~1036'-1040' (hand level from Westphalia Limestone).

51. Very poor outcrop of ?Haskell Limestone in east-west road about 200' west of midpoint, southern edge sec. 13, T22S, R16E, at ~1011' (hand level to spot elevation). This may be float.

    (Revisited 1-8-90) - I goofed. This probably is all float.

52. Fair-good exposure of Westphalia and Haskell Limestones. Westphalia is thin (<6"), hard, argillaceous, fusulinid packstone. Haskell is hard, dense, dark wackestone (<1'). Exposure is in ditches along east-west road, along south edge of SW 1/4, SE 1/4, SE 1/4, sec. 13, T22S, R16E. Westphalia at ~1021', Haskell at ~1032' (both hand level to spot elevation).

10-14-90

53. Westphalia and Haskell Limestone Members exposed in ditch on north side of east-west road along south edge S 1/2, SE 1/4, SE 1/4, sec. 35, T21S, R17E. Westphalia exposed at ~1082'; Haskell exposed at ~1094' (both hand level to spot elevation).

4-7-91

54. New pond dredged about 100'-200' northwest of southeast corner sec. 16, T22S, R17E; encountered Westphalia Limestone Member about 8' below water level. Elevation estimated at ~1085' (by W.D. Johnson, USGS, altimeter reading).

4-8-91

55. Sandstone exposed on west side of north-south road along east edge, SE 1/4, SE 1/4, NE 1/4, sec. 32, T21S, R17E.

56. Sandstone exposed on east side of north-south road on west edge of Aliceville, along west edge NW 1/4, NW 1/4, sec. 9, T22S, R17E.

57. Haskell Limestone Member, very poorly exposed in ditch on northwest side of northeast-southwest railroad track near center S 1/2, SE 1/4, sec. 18, T22S, R17E, at ~1043' (hand level to topographic line). Float on both side of railroad track near tops of railroad cuts.

58. Haskell float on dam of pond in northeast corner of SE 1/4, sec. 13, T22S, R16E; estimated to be at ~1035'.

59. Westphalia Limestone Member exposed on southwest side of creeklet in NW 1/4, NW 1/4, SE 1/4, sec. 7, T22S, R17E, at ~1042' (hand level to topographic line).

60. Westphalia and Haskell Limestone Members exposed in creek in northwest corner sec. 7, T22S, R17E, at ~1032' and 1034', respectively (hand level to spot elevation).

Burlington Quadrangle Chris Maples 8-27-89
MAP STA:

1. Approximately 2' of Toronto Limestone exposed at ~1076' (hand level to topographic line) on south side of E-W road approximately 50' west of midline of northern boundary of NE 1/4, sec. 15, T21S, R16E.

2. Toronto Limestone at ~1075' (hand level to topographic line). Exposure on both sides of creek ~200' south of midline of eastern boundary NE 1/4, sec. 15, T21S, R16E, along N-S road (not shown on 1979 photorevision).

3. Thin veneer of Toronto Limestone at top of hill on east side of N-S road (not shown on 1979 photorevision) near midline of west edge SW 1/4, SW 1/4, sec. 14, T21S, R16E, at elevation ~1078' (hand level from spot elevation).

4. Extremely poor exposure of thin veneer of Toronto Limestone at ~1081' (hand level from spot elevation) at top of hill on E-W road near mid line on north edge NE 1/4, NE 1/4, sec. 16, T21S, R16E.

5. Active quarry in Plattsmouth Limestone. Base of limestone at ~1065' (hand level from spot elevation). Floor of quarry in Heebner Shale, sloping westward. Plattsmouth here is ~10' thick: 5.5'. of medium-bedded gray limestone with thin, wispy stringers of black clay, 0.5' clay shale, 4.0' of thin bedded, platy limestone. Quarry is SE 1/4, SW 1/4, sec. 4, T21S, R16E.
6. Apparent Plattsmouth/Heebner contact at ~1086' (hand level to spot elevation) exposed on east side of N-S road ~400' north of center sec. 9, T21S, R16E. Exposure a bit strange--I may need to come see this one again.

7. Toronto Limestone as thin veneer on top of low hill exposed on east side of N-S road between sec. 21 and sec. 22, T21S, R16E, approximately 1,200' north mid line; elevation at ~1063' (hand level from topographic line).

8-28-89

8. Good exposure of Leavenworth (~0.5'), Heebner (~4.0'), and Plattsmouth in gully draining from curve in road toward railroad track (east side of track) SW 1/4, NW 1/4, SW 1/4, SW 1/4, SE 1/4, sec. 9, T21S, R16E. Base of Leavenworth at ~1092' (hand level/pace from topographic line). Only lowermost ~1.5' of Plattsmouth exposed at this locality.

9. Toronto(?) Limestone on both sides of creek along east side of N-S road near midline of western boundary of sec. 3, T21S, R16E. Elevation estimated at 1050' (coincident with topographic line) based on break in slope. Same type of exposure seen in next creek south near mid line of western boundary of SW 1/4, sec. 3, T21S, R17E.

10. Exposure northwest bridge in SE 1/4, SE 1/4, SW 1/4, SE 1/4, sec. 4, T21S, R16E of ~2' of Toronto (?-dark orange weathering, relatively few fossils) limestone at ~1046' (hand level to spot elevation). Evidence that creek flood from the past week covered the Toronto here.

11. Thin veneer of Toronto Limestone on east side of N-S road near midline of western boundary of SW 1/4, sec. 22, T21S, R16E, at ~1083' (hand level from spot elevation).

12. Nice exposure of upper 40' or so of Lawrence Shale overlain by ~2' of Toronto Limestone. Thin (1"-3") limestone with pretty fair brachiopod fauna occurs in Lawrence Shale approximately 30' from the top; probably is the Amazonia Limestone. COLLECTION: BUR 12-1 for conodonts. Toronto Limestone at ~1103' (hand level to topographic line). Exposure along east side of N-S road and north side of E-W road that wrap around outside of SE 1/4, SE 1/4, SE 1/4, SE 1/4, sec. 28, T21S, R16E.

    (Revisited with T.W. Henry, USGS - 9-7-89) - Collection made for brachiopod biostratigraphic analysis. Amazonia Limestone Member at this locality is dominated by Juresania with lesser amounts of Neospirifer and Derbyia. Relatively rare Linoproductus, Orthomyalina ?Myalinella, a large stick bryozoan, barnacle borings (only in Neospirifer), and poorly preserved, rounded inadunate crinoid debris. A lowermost limestone (north end of exposure) bed contains abundant fusulinids and rare, small rugose corals. Rare Echinoconchus debris (pieces only, not collectable). Rare pectinid clam debris and an Edmondia. Directly over hill in NE corner sec. 33, T24S, R16E is an excellent exposure of upper part of Lawrence shale, including Amazonia (0.75-1.5 feet) overlain by clay shale with siltstone beds; the Williamsburg Coal bed is nicely exposed on west side of road at ~11 feet above the Amazonia base (hand level) and is ~0.25-0.5 foot thick. Shale under Amazonia (5' + exposed) is very clayey and has scattered, large (up to ~1' diameter) platy (less than 2" thick), rounded sideritic concretions that are dark in the lower 2/3 of concretion and light and laminated in the upper 1/3. Rare ?Punctospirifer in Amazonia, + a cromyocrinid-like crinoid. Coal is ~17' below base of Toronto (hand level).

13. Approximately 1-2' feet of Toronto Limestone exposed in road and on south side of road at mid line along northern edge of NW 1/4, NW 1/4, NW 1/4, sec. 33, T21S, R16E, at ~1082' (hand level from topographic line).

14. Toronto(?) Limestone (~2' of base?) exposed and dug on east side of low road cut along N-S road at mid line of western boundary of SW 1/4, sec. 28, T21S, R16E. Elevation estimated from topographic map at ~1083'. Chert pebbles in float from overlying soil (~1.5' thick).

15. Leavenworth-Plattsmouth poorly exposed on north side of E-W road near mid line of northern boundary NW 1/4, NE 1/4, sec. 28, T21S, R16E. Leavenworth (~6") base at ~1101', ~3' Heebner shale, ~2' + Plattsmouth limestone (hand level to spot elevation).

16. Basal 3-4' of Plattsmouth exposed on south side of E-W road near mid line of southern boundary SW 1/4, SE 1/4, sec. 29, T21S, R16E, at ~1102' (hand level from topographic line). Abundant chert-pebble float at top of road cuts. Black shale (Heebner) float and Leavenworth float near base of roadcut.

12-5-89

17. Excellent, large, well-exposed quarry in Plattsmouth Limestone. Plattsmouth is about 8' thick here and overlain by about 7' of very fossiliferous shale. This fossiliferous shale probably is equivalent to the upper slabby Plattsmouth northeast of Waverly, but will be mapped as Heumader. This sequence is capped by about 1'-2' of chert gravel. Base of Plattsmouth at ~1044' (hand level to spot elevation). Quarry is in NE 1/4, NE 1/4, sec. 25, T21S, R15E.

18. Fair Plattsmouth exposure on both sides of east-west road along northern edge of NE 1/4, NE 1/4, NW 1/4, sec. 25, T21S, R15E, at ~1024' (hand level to spot elevation).

12-18-89

19. Limestone (about 3' thick) overlying silty shale with common myalinids in growth position(?) and other molluscs. Stallard (1966) mapped this as Clay Creek, as did Dames and Moore in their Wolf Creek project report. However, Newell measured the section here and called it Kereford. Base of limestone at ~1050' near midline, south edge SW 1/4, SW 1/4 sec. 11, T21S, R15E (north side of east-west road), and at ~1047' near center, W 1/2, SW 1/4, SW 1/4, sec. 11, T21S, R15E along east side of NNW-SSE US75 (both hand level from spot elevation). Myalinid bed (and other, less obvious fossils) approximately 3' below limestone. Limestone here is about 8' thick.

    (Revisited 12-7-91) - This probably is Kereford Limestone Member.

20. Approximately 2' thick chert gravel at top of hill near center, south line, SE 1/4, SW 1/4, sec. 11, T21S, R15E; base at ~1085' (estimated from topographic map). Basal contact very irregular.

12-30-89

21. Nice exposure of about 20' of Lawrence Shale; very common weathered-out burrows; bioturbated sandstone/siltstone lenses (less than 1" thick); abundant weathered-out sideritic/hematitic concretions. Thin (<3"), calcareous siltstone/silty limestone near top of hill at ~1070' (estimated from topographic map) with some bivalve and brachiopod debris and common disarticulated crinoid debris. Section is mostly on south side of east-west road along west side of hill in NW 1/4, NW 1/4, NE 1/4, NW 1/4, sec. 11, T22S, R15E. Fossiliferous bed probably is above Plattsmouth.

22. Orangish crinoidal wackestone/packstone about 10' thick at ~1022' (hand level from topographic line); looks like Toronto. Section along north-south road on south side of northeastward-flowing stream near midline of west edge sec. 12, T22S, R15E.

23. Leavenworth Limestone at ~1054'; Plattsmouth Limestone at ~1058' (both hand level to spot elevation). Leavenworth is a single, massive, dark limestone (weathers with whitish rind) about 9" thick; Plattsmouth here is several beds (<1' each) of whitish, fossiliferous limestone about 3' thick. Exposure along north-south road near midpoint of west edge SW 1/4, sec. 12, T22S, R15E.

24. Chert gravel; very irregular lower contact with clayey soil; good exposure on east side of hill along west side of north-south roadcut near midpoint of east edge of NE 1/4, sec. 14, T22S, R15E. Base of chert gravel at ~1088' (hand level from spot elevation); this is a generalized elevation, though, because of the highly irregular contact with up to 3' of relief seen. Chert gravel up to 6' thick, but seems to present as a thin veneer at elevations lower than indicated here.

25. Leavenworth-Plattsmouth-Chert gravel exposure on hill along north-south road on east edge SE 1/4, NE 1/4, NE 1/4, sec. 11, T22S, R15E. Leavenworth at ~1042'; Plattsmouth about 8' thick, at 1046'; base of chert gravel (about 7' thick) at ~1054' (all hand level from spot elevation).

12-31-89

26. Poor exposure of Plattsmouth Limestone in east-west road near midpoint of north edge NE 1/4, sec. 11, T22S, R15E, at ~1035' (hand level to topographic line).

27. Exposure along field-access road in SW 1/4, SW 1/4, SW 1/4, sec. 1, T22S, R15E. Toronto Limestone is about 11' thick at ~1023'; Snyderville Shale is mostly covered, about 6' thick at ~1034'; Leavenworth Limestone is about 6"-9" thick at ~1040' (all hand level to spot elevation).

28. Chert gravel in new north-south roadcuts along east edge of SE 2/3, SE 1/4, sec. 13, T22S, R15E, at ~1085' (estimated from topographic map).

29. Chert gravel in roadcuts along north edge of NE 1/4, SE 1/4, sec. 13, T22S, R15E. No base seen.

30. Sandstone, about 4' thick, with highly irregular chert-gravel veneer (3'-5' thick) above; exposure on north side of east-west road on northern edge of NW 1/4, NW 1/4, NW 1/4, SE 1/4, sec. 13, T22S, R15E, at ~1103' (hand level to spot elevation).

Comment: The chert gravel, which is plastered on top of other units in this area, seems to follow the existing topography. In other words, just because a hill is capped with chert gravel, it won't necessarily be thicker on the hill relative to the slopes.

31. Plattsmouth Limestone and overlying, highly fossiliferous shale exposed in ditch on south side of east-west road near midpoint of north edge SE 1/4, sec. 13, T22S, R15E, at ~1086' (hand level from topographic line).

32. Sandstone at ~1093' (hand level from topographic line) exposed along creek, south of east-west road on northern edge of NE 1/4, NW 1/4, NW 1/4, NE 1/4, SW 1/4, sec. 13, T22S, R15E.

33. Abundant chert gravel capping hill in center, W 1/2, sec. 13, T22S, R15E. Base estimated at ~1110' (estimated from topographic map).

34. Limestone, about 3' thick, exposed in ditch on north side of east-west road near midpoint of north edge NE 1/4, NE 1/4, sec. 15, T22S, R15E. Lower part of limestone is dark fossiliferous grainstone/packstone (BUR 34-1); upper part of limestone is slightly lighter color, coated-grain grainstone with a few large myalinids (BUR 34-2). Base of limestone at ~1108' (hand level to spot elevation). I'm not sure what unit this is, but it seems to be higher than the Plattsmouth. The shale overlying this limestone is greenish, clay-rich, and unfossiliferous. Chert-gravel veneer 3'$\pm$ thick is present also.

    (Revisited - 12-12-90) - I think this may be Beil, not Ozawkie as I previously thought.

35. Limestone, about 6' thick, exposed in ditch on north side of east-west road near midpoint of north edge sec. 14, T21S, R15E, at ~1058' (hand level to spot elevation). This is the same limestone exposed at MS19.

(Revisited - 12-7-91) - This probably is Kereford Limestone Member.

36. Thick Toronto Limestone exposed mostly on north side of east-west road (abandoned quarry) near center, south edge, SW 1/4, sec. 30, T21S, R16E, at ~1039' (hand level from spot elevation). Toronto is about 15'-17' thick here.

37. Toronto Limestone, about 13'-15' thick, exposed on north and south sides of east-west roadcut at intersection of sec. 29, 30, 31, and 32, T21S, R16E, at ~1046' (hand level from topographic line). Coaly streak seen in weathered Lawrence Shale about 18' below Toronto Limestone. Thin veneer (<2') of dark soil and chert gravel caps exposure.

38. Poor exposure of Toronto Limestone in north-south road near midpoint of western edge NW 1/4, sec. 32, T21S, R16E, at ~1047' (hand level to topographic line).

1-2-90

39. Exposure of ?Toronto Limestone at top of west river bluff, on access road near center W 1/4, sec. 18, T22S, R16E, at ~1061' (hand level to topographic line). Toronto is about 10' thick at this locality.

40. Nice exposure of uppermost Lawrence Shale, Toronto, and Plattsmouth Limestone along field-access road near center NE 1/4, sec. 13, T22S, R15E. Upper 15' or so of Lawrence very well exposed in ditch on northwest side of road; dark coaly streak with rare ostracodes and brachiopods at ~1032'; Toronto is about 12' thick, base at ~1043'; Leavenworth float common at ~1071'; base of Plattsmouth (about 5' thick) at ~1082' (all hand level from topographic line).

41. Very poor exposure of about 6"-thick, dense, dark, single bed of limestone overlain by coated-grain grainstone about 5' higher. Exposure in east-west road, on west side of hill, near midpoint of south edge sec. 15, T22S, R15E. Dark limestone at ~1095'; coated-grain grainstone at ~1100' (both hand level from spot elevation). The coated-grain grainstone is the same one seen at MS34. With this dark limestone below, I suspect that these two limestone beds are the Ozawkie Limestone. Hill capped by 1'-3' of chert gravel.

42. Abandoned quarry in S 1/2, SW 1/4, sec. 2, T21S, R15E. Other authors have referred to this unit as Clay Creek Limestone. No limestone visible in place, but abundant float blocks indicate that the collection mode by T.W. Henry (USGS) and me on the rip-rap on John Redmond Dam, came from this quarry. Sandstone exposed on west edge of quarry; about 6' thick; ripple-marked, cross-bedded, fine- to medium-grained; base at ~1058' (hand level to topographic line). This sandstone is above the ?Clay Creek Limestone. The ?Clay Creek is clearly below 1050' here.

(Revisited - 12-7-91) - The sandstone here overlies ?Kereford Limestone Member. This probably is the dam rip-rap.

1-6-90

43. Poor exposure of about 2' of thin bedded (<3"), very light gray, fossiliferous grainstone/packstone on east side of north-south road, near southwest corner of NW 1/4, SW 1/4, sec. 2, T21S, R16E. Limestone at ~1091' (hand level to topographic line). Looks like one of the Plattsmouth lithotypes.

1-7-90

44. Leavenworth Limestone float overlain by black soil on east side of north-south road, near midpoint of west edge NW 1/4, NW 1/4, sec. 11, T21S, R16E, at ~1197' (hand level from spot elevation).

45. Thin (<1'), medium- to light-gray, light-yellow weathering, fossiliferous wackestone/packstone; some mollusc fragments seen; abundant, fragmented, algal-encrusted myalinids directly below the limestone in shale. Exposure near top of south side of hill along north-south road, near midpoint of SW 1/4, SW 1/4, NW 1/4, sec. 11, T21S, R16E, at ~1110' (hand level from topographic line). Entire outcrop very reminiscent of Spring Branch, but this probably is Plattsmouth.

1-8-90

46. Shales and thin (<2"), ripple-marked, lightly bioturbated sandstones of Lawrence Shale in roadcuts along east edge of NE 1/4, sec. 22, T21S, R16E.

1-9-90

47. Exposure of uppermost Plattsmouth and lower 3'-5' of Heumader on northwest creek bank in NW 1/4, NW 1/4, sec. 24, T21S, R15E; base of Heumader at ~1021' (hand level to topographic line). Near center, west edge of NW 1/4, NW 1/4, sec. 24, T21S, R15E, on east side of north-south road is a thin (<3') sandstone (poorly exposed) at ~1052' (hand level from topographic line). Hill capped by about 1'-3' of chert gravel.

48. Poorly exposed very fine-grained, bioturbated grainstone (almost looks micritic). Burrows are similar morphologically to Macaronichnus (Sample BUR 48-1 is a float block of these trace fossils). This limestone (< 1' exposed) is underlain by calcareous siltstone with a few, large, splayed fenestrate bryozoans. Section is capped by about 1'-4' of chert gravel. Exposure is on east side of north-south road near center, west edge, sec. 13, T21S, R15E. Limestone is at ~1085' (hand level from spot elevation). This limestone lithologically is similar to the "Waverly Flagging" (=Kereford) around Waverly, and appears to be the same limestone as at MS19 and MS35.

49. Good exposure of Heumader Shale on hill, along north side of east-west road, near center, sec. 24, T21S, R15E. The Heumader in this area is extremely fossiliferous and contains a distinctive fauna co-dominated by sponges. Taxonomic diversity in the Heumader generally decreases upward to the point where the shale is very sparsely fossiliferous.

2-10-90

50. Chert gravel on hilltop in SW 1/4, SE 1/4, sec. 10, T22S, R15E, at ~1120' (estimated from topographic map).

4-8-91

51. ?Clay Creek Limestone Member (dense, dark, single bed of limestone weathering into thin chips) exposed along west edge SW 1/4, SW 1/4, sec. 14, T22S, R15E, in ditch along east side of north-south highway, at ~1046' (hand level to spot elevation).

52. Excellent exposure of Leavenworth-Heebner-Plattsmouth on northeast bank of Rock Creek, near center SW 1/4, NW 1/4, sec. 26, T21S, R15E, at ~995' (hand level to topographic line). Leavenworth about 1' thick; Heebner about 4' thick; Plattsmouth about 10'+ thick with shaly break near middle.

12-7-91

53. ?Kereford Limestone Member exposed about 600' south of center sec. 10, T21S, R15E, at ~1030' (hand level to topographic line). Exposure on and along west side of north-south road; lithology very reminiscent of the "Waverly flags." Abundant *Linoproductus* at this locality--samples B53.1 and B53.2.

Gridley Quadrangle Chris Maples 8-27-93
Map Sta:

1) Excellent exposures of limestones and shales along South Big Creek and north-flowing creek in E 1/2, SE 1/4, SE 1/4, NE 1/4, sec. 20 and W 1/2, SW 1/4, SW 1/4, NW 1/4, sec. 21, T23S, R14E. Two main limestone beds at ~1086' and 1100' (hand level from spot elevation) separated by a shale with abundant Neochonetes and diverse brachiopods in the upper 2'; zone of myalinids about 4' below lower limestone. Both limestones are coated-grain grainstones. This probably is in the Big Springs-Beil interval. Examined with S.A. Marcus.

2) Poor exposure of limestone conglomerate and argillaceous, fossiliferous micrite (probably all less than 2' thick) in east-west road at ~1178' (hand level to topographic line). Exposure near midpoint, south edge SW 1/4, SE 1/4, sec. 29, T23S, R14E. Examined with S.A. Marcus.

3) Good exposure of thin (<6") fossiliferous micritic limestone with some grainstone/packstone beds (<2") in center, SW 1/4, SW 1/4, sec. 29, T23S, R14E. This looks a lot like the limestone above the conglomerate at MS2 and probably is the lower part of the Avoca. Exposure at ~1170' (estimated from topographic map); examined with S.A. Marcus.

4) Sandstone exposed in roadcuts and creeks along north-south road separating sec. 29 and sec. 30, T23S, R14E. Examined with S.A. Marcus.

5) Exposure (poor) of upper Beil through upper Avoca along north-south road on west edge NW 1/4, sec. 20, T23S, R14E. Top of Beil at ~1116', base of Beil estimated at ~1114'; yellow nodular zone in King Hill Shale at ~1117'; base of lower Avoca Limestone Member at ~1126'; base of upper Avoca Limestone Member at ~1131' (all hand level to spot elevation). Examined with S.A. Marcus.

Gridley Quadrangle Chris Maples 9-23-93
Map Sta:

6) Exposures along north-south road on west edge SW 1/4, NW 1/4, sec. 23, T23S, R13E. Rock Bluff-Ervine Creek Limestone Members poorly exposed in roadway at ~1172'; Hartford Limestone Member poorly exposed at ~1204' (both hand level to topographic line).

7) Exposure in north-south road, approximately 100' north of midpoint, west edge SW 1/4, sec. 23, T23S, R13E. Exposure seems to be Rock Bluff Limestone Member.

8) Hartford Limestone Member exposed in north-south road and field in northeast corner SE 1/4, SE 1/4, sec. 26, T23S, R13E, at ~1225' (hand level from spot elevation).

9) Sandstone exposed on north side of east-west road at ~1146' (hand level to spot elevation).

10) ?Big Springs/Spring Branch Limestone Member exposed in east-west road near midpoint, south edge SE 1/4, SE 1/4, sec. 30, T23S, R14E, at ~1141' (hand level from spot elevation). Abundant syringoporoid limestone float along road to west for approximately 1/4 mile.

11) Upper Avoca limestone exposed in ditch on east side of north-south road near midpoint, west edge SW 1/4, sec. 30, T23S, R14E, at ~1148' (hand level to topographic line). Lower Avoca limestone may be only 1' or less below the upper Avoca at this locality.

12) King Hill-Avoca poorly exposed along north-south road at ~1124' and 1132', respectively (both hand level from topographic line). Exposure on south side of South Big Creek near midpoint, west edge NW 1/4, sec. 30, T23S, R14E.

13) Big Springs-Beil Limestone Members exposed in creek in northwest corner sec. 30, T23S, R14E. Good exposure with green Queen Hill Shale Member exposed between the two limestones. Base of Big Springs at ~1112' (hand level to spot elevation).

Gridley Quadrangle Chris Maples 9-24-93
Map Sta:

14) Lower Avoca Limestone Member exposed on east side of north-south road along west edge SW 1/4, SW 1/4, NW 1/4, sec. 32, T23S, R14E, at ~1151' (hand level to spot elevation). Examined with S.A. Marcus.

Gridley NW Quadrangle Chris Maples 12-19-90

1. Hartford-Curzon limestones exposed along east-west road near midpoint, south edge, SW 1/4, sec. 4, T21S, R14E, at ~1173'; limestone in Calhoun Shale at ~1159' (both hand level from spot elevation).

2-11-91

2. Hartford-Curzon (Orangish-weathering oncolitic wackestone with sponges overlain by phylloidal limestone) exposed about 600' east of northwest corner sec. 33, T21S, R14E, at ~1137' (hand level to spot elevation). Quarry operating in NW 1/4, NW 1/4, sec. 33, T21S, R14E.

2-25-91

3. Limestone (molluscan packstone/grainstone) in Calhoun Shale, <1' thick, at ~1133'; Hartford Limestone Member at ~1145' (both hand level to topographic line). Exposure along east side of north-south road, along west side NW 1/4, SW 1/4, NW 1/4, SW 1/4, sec. 16, T22S, R14E.

4. Exposures along north and east edges of NW 1/4, SW 1/4, NW 1/4, sec. 16, T22S, R14E (includes new east-west road not shown on 1967 map). Rock Bluff-Ervine creek exposed at ~1111' (hand level to topographic line). Hartford Limestone Member exposed at ~1145' (hand level from topographic line).

5. Rock Bluff-Ervine Creek exposed on north side of east-west road (not shown in 1967 map) at about midpoint, south edge SE 1/4, NE 1/4, NW 1/4, sec. 16, T22S, R14E, at ~1130' (hand level to topographic line).

6. Rock bluff-Ervine Creek at ~1121' (hand level from topographic line). Exposures along north-south and east-west roads in NE 1/4, NE 1/4, NE 1/r, NE 1/4, sec. 17, T22S, R14E.

7. Limestone (<1', molluscan, sandy near top) in Calhoun Shale at ~1156'; Hartford Limestone Member at ~1166' (both hand level from topographic line). Exposures on both sides of north-south road, about 100'-400' south of midpoint, east edge sec. 5, T22S, R14E.

8. Ervine Creek Limestone Member exposed on east side of north-south road near midpoint, west edge SW 1/4, SW 1/4, sec. 4, T22S, R14E, at ~1124' (hand level to spot elevation).

9. Rock Bluff-Ervine Creek limestones exposed on east side of north-south road, south side of North Big Creek, near midpoint west edge SW 1/4, NW 1/4, SW 1/4, sec. 8, T22S, R14E, at ~1107' (hand level from topographic line).

10. Two molluscan packstones/grainstones in Calhoun Shale at ~1125' (hand level to spot elevation) and at ~1140' (hand level from spot elevation). Common Hartford float on top of hill. Exposures from northeast corner sec. 18 to near midpoint north edge NW 1/4, NW 1/4, sec. 17, T22S, R14E.

11. Rock Bluff-Ervine Creek exposures in drainage south of east-west road near midpoint, north edge NE 1/4, NW 1/4, sec. 17, T22S, R14E, at ~1105' (estimated from topographic map).

12. Ozawkie Limestone Member (yellow, sandy, wackestone to biomicrite) exposed in creek bed about 30' north of east-west road, near midpoint, south edge SE 1/4, sec. 8, T22S, R14E, at ~1088' (hand level to topographic line).

13. Very poor exposures of Hartford Limestone Member on east side of north-south road about 200' south of midpoint, west edge, NW 1/4, sec. 17, T22S, R14E, at ~1140' (hand level to topographic line).

14. Very poor exposure of Hartford Limestone Member at ~1145'; molluscan limestone in Calhoun Shale at ~1135' (both hand level to spot elevation). Exposures along east and west sides of north-south road along west edge, NW 1/4, NW 1/4, SW 1/4, sec. 5, T22S, R14E.

3-3-91

15. Roadcut exposure on both sides of north-south road about 200' south of southwest corner NW 1/4, NW 1/4, sec. 14, T21S, R13E. Thin bedded (<3"), slabby, sandy, fossiliferous grainstone/packstone. Fossil fragments so small that they are nearly unrecognizable. Slope below limestone is shale with some siltstone and limonite-stained mudstone; no indication of coal or other limestone beds. I think the slabby, sandy grainstone is the Bachelor Creek Limestone Member at ~1171' (hand level from topographic line).

16. Exposures in roadcuts and pasture along west edge SW 1/4, NW 1/4, sec. 32, T21S, R13E. Bachelor Creek Limestone Member (same as at MS15) at ~1168'; coated-grain, molluscan grainstone at ~1185' (both hand level to spot elevation). Church Limestone Member float on west side of north-south road between these two exposures. Upper limestone probably is Utopia Limestone Member.

17. Poor exposures on east and west sides of north-south road (not shown on 1967 edition of map); west edge SW 1/4, SW 1/4, NW 1/4, sec. 21, T21S, R14E. Hartford Limestone Member, with abundant sponge oncolites, at ~1130' (hand level from topographic line), overlain by white, phylloidal limestone.

18. Hartford-Curzon Limestone Members exposed near midpoint, west edge, SW 1/4, sec. 16, T21S, R14E, at ~1134' (hand level to spot elevation).

19. Hartford Limestone Member exposed in east-west roadway near midpoint, north edge NE 1/4, NW 1/4, sec. 21, T21S, R14E, at ~1145' (hand level to topographic line).

3-4-91

20. Roadcut on north side of east-west road near midpoint, south edge SW 1/4, sec. 20, T21S, R14E. Hartford Limestone Member at ~1133' (hand level from spot elevation).

21. Hartford-Curzon Limestone Members exposed on both sides of east-west road, along south edge, SW 1/4, SE 1/4, SE 1/4, sec. 19, T21S, R14E, at '1118' (hand level from spot elevation).

3-9-91

22. Hartford Limestone Member exposed across east-west road about 200' west of southeast corner sec. 29, T21S, R14E, at ~1127' (hand level to spot elevation).

23. Very poor exposure of Hartford Limestone Member near center, SW 1/4, SW 1/4, SW 1/4, sec. 29, T21S, R14E, at ~1107' (hand level to spot elevation).

24. Very poor exposure of Church Limestone Member about 500' east of northwest corner sec. 36, T21S, R13E, at ~1199' (hand level from spot elevation).

25. Exposure of Utopia Limestone Member (mostly coated-grain packstone/grainstone) near midpoint, south edge SE 1/4, sec. 27, T21S, R13E (Lyon County), at ~1167' (hand level to spot elevation).

26. (?)Bachelor Creek Limestone Member exposed in creek on west side of north-south road near midpoint, east edge NE 1/4, sec. 27, T21S, R13E (Lyon County), at ~1160' (hand level to spot elevation).

27. Bachelor Creek Limestone Member at ~1178' (hand level to spot elevation), on south side of east-west road near midpoint, north edge NW 1/4, NE 1/4, NW 1/4, sec. 23, T21S, R13E. Also exposed about 50' east of northwest corner NE 1/4, sec. 23, T21S, R13E, at ~1182' (hand level to spot elevation).

28. Bachelor Creek Limestone Member exposed along east-west road about 350' west of southeast corner, sec. 11, T21S, R13E, at ~1180'; also exposed about 500' east of southeast corner, sec. 11, T21S, R13E, at ~1182' (both hand level to spot elevation).

10-18-91

29. Chert gravel exposed at top of hill along midpoint, north edge NW 1/4, sec. 5, T22S, R14E. Contact not exposed, but chert extends west to southwest corner sec. 32, T21S, R14E.

30. Church-Utopia Limestone Members poorly exposed along west side of north-south road on east edge NE 1/4, SE 1/4, NE 1/4, sec. 15, T22S, R13E. Church at ~1223'; Utopia at ~1235' (both, hand level from topographic line).

31. Sandstone, about 8' thick, exposed on southeast cutbank of northeast-flowing creek in NW 1/4, SW 1/4, SW 1/4, SW 1/4, sec. 11, T22S, R13E, at ~1167' (estimated from topographic map).

32. Utopia Limestone Member float exposed along north-south road near midpoint, west edge, NW 1/4, NW 1/4, SW 1/4, sec. 2, T22S, R13E, at ~1192' (estimated from topographic map).

33. Sandstone overlain by very poor exposure of Utopia Limestone Member, which in turn is overlain by chert gravel. Exposure on north side of east-west road along south edge of SE 1/4, SW 1/4, SW 1/4, SE 1/4, sec. 14, T22S, R13E. Utopia here is thin remnant (if really present). Utopia/chert gravel at ~1227' (hand level from spot elevation). Could be no Utopia at all, just slabs at base of chert gravel).

34. Hartford Limestone Member (phyllodial algal lithofacies) at ~1162'; Curzon Limestone Member at ~1176' (both hand level from topographic line). Exposures in creek north of east-west road and uphill east of creek along road. Exposures along south edge SE 1/4, SE 1/4, SW 1/4, SW 1/4, sec .18, T22S, R14E.

1. Toronto Limestone Member (about 5' thick) exposed along east-west road near mid-point, south edge SW 1/4, sec. 15, T23S, R15E, at ~1052' (hand level from topographic line).

2. Toronto Limestone Member exposed along east-west road near mid-point, SE 1/4, SE 1/4, sec. 16, T23S, R15E, at ~1044' (hand level to topographic line).

3. Leavenworth Limestone Member exposed on south side of east-west road near midpoint, north edge NW 1/4, SW 1/4, sec. 4, T23S, R15E, at ~1043' (hand level from topographic line). Thin (<1") molluscan/myalinid limestone occurs within 1' of Leavenworth base.

4. Sandstone and shale exposed north and west of road in southeast corner NW 1/4, sec. 4, T23S, R15E.

10-13-90

4a. Leavenworth Limestone Member exposed in SW 1/4, SW 1/4, SW 1/4, SW 1/4, SE 1/4, sec. 21, T22S, R15E, at ~1019' (hand level to spot elevation). Sequence overlain by >5' of chert gravel. Some black shale chips seen above Leavenworth in chert gravel.

5. Partial section of poorly exposed Plattsmouth Limestone Member at ~1024' (hand level to topographic line). Exposure in southeast corner NE 1/4, SE 1/4, sec. 21, T22S, R15E. Section overlain by >5' of chert gravel.

11-10-90

6. Exposure near midpoint, east edge NE 1/4, sec. 18, T23S, R15E; sandstone (yellowish-brown, fine- to medium-grained, bioturbated in part, about 5' thick) at ~1120' (hand level to spot elevation).

7. Sandstone exposed to top of hill near midpoint, south edge, SE 1/4, SW 1/4, sec. 15, T23S, R15E. Is this a sandstone (with subsequently thickened section) in the Snyderville, or have I missed the Leavenworth-Plattsmouth interval? My suspicion is the former, although I cannot rule out the latter.

11-11-90

8. Sandstone-siltstone-shale float along east-west road on top of hill in SW 1/4, SW 1/4, SW 1/4, sec. 18, T23S, R15E.

9. Sandstone, 2'-3' thick, poorly exposed on north side of east-west road at ~1094' (hand level to topographic line). Exposure along south edge SE 1/4, SE 1/4, SW 1/4, SE 1/4, sec. 13, T23S, R14E.

10. Sandstone, same as MS9, poorly exposed on north side of east-west road at ~1083' (hand level from topographic line). Exposure along south side of SE 1/4, SE 1/4, SW 1/4, sec. 13, T23S, R14E.

11. Limestone, coated-grain, molluscan grainstone, about 2' thick, exposed on north side of east-west road at ~1080' (hand level to spot elevation). Sandstone exposed below(?) this limestone to creek level. Exposures along south edge SE 1/4, SW 1/4, SW 1/4, sec. 13, T23S, R14E. Thin-bedded, ripple-marked, bioturbated sandstone exposed in ditch along north edge NE 1/4, NW 1/4, NW 1/4, NW 1/4, sec. 24, T23S, R14E. The limestone seems to be one of those usually discontinuous limestones that occur in predominantly siliciclastic sediments (e.g., the limestone in the Calhoun Shale).

12. Avoca Limestone Member, lower and upper beds, poorly exposed along south edge SE 1/4, SW 1/4, sec. 15, T23S, R14E. Lower bed dark, weathers chippy, with brown fusulinids, at ~1150'; upper bed lighter colored, with abundant syringoporoid coral slabs scattered on the hilltops, at ~1158' (both hand level from topographic line). SAMPLE: GSE12.1, syringoporoid from upper Avoca.

13. Curve ball. Sandstone and silty shale exposed in gulley at ~1118'; two, about one-foot thick limestone beds, separated by <1' of cover; lower bed fusulinid-rich, dark limestone; upper bed lighter in color and contains more echinodermal debris. Overlain by about 2' of covered interval, then yellow, earthy, unfossiliferous limestone seen elsewhere near the top of the King Hill Shale, below the Avoca Limestone. Lower limestone bed at ~1130', yellow bed at ~1135' (all hand level from spot elevation). Exposures along east edge, NW 1/4, SW 1/4, sec. 15, T23S, R14E. Are the two limestones all that remains of the Beil/Big Springs interval?

14. Exposures along north-south roading, extending from east edge SE 1/4, SE 1/4, SE 1/4, sec. 9, T23S, R14E, to east edge N 3/4, N 1/2, NE 1/4, sec. 16, T23S, R14E. Poor to good exposure along entire road. White, fossiliferous grainstone about 2'-3' thick exposed at ~1078'; yellow-weathering, coarse-grained, fossiliferous grainstone to packstone about 2' thick, with fusulinids decreasing in abundance upward, at ~1084' (could this be the Clay Creek?); sandstone, yellow to cream colored, fine to medium grained, crossbedded, same bioturbation, about 1'-2' thick at ~1092'; sandstone, about 1' thick, weathers light gray with some yellow, mostly fine grained, at ~1110'; limestone, about 2'-4' thick, yellow weathering to medium-gray weathering, coarse fossiliferous packstone/grainstone to fusulinid grainstone, at ~1127' (all hand level from topographic line). This upper limestone may be the Beil.

(Revisited - 11-3-91) - The lower limestone couplet that I called questionably Clay Creek is one of those coated-grain pack-grainstones that shows up in thick siliciclastic sequences, which means it may equate with no named limestone.

15. Excellent exposures along intermittent stream in N 1/2, SE 1/4, sec. 16, T23S, R14E. All sandstone and shale from road on east to center of section; sandstone more common in upper 1/2 of unit; reddish shale more common in lower 1/2 of unit.

11-17-90

16. Exposures of thin (<2') dark, fossiliferous wackestone/packstone examined with Al Robb. Dark limestone is single bed, weathers slabby, looks like Avoca, at ~1099'; overlain by sandstone, very poorly exposed, at ~1113' (both hand level to topographic line). Exposure in creek valley along east edge SE 1/4, SE 1/4, NW 1/4, sec. 33, T22S, R14E.

(Revisited - 10-11-91 - with Ronald R. West, Kansas State University). This is Big SPrings-Beil, with about 1' of Doniphan between the two.

17. Very poor exposure of dark, argillaceous, yellow-brown weathering wackestone on south side of east-west road at ~1125' (hand level to spot elevation). Exposure examined with Al Robb, situated on north edge of NW 1/4, NW 1/4, NE 1/4, sec. 3, T23S, R14E.

(Revisited - 10-11-91) This may be Ozawkie or Avoca. Revisited with Ronald R. West (Kansas State University). A few general comments about this Big Springs-Ozawkie interval: The Big Springs looks a lot like the Ozawkie (yellow weathering, small fusulinids); the Avoca is more massive, dark, and contains larger fusulinids. There is a sandstone either within (i.e., between upper and lower) or above the Avoca in this area, which I have not seen before.

2-10-91

18. Exposure of west side of north-south road about 300' north of southeast corner sec. 19, T22S, R15E. Yellowish-orange crinoidal-brachiopod-coated-grain packstone about 1'-2' thick at ~1118' (hand level from spot elevation). This looks like more of the Clay Creek interval.

10-11-91

19. Sandstone exposed along south edge SW 1/4, SW 1/4, SW 1/4, sec. 25, T22S, R14E. Thin veneer (<2') of chert gravel on top of sandstone. Visited with Ronald R. West (Kansas State University).

20. Ozawkie Limestone Member (I think) exposed on east end of farm pond in SE 1/4, SW 1/4, SW 1/4, SW 1/4, sec. 26, T22S, R14E, at ~1108' (hand level to spot elevation). Visited with Ronald R. West (Kansas State University). After a further look at MS21 we think this is the Big Springs-Beil interval instead.

21. Big Springs--Beil interval exposed on east side of Varvel Creek, about 15' north of east-west highway near midpoint, south edge SE 1/4, SW 1/4, SW 1/4, sec. 27, T22S, R14E, at ~1086' (hand level to topographic line). Visited with Ronald R. West (Kansas State University).

22. Exposure along dead-end road on west edge SW 1/4, NW 1/4, SE 1/4, sec. 34, T222S, R14E. Big Springs-Beil at ~1093'; Avoca at ~1109' (both hand level from topographic line). Visited with Ronald R. West (Kansas State University).

11-3-91

23. Sandstone exposed on south side of east-west road near midpoint, north edge NE 1/4, sec. 9, T23S, R14E.

11-29-91

24. Chert gravel on both sides of east-west highway near midpoint north edge NW 1/4, NW 1/4, sec. 34, T22S, R15E. Contact covered, but estimated to be at about 1055' (purely arbitrary and completely indefensible).

25. Chert gravel on north side of east-west highway in southwest corner SE 1/4, SW 1/4, sec. 28, T22S, R15E. No lower contact seen and none estimated.

26. Chert gravel on north side of east-west road and in dam (from pond excavation) along south edge SW 1/4, sec. 29, T22S, R15E. No Lower contact seen and none estimated.

27. Chert gravel on both sides of east-west road near midpoint, south edge SE 1/4, sec. 30, T22S, R15E. No Lower contact seen and none estimated.

28. Chert gravel in dam from pond excavation in NW 1/4, NW 1/4, NE 1/4, sec. 6, T23S, R15E. No lower contact seen and none estimated.

29. Sandstone with abundant ripple marks and trace fossils (similar to sandstone in Stull Shale near Waverly) exposed on southwest bank of creek in NE 1/4, NE 1/4, NE 1/4, sec. 31, T22S, R15E, at ~1050' (hand level to spot elevation).

30. Chert gravel, mostly on west side of north-south road extending from near midpoint east edge SE 1/4 to near midpoint east edge NE 1/4, sec. 31, T22S, R15E. No lower contact seen and none estimated.

31. Shale with thin (mostly < 1") sandstone and ironstone (hematite/limonite) beds scattered throughout; about 40' of nearly continuous exposure along both sides of north-south road along west edge SW 1/4, NW 1/4, sec. 7, T23S, R15E. Trace fossils common (but not very diverse) throughout. Small (~60' x 15') soft-sediment on "pop-up" structure exposed in ditch on west side of road. Orientation of structure about N20 degrees E; about 3' of relief on each bed.

32. Same unit seen at MS31 exposed mostly on east side of north-south road along west edge SW 1/4, SW 1/4, sec. 7, T23S, R15E.

33. Exposure of gray, silty shale with thin (< 1/2"), sandy, bioturbated intervals exposed in floor of Varvel Creek near its confluence with South Big Creek on east side of north-south road at bridge 250'-300' north of southwest corner sec. 1, T23S, R14E. Shale overlain by 7' of chert gravel and 5' of alluvium (all considered to be Qal). Contact of chert gravel and shale at ~1032' (hand level to spot elevation).

34. Sandy, slightly molluscan carbonate, about 1' thick, very poorly exposed at ~1060' (hand level to spot elevation). Exposure on east side of north-south road near midpoint west edge SW 1/4, NW 1/4, sec. 12, T23S, R14E.

35. Limestone, crinoidal and molluscan ("oatmeal rock") packstone with shale clasts; about 3' thick with 1'-1 1/2' thick shale in middle part, at ~1043' (hand level to topographic line). Exposure on northeast edge of road NE 1/4, NE 1/4, SE 1/4, SW 1/4, sec. 1, T23S, R14E. This limestone probably does not equate with a named limestone member. I make the statement because this lithotype tends to be randomly occurring in thick siliciclastic units throughout the Coffey County section.

36. Limestone, dark with very common Crunithyris and some mollusks and trilobites, underlain with dark calcareous shale, overlain by thin yellowish-orange calcareous shale and limestone beds. Below dark shale (with chonetids) is a thin (< 1/2") molluscan limestone with some myalinids. Brachiopod collection GSE 36.1 from the total sequence (~10'). Exposure fairly poor on top of hill along east edge, midpoint NE 1/4, SE 1/4, sec. 11, T23S, R14E. Dark limestone at ~1115' (hand level from spot elevation). This is the Spring Branch-Big Springs-Beil interval (I think).

37. Limestone as at MS35 and MS34 exposed on south side of east-west road near midpoint north edge NW 1/4, NW 1/4, SW 1/4, sec. 12, T23S, R14E, at ~1060' (hand level to spot elevation).

12-21-91

38. Sandstone in float of old railroad cut in SW 1/4, SE 1/4, SW 1/4, SE 1/4, sec. 31, T22S, R15E.

Gridley SE Quadrangle Chris Maples 11-27-92
Map Sta:

1) Toronto Limestone quarry in SE 1/4, NW 1/4, SW 1/4, sec. 28, T23S, R15E. Base of Toronto here at ~1049' (hand level to topographic line). Toronto is about 11' thick here.

2) Toronto Limestone Member exposed on east side of north-south road, south of Duck Creek, near midpoint, west edge NW 1/4, SW 1/4, sec. 28, T23S, R15E, at ~1035' (hand level to spot elevation).

3) Toronto Limestone Member exposed on east side of unnamed, south-flowing tributary into Duck Creek at ~1032' and on west side of Duck Creek, south of bridge on east-west road at ~1024' (both hand-level to spot elevation). Exposures near center NE 1/4, sec. 29, T23S, R15E.

4) Leavenworth Limestone Member exposed in ditch on east side of north-south road at ~1058' (hand level from topographic line). Exposure near midpoint, west edge NW 1/4, SW 1/4, sec. 29, T23S, R15E.

5) Toronto Limestone Member poorly exposed in north-south road near midpoint, east edge NE 1/4, SE 1/4, sec. 32, T23S, R15E, along south side of east-flowing tributary to Turkey Creek, at ~1046' (hand level from topographic line).

6) Sandstone poorly exposed in and on both sides of east-west road near midpoint, north edge NW 1/4, NW 1/4, NE 1/4, sec. 36, T23S, R14E.

7) Thin (<3"), argillaceous, Neospirifer- and Linoproductus- bearing limestone poorly exposed in and along east-west road at ~1130' (hand level to topographic line). This looks like one of those limestones that occurs near the tops of thick siliciclastic packages; these limestones commonly have limited lateral extent (compared with named units). Exposure near midpoint, north edge NW 1/4, sec. 31, T23S, R15E.

Gridley SE Quadrangle Chris Maples 8-26-93
Map Sta:

8) Plattsmouth Limestone Member exposed in bedding planes along floor of south-flowing creek near east edge NW 1/4, NW 1/4, sec. 20, T23S, R15E. Fossils weathering from shale partings from ripples, dunes, and bars in creek bed. Judging from the fossil fauna (brachiopods, echinoderm debris, bryozoans, and sponges), this looks like upper Plattsmouth to Heumader transitional strata.

9) Sandstone float poorly exposed in field-access road near midpoint, north edge, NE 1/4, NW 1/4, sec. 28, T23S, R15E.

10) Sandstone float poorly exposed in dead end farm road near midpoint, north edge, SW 1/4, SW 1/4, sec. 19, T23S, R15E.

11) Fine-grained, ripple-marked, bioturbated, thin-bedded sandstone and shale/siltstone exposed in ditch on east side of north-south road along west side SW 1/4, NW 1/4, sec. 24, T23S, R14E.

12) Sandstone exposure and float on south side of east-west road and in northeast-flowing creek in NW 1/4, NE 1/4, NW 1/4, sec. 35, T23S, R14E.

13) Sandstone poorly exposed in roadway near midpoint, north edge, NE 1/4, NE 1/4, sec. 34, T23S, R14E.

14) Jurasenia-rich limestone (< 1") overlain by myalinid-rich limestone/mudstone at ~1090' (estimated from topographic map) in ditch on west side of north-south road in southeast corner NE 1/4, NE 1/4, NE 1/4, sec. 27, T23S, R14E. May be in Stull Shale.

Gridley SE Quadrangle Chris Maples 8-27-93
Map Sta:

15) Sandstone float and poor exposures on hill and hill slopes in W 1/2, SW 1/4, sec. 34 and E 1/2, SE 1/4, sec. 33, T23S, R14E. Examined with S.A. Marcus.

16) Coated-grain, molluscan, echinodermal grainstone (< 1') poorly exposed in north-south road about 200' north of the southwest corner of sec. 27, T23S, R14E, at ~1116' (hand level from topographic line). Examined with S.A. Marcus.

17) Sandstone exposed in creek cuts in SE 1/4, SE 1/4, NE 1/4, sec. 21, T23S, R14E and SW 1/4, SW 1/4, NW 1/4, sec. 22, T23S, R14E. Examined with S.A. Marcus.

Hartford Quadrangle Chris Maples 1-21-90

1. Fair exposure in roadcut on north side of east-west road about 100' west of midpoint, south edge SW 1/4, sec. 32, T19S, R14E. Dark, single bed of crinoidal packstone to wackestone about 1.5' thick, overlain by about 3" of brachiopod wackestone (possibly good crack-out fauna here), overlain by thin veneer (<1"?) of fusulinid-rich packstone. Top of hill has about 2'-3' of thin-bedded (<4"), light gray, echinoderm, brachiopod, fusulinid, wackestone/packstone. Limestone almost appears phylloidal in part. Base of lower limestone at ~1079'; base of upper limestone at ~1089' (both hand level to spot elevation). Lower limestone may be Hartford, upper may be the Curzon.

2. Church Limestone Member on east side of hill, near midpoint, north edge, NW 1/4, NW 1/4, sec. 31, T19S, R14E, at ~1163' (hand level to spot elevation).

3. Hartford/Curzon limestones exposed in ditch on south side of east-west road, near midpoint, north edge, NE 1/4, NE 1/4, NE 1/4, sec. 32, T19S, R14E, at ~1088' (hand level to topographic line).

   (Revisited - 10-14-90) - Creek near midpoint, south edge SE 1/4, sec. 29, T19S, R14E, is dry. Phylloidal Hartford Limestone Member exposed in creek bed. Base of limestone not seen.

4. Poor exposure of Hartford/Curzon limestones on east side of Logwater Branch along east-west road, near midpoint, south edge, SW 1/4, sec. 29, T19S, R14E, at ~1076' (hand level to spot elevation).

5. Church Limestone Member (about 2' thick) exposed in and south of east-west road, near midpoint, north edge NE 1/4, sec. 35, T19S, R13E, at ~1109' (hand level to topographic line). Chert gravel is very common up hill toward east, beginning at ~1120' (estimated from topographic map). No Utopia seen--just chert gravel.

6. Very good exposure of Utopia Limestone Member on east side of drainage in N 1/2, NW 1/4, NW 1/4, NE 1/4, sec. 34, T19S, R13E (about 1/2 mile into Lyon County), at ~1090' (hand level to spot elevation). Lower part of Utopia here is a thin (about 3"), myalinid packstone/wackestone; upper part is about 1.5' thick, rubbly, fusulinid and echinoderm packstone. Total Utopia thickness here is about 7'.

1-22-90

7. Exposures of chert gravel from about midpoint, west edge NW 1/4, SW 1/4, sec. 35, T19S, R13E, to northwest corner sec. 35, T19S, R13E, along north-south road, beginning at ~1100' (estimated from topographic map). (Revisited - 1-22-90) - Adjusted elevation of chert gravel upward to ~1125' (estimated from topographic map). Exposure along west edge, NW 1/4, sec. 35, T19S, R13E.

8. Poor exposure of chert gravel at 1130' (estimated from topographic map), at and about 200' west of midpoint, north edge, NE 1/4, sec. 34, T19S, R13E, along east-west road.

9. Fair exposure of Church-Utopia Limestone Members on northeast side of northwest-southeast road near center, sec. 34, T19S, R13E. Church Limestone Member (about 2' thick) at ~1090'; basal part of Utopia Limestone Member (coated-grain packstone) at ~1104' (both hand level to topographic line).

10. Approximate northern edge of chert gravel at ~1150' (estimated from topographic map) near midpoint, west edge, SW 1/4, sec. 26, T19S, R13E.

11. Good-excellent exposure of Hartford/Curzon Limestone north and south of drainage along north-south road on west edge, SW 1/4, NW 1/4, sec. 35, T20S, R14E. Base of limestone at ~1080' (hand level to topographic line). Curzon here is light gray, fusulinid, brachiopod, and echinoderm rich, thin bedded (<4") separated by shale beds (<3") except uppermost shale bed, which is about 4' thick and fossiliferous, overlain by thin (<3"), silty, earthy, fossiliferous wackestone. I consider this whole package part of the Topeka (total thickness here about 14'+). Some chert gravel seen at ~1105', near top of hill.

12. Fair exposure (punctuated with a lot of covered intervals) of Hartford-Curzon Limestone Members in west cutbank of Lebo Creek and along east-west road along north edge, NW 1/4, NW 1/4, sec. 8, T20S, R14E (Curzon best exposed in drainage near midpoint of road). Hartford at water level in Lebo Creek at ~1042'; last occurrence of limestone (?Curzon) is at ~1088' (all hand level to spot elevation). Curzon here is thick in lower part and somewhat phylloidal. This phylloidal part is separated from the top of the Utopia by about 10' of shale. Last limestone is about 4" thick, argillaceous, and fusulinid-profuse. Chert gravel at top of hill at ~1100' (estimated from topographic map).

    (Revisited - 10-14-90) - I goofed. The limestone I called Hartford is really an unnamed limestone bed in the Calhoun Shale. I made two mistakes: 1) there is Hartford float on the slope, but clearly none in place, and 2) I failed to notice the small, dark coated grains typical of this limestone bed. The Hartford base is not exposed, but estimated to be at ~1065'.

13. Chert gravel at ~1100' (estimated from topographic map); underlain by upper part of Topeka Limestone. Exposure near midpoint, west edge, NW 1/4, sec. 8, T20S, R14E.

14. Poor exposure of Topeka Limestone (thin bedded, fusulinid and coated-grain packstone/grainstone) at ~1060'; exposure on south side of hill about 800'-900' south of center, sec. 12, T20S, R13E.

15. Excellent exposure of chert gravel (abandoned pit) resting directly on Topeka Limestone (quarry floor). Numerous gouges and striations in Topeka at limestone-chert gravel contact range from N60°W to N65°W (S60°E to S65°E), roughly parallel to present-day Neosho River valley. Base of chert conglomerate at ~1080' (estimated from topographic map). Exposure in S 1/2, NE 1/4, SE 1/4, sec. 12, T20S, R13E.

16. Section (fair exposure) in ditch on south side of east-west road along north edge, NW 1/4, SE 1/4, sec. 12, T20S, R13E. Sandy, argillaceous, packstone/wackestone with red-colored productids at ~1063' (about 1'-2' thick); this is followed by about 3' of greenish shale and then a fusulinid-profuse limestone about 3" thick. Last limestone exposure at ~1076' (all hand level from spot elevation). I assume this is a partial section through the Topeka Limestone. Chert-pebble conglomerate above last limestone exposure.

17. Good-fair exposure of contact between chert gravel and white-weathering, fusulinid and brachiopod wackestone/packstone, along west side of north-south road about 400' north of center, sec. 12, T20S, R13E. Limestone probably is Curzon. Contact at ~1071' (hand level from spot elevation).

18. Chert gravel-Curzon(?) contact at ~1074' (hand level to spot elevation). Exposure on east side of drainage on south side of east-west road near midpoint, north edge, NW 1/4, NE 1/4, NE 1/4, sec. 11, T20S, R13E.

2-12-90

19. Exposure on west cut bank of Neosho River near water level of about 6"-1' sandstone at ~1039' (hand level to topographic line). Exposure is 200'-900' south of bridge over Neosho River, east of Hartford in W 1/2, NE 1/4, SW 1/4, SW 1/4, sec.14, T20S, R13E. Sandstone is fine-grained, ripple-marked, bioturbated; molluscan fauna at top, some poorly-preserved Neospirifer seen. I suspect that this is a sandstone in the Calhoun Shale.

20. Excellent exposure of sandstone and limestone in upper part of Calhoun Shale, the upper part of the Calhoun shale, and the lower 4' or so of the Hartford/Curzon Limestone along south cut-bank of Neosho River. Sandstone is 2' thick, massive, medium-grained, overlain by about 1' of shale, overlain by about 2' of sandstone grading upward into echinoderm-mollusc-coated grain grainstone (lower 1' of this horizon is same sandstone as at MS19), overlain by about 18' of gray, silty to clay-rich shale, overlain by about 2' of Hartford Limestone, and about 2' of phylloidal, white limestone (=Curzon?). Limestone in Calhoun at ~1042'; base of Hartford at ~1060' (hand level to topographic line). Exposure along gulley in N 1/2, SE 1/4, NE 1/4, SE 1/4, NW 1/4, sec. 23, T20S, R13E.

21. Excellent exposure of upper 10'-15' of Calhoun Shale, Hartford Limestone, and about 10' of white, phylloidal limestone (=Curzon?) along creek in middle of SW 1/4, NW 1/4, sec. 23, T20S, R13E. Hartford is about 3' thick, with orange-stained surface having open burrows about 1' from top; upper 1' of Hartford is typical (for Hartford) oncolitic, sponge limestone. Base of Hartford at ~1058' (hand level to spot elevation).

22. Very poor exposure of Hartford Limestone Member along west side of small creek in SE 1/4, SW 1/4, SW 1/4, SE 1/4, sec. 27, T20S, R13E. Hartford base at ~1061' (hand level to spot elevation).

23. Good exposure of Hartford/Curzon Limestone along north side of east-west road and along creek banks along W 1/2, SE 1/4, NE 1/4, sec. 26, T20S, R13E. Lower part of Hartford is yellow weathering, brownish wackestone about 1.5' thick, overlain by a thin shale break (covered, less than 1' estimated), overlain by about 6" of white, oncolitic limestone, overlain by about 5' of white, phylloidal limestone, overlain by chert gravel. Base of Hartford at ~1065'; base of chert gravel at ~1073' (both hand level to spot elevation).

2-19-90

24. Topeka Limestone exposed in active quarry (Nelson Quarry, operated by Blacktop Company); about 18' thick, lower 9' or so shows nice transition from bottom to top of phylloidal limestone, brecciated/conglomeratic limestone, and coated-grain grainstone. Thin shale part (~1' thick) at top of coated-grain grainstone. Upper limestone is about 8' thick, yellowish weathered, less grainy in general appearance, some surfaces with common brachiopods. Quarry is in NE 1/4, NE 1/4, sec. 3, T21S, R13E. Base of Topeka at ~1055' (hand level to spot elevation). Quarry floor is in shale, therefore the phylloidal limestone appears to be Hartford equivalent (but I'm not entirely certain about this).

25. Abandoned strip pit in Topeka Limestone. Sequence same as at MS24. Large linear quarry bisects hill on map; quarry trends N-S; base of Topeka at ~1071' (hand level to topographic line). Quarry situated in W 1/2, NE 1/4, NW 1/4, sec. 2, T21A, R13E.

26. Base of Hartford/Curzon at ~1084' (hand level to topographic line). Exposure on west side of north-flowing creek along both sides of east-west road near midpoint north edge, NE 1/4, NE 1/4, sec. 6, T21S, R14E. Hartford here is about 3' thick; basal foot is grainstone; middle foot is yellow wackestone; upper foot is sponge-oncolite-wackestone. Middle foot looks like it may be an exposure surface. Hartford here is undulatory and even dips toward the northeast in places. Upper surface of lower grainstone is bioturbated with common Skolithos-like burrows.

27. Exposure along road extending from northwest corner of NE 1/4, NW 1/4, sec. 32, T20S, R14E, westward and then northward to west edge SW 1/4, SW 1/4, SW 1/4, sec. 29, T20S, R14E (road does not follow section lines). Hartford limestone at ~1095'; the dense, orange-weathering, Topeka-like lithology has returned. A limestone about 3' thick in the Calhoun Shale is at ~1058' (former hand level from spot elevation; latter hand level to spot elevation).

    (Revisited - 3-18-90) - Lower limestone I called "limestone in Calhoun Shale" is really Ervine Creek Limestone. Limestone in Calhoun Shale will be named "Tonovay Limestone Member" according to D.F. Merriam (Wichita State University). I will refer to it by this name in future notes.

28. Yellowish, earthy, slabby limestone in ?Calhoun Shale at ~1055'; Hartford(?)/Curzon? Limestone at ~1077' (both hand level to spot elevation). Lowermost limestone of Topeka interval here is thin (~6"), dense, dark single bed of hard Rock Bluff-like limestone with some fusulinids. I am very suspicious that this is the Ozawkie-Rock Bluff-Ervine Creek sequence. In fact, the longer I sit here, the more convinced I become, but I'm not sure.

3-19-90

29. Exposure in Jacobs Creek and along east-west road on south edge, W 3/4, SW 1/4, sec. 32, T20S, R14E. Fair-good exposure of Rock Bluff-Larsh/Burroak-Ervine Creek along creek. Hartford-Curzon exposed at top of hill. Hartford contains oncolites with Amblysiphonellid-like sponges; Curzon is phylloidal limestone. Base of Rock Bluff at ~1065'; top of Ervine Creek at ~1075'; base of Hartford/Curzon at ~1109' (all hand level to spot elevation). Major joint set in Rock Bluff Limestone Member trends ~N65°E.

30. Poor-fair exposure of Calhoun Shale to top of hill in roadcuts along east-west road near mid-point, south edge SW 1/4, SE 1/4, sec. 32, T20S, R14E.

31. Exposures along east-west road on south edge, SE 1/4, SE 1/4, sec. 32, T20S, R14E. Top of Ervine Creek Limestone Member at ~1100'; Tonovay Limestone Member of Calhoun Shale at top of hill at ~1135' (both hand level to spot elevation).

10-14-90

32. Ditch/bank on east side of north-south road has fair-poor exposure of upper part of Calhoun Shale and Hartford Limestone Member. Hartford here is about 1' thick and has paired tubes on upper surface as in quarry base (Ottumwa quadrangle, MS7) nearby. Exposure near midpoint, west edge sec. 9, T20S, R14E. Exposure near midpoint, west edge sec. 9, T20S, R14E. Hartford base at ~1105' (hand level from spot elevation). Phylloidal facies of Curzon rests directly on Hartford.

10-21-90

33. Topeka Limestone/Calhoun Shale exposure examined with K.D. Newell. Exposure on south bank of Eagle Creek northwest corner SW 1/4, NW 1/4, NE 1/4, sec. 36, T20S, R13E. Topeka Limestone exposed at ~1068' (hand level to topographic line). Calhoun Shale mostly silty gray shale with septarian concretion horizons; molluscan rich in uppermost 6' or so; dense, dark limestone bed about 1' thick near creek level at about 1038'.

34. Base of Topeka exposed at ~1062' (hand level to spot elevation); exposure on creek along north-south road in southwest corner NW 1/4, SW 1/4, SE 1/4, sec. 36, T20S, R13E. Exposure examined with K.D. Newell.

12-7-90

35. Limestone (molluscan packstone/grainstone) with charcoal fragments in upper part of Calhoun Shale at ~1096'; Hartford Limestone at ~1105' (both hand level from spot elevation). Exposure along north-south roadway near east edge SE 1/4, SE 1/4, SE 1/4, sec. 8, T20S, R14E.

3-3-91

36. Limestone in Calhoun Shale exposed in ditch on east side of north-south road at ~1119' (hand level from spot elevation). Exposure near midpoint, west edge, NW 1/4, sec. 4, T21S, R14E.

37. Limestone in Calhoun Shale and Hartford Limestone Member exposed on east side of north-south road, exposed along west side, NW 1/4, NW 1/4, SW 1/4, NW 1/4, sec. 4, T21S, R14E, at ~1132' and 1139', respectively (hand level from topographic line).

John Redmond Dam Quadrangle Chris Maples 3-19-90

1. Dark, dense limestone with common syringoporoids exposed in bottom of drainageway, about 15' south of east-west road near midpoint, north edge NE 1/4, NE 1/4, sec. 15, T21S, R14E, at ~1068' (hand level to spot elevation). This probably is the Avoca Limestone, but I'm not sure which part of the Avoca it is (my guess is the lower part).

   (Revisited - 12-15-90) - This is the upper Avoca Limestone.

2. Exposures of 3 (possibly 4) limestone beds 1'-2' thick each; mostly dark; lowermost limestone weathers yellowish and seems to be more fossiliferous than the others. Middle limestone bed has very common Rhizocorallium/Zoophycus on top surface (another limestone may occur between these 2 limestones, but it is difficult to be certain). Upper limestone has reddish, hematitic-like inclusions in a dark, micritic matrix. SAMPLE-JRD2-1 is lower limestone bed with syringoporoid. SAMPLES-JRD 2-2.1, 2.2, 2.3 are middle bed with Rhizocorallium/Zoophycus. Exposure along east edge, SE 1/4, SE 1/4, SE 1/4, sec. 3, T21S, R14E and west edge NW 1/4, NW 1/4, NW 1/4, sec. 11, T21S, R14E. Lower limestone at ~1078'; middle limestone at ~1100' (both hand level to spot elevation); upper limestone at ~1105' (hand level from spot elevation). I think this is all Avoca Limestone. A few pieces of the yellow earthy layer in the King Hill Shale were seen in float. King Hill Shale seems to go to valley floor to north.

   (Revisited - 12-15-90) - Oops, I goofed. The lowest of three exposed limestones here is in the Spring Branch-Beil interval, the middle limestone (with small, dark Rhizocorallium in the top) is the lower Avoca, and the upper Avoca (with some syringoporoids) is the uppermost of the three. The yellow, earthy limestone in the King Hill Shale occurs beneath the lower Avoca Limestone. Myalinids and bioturbated sandstone are poorly exposed east of north-south fence line east of road below Spring Branch-Beil interval.

12-11-90

3. Limestone, dark, weathers brownish yellow, fusulinid packstone-wackestone, exposed in north-south roadway near midpoint, west edge SW 1/4, NW 1/4, sec. 19, T21S, R15E, at ~1067' (hand level to topographic line). Could be Ozawkie, but based on MS4, I think it probably is Spring Branch/Beil. The fusulinids are small.

4. Excellent exposure of Spring Branch-Doniphan-Beil interval (I think). Spring Branch at ~1050', Beil at ~1053' (both hand level from spot elevation). Abundant myalinids in zone about 4' below Spring branch Limestone. Exposure along south side of NNW-flowing creeklet about 400' south of northwest corner sec. 24, T21S, R16E. Myalinids exposed in base of creek in northeast corner sec. 23, T21S, R14E.

5. Fossiliferous wackestone exposed on both sides of north-south road at ~1135'. Exposure about 200-300' north of southwest corner sec. 24, T21S, R14E (hand level to spot elevation). This may be Hartford-Curzon.

   (Revisited - 12-15-90) - This is Rock Bluff/Ervine Creek.

6. Sandstone, fine- to medium-grained, orangish-brown, exposed in roadcut north and south of east-west road at ~1104' (hand level from spot elevation). Sandstone is 1'-2' thick, exposed near midpoint, south edge SW 1/4, sec. 29, T21S, R15E.

7. Spring Branch(?) Limestone exposed in ditch on south side of east-west road about 200' est of northwest corner sec. 31, T21S, R15E, at ~1093' (hand level to spot elevation).

8. Sandstone, yellowish- to orangish-brown, fine- to medium-grained, about 1'-2' thick, with zones of abundant bioturbation and common moldic molluscan fauna. Exposure on south side of east-west road near midpoint north edge NE 1/4, sec. 31, T21S, R15E, at ~1079' (hand level to topographic line). Looks like the same sandstone as at MS6.

9. Sandstone, as at MS6, overlain by fusulinid packstone about 6" thick, poorly exposed on east side of north-south road near midpoint, west edge SW 1/4, sec. 31, T21S, R15E. Limestone probably is Spring Branch at ~1106', sandstone at ~1092' (both hand level to spot elevation).

10. Three limestone beds in five-foot interval on north side of east-west road near midpoint, south edge, SW 1/4, sec. 31, T21S, R15E. Lower two limestones are dark, with abundant small fusulinids. Uppermost limestone is light- to medium-gray coated-grain grainstone. Base of three limestones (+ Spring Branch?) at ~1107' (hand level to spot elevation).

11. Spring Branch(?) Limestone exposed in ditch on both sides of east-west road near midpoint, north edge NE 1/4, sec. 6, T22S, R15E, at ~1120' (hand level to spot elevation). Molluscan limestone with myalinids (all less than 4" thick) at ~1116'; sandstone (about 1'-3' thick) at ~1110' (both hand level to spot elevation).

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12. Hartford-Curzon Limestone exposed on both sides of east-west road near midpoint, south edge SW 1/4, SW 1/4, sec. 23, T21S, R14E, at ~1128' (hand level from spot elevation).

(Revisited 12-15-90) - I goofed--this is Rock Bluff/Ervine Creek.

13. Crinoidal and coated-grain grainstone with some charcoal in it; generally similar to limestone at New Strawn MS9 and 10. Exposure on south side of east-west road in bottom of creek near midpoint, north edge sec. 26, T21S, R14E, at ~1079' (hand level to spot elevation). Is this Ozawkie?

14. ?Ozawkie Limestone (fusulinid wackestone/packstone) with some syringoporoids at ~1076' (hand level to spot elevation). Exposure on east side of north-south road about 400' north of southwest corner sec. 23, T21S, R14E.

15. Lower Avoca Limestone exposed along creek in E 1/2, SE 1/4, NE 1/4, SE 1/4, sec. 22, T21S, R14E and on north side of same creek along south edge NW 1/4, NW 1/4, SW 1/4, sec. 23, T21S, R14E. at ~1053'. Upper Avoca Limestone very poorly exposed in ditch on west side of north-south road near midpoint, east edge NE 1/4, SE 1/4, sec. 22, T21S, R14E, at ~1058' (both hand level to spot elevation). Earthy yellow limestone (about 2' thick) exposed below lower Avoca; lower Avoca with abundant, small, dark Rhizocorallium on upper surface.

12-16-90 IS THIS DATE CORRECT??????????????????????????????????

16. Avoca Limestone exposed south and west of farm pond in W 1/2, SE 1/4, SW 1/4, SE 1/4, sec. 24, T21S, R14E. Lower Avoca at ~1080', upper Avoca (with syringoporoids) at ~1085' (both hand level to spot elevation). Pieces of earthy yellow limestone from underlying King Hill Shale scattered around edge of pond.

17. Excellent exposure of Spring Branch-Beil interval across Otter Creek in SE 1/4, SW 1/4, SE 1/4, sec. 14, T21S, R14E. Spring Branch is about 6" thick and separated from overlying Beil by about 1' of shale (estimated owing to slumping). Beil is about 2' thick. Overlying Beil (within 5' of top) is a crossbedded, coated-grain grainstone (crossbeds dip to southwest), about 2'-3' thick. Base of Spring Branch at ~1041' (hand level to topographic line). Gravel bars below Spring Branch have molluscan slabs (< 1" thick) with abundant myalinids. The coated-grain grainstone books a bit like that present at New Strawn MS9 and MS10. Springoporoids common near top of Beil at this locality.

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18. Exposures of lower Avoca Limestone (with yellow, earthy layer in King HIll Shale below) at ~1094', and upper Avoca Limestone (with common syringoporoids at ~1098' (both hand level to spot elevation). Lower Avoca Limestone exposed in ditch on north side of east-west road along south edge of SW 1/4, SE 1/4, SW 1/4, SE 1/4, sec. 25, T21S, R14E. Upper Avoca LImestone exposed in ditch on south side of east-west road along north edge of NW 1/4, NE 1/4, NW 1/4, NE 1/4, sec. 36, T21S, R14E.

19. Very poor exposure of fusulinid-rich limestone near midpoint, south edge SE 1/4, sec. 26, T21S, R14E, at ~1148' (hand level to topographic line). Is this Topeka Limestone or Ervine Creek? My guess is Ervine Creek.

20. Hartford-Curzon limestones at ~1169' (hand level from spot elevation). Exposure is poor along south side of east-west road near midpoint, north edge NE 1/4, NW 1/4, sec. 35, T21S, R14E.

21. Rock Bluff-Ervine Creek limestones exposed at ~1122' (hand level from spot elevation) along north-south road about 300' north of southeast corner NE 1/4, NE 1/4, sec. 27, T21S, R14E. Molluscan limestone exposed at ~1153' (hand level from spot elevation) near midpoint, west edge NW 1/4, SW 1/4, NW 1/4, sec. 26, T21S, R14E. Rock Bluff-Ervine Creek interval is about 5' thick.

22. Molluscan limestone in Calhoun Shale at ~1143'; Hartford-Curzon limestones with Amblysiphonella common, uppermost part phylloidal, at ~1158' (both hand level to topographic line). Exposures on along north-south road about 600' north of southwest corner NW 1/4, SW 1/4, sec. 26, T21S, R14E.

12-19-90

23. Exposures in SW 1/4, NW 1/4, sec. 12, T21S, R14E and along south edge SE 1/4, SE 1/4, NE 1/4, sec. 11, T21S, R14E. ?Beil Limestone exposed at ~1046'; crossbedded coated-grain, fossiliferous grainstone (about 4' thick) exposed at ~1056' (both hand level to spot elevation). Sandstone exposed at ~1090' (hand level from spot elevation).

24. Lower Avoca Limestone exposed in north-south well-access road at ~1105' (hand level to topographic line). Exposure about 600' south of midpoint, north edge sec. 11, T21S, R14E.

25. Lower and upper Avoca Limestones exposed along east-west road about 300' east of center, sec. 10, T21S, R14E, at ~1103' and 1106' (both hand level to topographic line). Upper Avoca contains common syringoporoids.

26. Rock Bluff-Ervine Creek limestones exposed on south side of east-west road near midpoint, north edge SE 1/4, sec. 9, T21S, R14E, at ~1145' (estimated from topographic map).

27. Rock Bluff-Ervine Creek limestones exposed along north-south road about 200' north of southeast corner, sec. 9, T21S, R14E, at ~1124' (hand level to topographic line).

28. Rock Bluff-Ervine Creek limestones exposed about 200' south of midpoint, west edge sec. 22, T21S, R14E, at ~1118' (hand level from spot elevation).

29. Rock Bluff-Ervine Creek limestones exposed about 400' west of southeast corner sec. 16, T21S, R14E, at ~1114' (hand level to topographic line).

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30. Limestone, dark, weathers light orangish-tan, about 1' thick, molluscs, echinoderm debris, brachiopods, some fusulinids, some rip-up clasts and/or oncolites, and some small, dark "osagite" grains. Exposure along east side of north-south road, about 200-300' south of northwest corner sec. 3, T22S, R15E, at ~1050' (hand level to spot elevation). This may be Kereford.

31. Same limestone as at MS30. Exposure along east side of north-south road along west edge, NW 1/4, NW 1/4, SW 1/4, SW 1/4, sec. 3, T22S, R15E, at ~1066' (hand level to spot elevation). I'm not sure if this is KEreford or Clay Creek.

32. Spring Branch-Beil interval exposed on both sides of north-south road (better on west side), SW 1/4, NW 1/4, SW 1/4, SW 1/4, sec. 3, T22S, R15E, at ~1066' (hand level to spot elevation). I'm not sure if this is Kereford or Clay Creek.

32. Spring Branch-Beil interval exposed on both sides of north-south road (better on west side), about 100-300' north of southeast corner NE 1/4, sec. 9, T22S, R15E. Spring Branch at ~1128'; Beil at ~1131' (both hand level to topographic line). Myalinid zone about 7' below Spring Branch. Chert gravel common on top of hill along road. This sequence would seem to imply that the limestone at MS30 and MS31 is Clay Creek.

33. Chert gravel exposed on hilltop in SE 1/4, SE 1/4, sec. 8, T22S, R15E at ~1090' (estimated from topographic map).

34. Chonetid limestone about 1" thick, and many loose chonetids exposed in southwest corner sec. 8, T22S, R15E, at ~1061' (hand level to spot elevation). This looks like the chonetid interval below the Clay Creek Limestone.

35. Exposures of sandstone along both sides of north-south road, along east edge NE 1/4, NE 1/4, sec. 7, T22S, R15E.

36. Sandstone exposed on west side of north-south road near midpoint, east edge sec. 6, T22S, R15E.

37. Sandstone exposed on hill near midpoint north edge sec. 5, T22S, R15E.

38. Sandstone exposed on hill near midpoint, north edge, NE 1/4, sec. 5, TG22S, R15E.

39. Sandstone exposed on east slope of hill near midpoint, north edge NW 1/4, sec. 9, T22S, R15E.

40. Excellent section exposed along north-south road on north side of hill, along east edge NE 1/4, SE 1/4, SE 1/4, sec. 13, T22S, R14E. Medium gray brachiopod-mollusc, crinoid wackestone/packstone about 1' thick at ~1073'; yellowish, irregularly bedded, molluscan-brachiopodal wackestone/packstone about 3'-4' thick at ~1-81'; greenish gray coated-grain, crinoidal packstone/grainstone about 2' thick at ~1085'; "oatmeal rock," coated-grained packstone/grainstone about 2' thick at ~1089'; fine-grained sandstone with abundant molluscan fauna, about 2'-3' thick, at ~1094' (all hand level from topographic line). This is a very confusing interval. Norm Newell measured this section in 1937 (when it was much better exposed), but put no names on the units. P. Heckel added unit names to Newell's section, in which this interval was labelled Spring Branch. I think this may be part of the rather strange Clay Creek sequence in this area, but I'm not sure.

41. Exposure in creeklet and along north-south road adjacent to Cola Hill Cemetery. Tin (<4"), fine-grained, highly bioturbated sandstone in creek floor east of road at ~1025'; overlain by shale and bioturbated siltstone; overlain by about 2' of dark gray, slabby weathering, crinoidal wackestone at ~1040' (hand level to topographic line). I think this is the basal unit of the Clay Creek interval that I've been seeing. Exposure is about 400'-500' south of northwest corner SW 1/4, sec. 17, T22S, R15E.

42. Thin, molluscan sandy limestone/calcareous sandstone exposed at ~1051' (hand level to topographic line). Exposure in ditch east of bridge over creeklet, north of east-west road, near midpoint, south edge SE 1/4, sec. 12, T22S, R14E. This still looks like part of the complex Clay Creek sequence.

43. Limestone ledge well exposed in creeklet about 50' north of east-west road near mid-point, south edge, SW 1/4, sec. 12, T22S, R14E. Lower ledge is about 1' thick, yellow-weathering, coated-grain, echinodermal packstone/grainstone. This unit overlies a greenish blocky mudstone with abundant chonetids. Overlying this lower limestone is about 1' of covered shale(?), which is overlain by molluscan (myalinids) "oatmeal rock." This still looks like the uppermost Clay Creek interval (if I am correct about the interpretation of MS40). Base of limestone is at 1055' (hand level to topographic line). Measurable dip of 1 degrees west. Same unit exposed in next creeklet west, north of road.

44. Sandstone chips and float exposed in ditch on north side of east-west road along south edge SE 1/4, SE 1/4, SE 1/4, sec. 11, T22S, R14E.

45. Spring Branch-Beil(?) interval slumped, poorly exposed on south bank North Big Creek, north of east-west road near midpoint, north edge, NW 1/4, NW 1/4, sec. 14, T22S, R14E. Thin (<1"), molluscan (myalinids+) and brachiopod limestone slabs exposed as float above bioturbated sandstone and below 1'-thick dark, blocky fusulinid packstone/grainstone (Beil?) at ~1067' (hand level from spot elevation).

46. Spring Branch(?)-Beil interval exposed across east-west road near midpoint, north edge NW 1/4, NE 1/4, sec. 15, T22S, R14E, at ~1083' (hand level from topographic line).

47. Very poor exposures of light gray, fusulinid and phylloidal wackestone with minor syringoporoids at ~1117' (hand level to spot elevation). This may be Beil. Exposure is in creeklet south of east-west road about 200' east of midpoint, north edge sec. 2, T22S, R14E. Ervine Creek probably makes more sense for this exposure.

48. Thin (<4"?) molluscan limestone in Calhoun Shale exposed (very poorly) on north side of east-west road at ~1164'. Base of Hartford (oncolitic) Limestone, overlain by phylloidal limestone at ~1172' (both hand level to spot elevation). Exposure about 500'-600' east of southwest corner sec. 35, T21S, R14E.

49. Ervine Creek Limestone Member exposed across east-west road at ~1101' (hand level from spot elevation) about 400' west of southeast corner sec. 28, T21S, R14E.

51. Molluscan limestone (about 2' thick) exposed on east side of north-south road at ~1114'; very poor exposure of Hartford-Curzon Limestone (oncolitic packstone/wackestone with sponges overlain by phylloidal limestone) at ~1125' (both hand level to topographic line).

51. Dark, argillaceous (yellow weathering) crinoid-brachiopod wackestone/packstone exposed at base of new conduit on west side of north-south road at ~1098' (hand level to spot elevation). This may be lower Avoca. Syringoporoid/colony found as float along road south of exposure. Exposure near midpoint, east edge SE 1/4, NE 1/4, sec. 2, T22S, R14E.

52. Fusulinid rich, yellow-weathering packstone/grainstone about 1' thick exposed at ~1081' (hand level to spot elevation) in ditch north of east-west road about 600' west of southeast corner sec. 2, T22S, R14E. Earthy yellow zone near top of King Hill Shale exposed at ~1100' (hand level from spot elevation) near midpoint, west edge SW 1/4, SW 1/4, SW 1/4, sec. 1, T22S, R14E. The limestone is part of the Spring Branch-Beil interval. Yellow earthy zone also exposed in and south of east-west road about 100' east of southwest corner SE 1/4, SE 1/4, sec. 2, T22S, R14E, at ~1089'; lower part of the Avoca exposed about 50' farther west at 1092' (both hand level from topographic line).

53. Fine- to medium-grained sandstone about 2'-3' thick exposed near midpoint, west edge SW 1/4, sec. 12, T22S, R14E, at ~1065' (hand level to topographic line).

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54. Ozawkie Limestone Member exposed at ~1072' (hand level to spot elevation) in drainage culvert north and south of east-west road near midpoint, north edge, NE 1/4, NE 1/4, sec. 27, T21S, RE.

55. ?Ervine Creek Limestone exposed in creek cutbank on east side of north-west near midpoint west edge sec. 27, T21S, R14E, at ~1073' (hand level to spot elevation).

56. Poor exposure of Hartford-Curzon limestones in north-south roadway at ~1143' (hand level to topographic line). Exposure about 100' south of midpoint, west edge, NW 1/4, sec. 3, T22S, R14E.

57. Rock Bluff Limestone Member exposed in ditches on both sides of north-south road at ~1156' (hand level to spot elevation). Exposure about 200' north of southwest corner sec. 10, T22S, R14E.

58. Hartford-Curzon limestones poorly exposed in north-south road near midpoint, west edge SW 1/4, SW 1/4, sec. 15, T22S, R14E, at ~1176' (hand level to spot elevation).

59. Poor exposure of Calhoun Shale and Hartford-Curzon limestones in east-west road along south edge SE 1/4, SW 1/4, sec. 15, T22S, R14E. Sandy echinoderm-brachiopod grainstone at ~1170'; highly bioturbated sandstone with Lingula and Diplocraterion at ~1180'; Hartford-Curzon limestones at ~1188' (all hand level to spot elevation).

60. Poor exposure of Ervine Creek/Rock Bluff limestone sat ~1160' (hand level from spot elevation). Exposure near midpoint south edge SE 1/4, sec. 15, T22S, R14E.

61. Earthy yellow layer in upper King Hill Shale exposed at ~1088'; lower Avoca limestone at ~1093'; upper Avoca limestone (with abundant syringoporoids) at ~1096' (all hand level to topographic line). Exposures on both sides of east-west road near midpoint south edge SW 1/4, sec. 14, T22S, R14E.

62. Fine-grained, bioturbated, crossbedded sandstone exposed in creek bed 5-10' west of north-south road at ~1065' (hand level to topographic line). Spring Branch-Beil interval at ~1080' (hand level from topographic line) on both sides of north-south road. Some myalinid fragments in creek between Spring Branch-Beil and sandstone. Exposures about 200' north to 1000' south of midpoint, east edge NE 1/4, sec. 15, T22S, R14E. Lower Avoca limestone at ~1100'; upper Avoca limestone at ~1104' (both hand level from topographic line).

63. Spring Branch-Beil exposed in ditches north and south of east-west road at ~1093'; Avoca limestone at ~1111'; upper avoca (with some syringoporoids) at ~1115' (all hand level to spot elevation). Exposures along south edge, E 2/3, SE 1/4, SE 1/4, sec. 14, T22S, R14E.

2-25-91

64. Spring Branch-Beil limestones exposed in ditch on north side of east-west road near midpoint, south edge, SE 1/4, sec. 13, T22S, R14E, at ~1110' (estimated from topographic map).

65. Sandstone, about 1' thick, exposed in ditch on north side of east-west road near midpoint, south edge sec. 13, T22S, R14E, at ~1090' (hand level from spot elevation).

66. Sandstone at ~1080'; sandstone at ~1088'; limestone (?Spring Branch-Beil) at ~1106' (all hand level from topographic line). Poor exposure along both sides of north-south road on west side of NW 1/4, NW 1/4, SW 1/4, sec. 13, T22S, R14E.

67. Sandstones/siltstones/shales of Calhoun Shale exposed on north side of new east-west road (not shown on 1966 map). Exposures along south edge NE 1/4, NE 1/4, sec. 16, T22S, R14E.

68. Poor exposures of coated-grain, molluscan grainstone in Calhoun Shale about 120' east of southwest corner SE 1/4, SE 1/4, sec. 4, T21S, R14E, at ~1181' (hand level from topographic line).

69. Rock Bluff-Ervine Creek Limestone Members (Larsh-Burr Oakfloat common) exposed on west side of north-south road about 200' south of northeast corner SE 1/4, sec. 4, T21S, R14E, at ~1137' (hand level from spot elevation).

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70. Lower Avoca limestone exposed (very poorly) on south side of east-west road about 200' east of midpoint, north edge NE 1/4, sec. 1, T22S, R14E, at ~1104' (hand level to topographic line).

12-7-91

71. Exposure in drainageway of John Redmond Reservoir (Neosho River) immediately south of dam in W 1/2, NW 1/4, sec. 10, T21S, R15E. Excellent exposure of calcareous siltstone/shale with a few Crurithyris-rich beds, overlain by nodular limestone about 2'-3' thick. Limestone at ~1020', base of siltstone/shale at ~1009' (both hand level to printed elevations on southeast corner of dam). I am not sure whether this is Clay Creek or Kereford. Certainly there are some Linoproductus present in the calcareous siltstones within a few feet of the limestone base, similar to Kereford occurrences. However, the interval is more correct for Clay Creek, so I'll call this Clay Creek for now. Collection of loose Linoproductus from northeast river cut about 1200' southeast of dam (JRD71.1).

(Revisited - 12-7-91) - The more I look at this lithology, the more I become convinced that this is Kereford. The lithology is very much like the "Waverly Flags."

Lebo Quadrangle Chris Maples 12-18-89

1. Roadcut exposure about 200'-400' west of northwest corner sec. 16, T19S, R15E. Hartford/Curzon exposed at top of hill at ~1154'; excellent exposure of upper part of Calhoun Shale; hard, thin, silty, bioturbated layer at ~1150' (both hand level from spot elevation).

2. Hartford/Curzon exposed on east-west road along north edge NE 1/4, NW 1/4, sec. 17, T19S, R15E, at ~1152' (hand level from spot elevation).

3. Hartford/Curzon exposed on east-west road along north edge NW 1/4, NE 1/4, sec. 18, T19S, R15E, at ~1134' (hand level to spot elevation).

4. Hartford/Curzon exposed in N 1/2, NW 1/4, sec. 12, T19S, R14E, in partially active quarry, at ~1134' (hand level to spot elevation).

   (Revisited 2-11-90) - Hartford/Curzon interval collected for conodonts by Scott Ritter (Oklahoma State University). Two 7" x 12.5" bags collected, 1 from each member.

5. Old strip pit in Nodaway Coal at ~1135' (estimated from topographic map). Dense, dark, single bed of limestone about 1'-1.5' thick holds up hill at ~1150' (estimated from topographic map). Exposure in SW 1/4, NE 1/4, SE 1/4, sec. 4, T19S, R14E less than 1/2 mile north of Lebo, Kansas. Thin, argillaceous limestone float, very crinoid-rich, in strip pit as float (probably from above coal). Dense, dark limestone is Church.

6. Excellent exposure of upper part of Calhoun Shale along roadcut for I-35, along northern edge near midline of NE 1/4, SE 1/4, sec. 6, T19S, R15E. Hartford/Curzon caps hill at ~1141' (hand level from topographic line).

1-13-90

7. Exposure in creek and along east-west road in NE 1/4, NW 1/4, NE 1/4, NE 1/4 and along northern edge of NW 1/4, NE 1/4, NE 1/4, sec. 20, T19S, R15E. About 1' thick, medium-grained, yellowish sandstone in creek at ~1136'; limestone, 2 beds separated by thin shale parting, each bed about 6" thick; basal bed is coarsening upward, echinodermal-molluscan, coated-grain grainstone, sandy in lowermost portion; upper bed is coarser-grained, but essentially the same as the upper part of the lower bed, except the upper bed contains small (< 1 cm) rip-up shale clasts and is dark; base of limestone at ~1144' (both hand level to topographic line). I think this limestone is in the Calhoun Shale. Limestone, weathers orangish (like Toronto), but contains numerous, large (up to 3 cm) oncolites, at ~1161' (hand level from topographic line). This probably is Hartford/Curzon.

(Revisited - 2-10-90) - Unnamed limestone in Calhoun Shale collected for conodonts by Scott Ritter (Oklahoma State University). One 7" x 12.5" bag collected.

8. Exposure on east side of hill along east-west road about 200'-300' east of midpoint, north edge sec. 19, T19S, R15E; thin (<1') sandstone at ~1119'; limestone, about 5' thick, orangish, earthy, with oncolites and large crinoid fragments at ~1129' (both hand level to spot elevation). Limestone is Hartford/ Curzon.

9. Exposure on west side of hill along east-west road from lake level to near top of hill on north edge NW 1/4, NE 1/4, NW 1/4, sec. 19, T19S, R15E. Thin (<1'), argillaceous, conglomeratic, coated-grain packstone (some myalinids seen) at ~1123'; about 1' thick sandstone at ~1134', limestone, orangish earthy, oncolitic, underlain by thin (<6") zone of flaggy-to-nodular, argillaceous, brachiopod-rich limestone; oncolitic limestone is single bed about 6"-9" thick, at ~1142' (all elevations hand level to topographic line). This sequence is Calhoun Shale, Hartford/Curzon.

10. Poor exposure of Hartford/Curzon Limestone along east side of north-south road,south of creek, about 200' north of southwest corner sec. 18, T19S, R15E, at ~1131' (hand level to spot elevation).

11. Fair-good exposure of upper Calhoun Shale, Hartford/Curzon Limestone in ditch on north side of east-west road, along south edge of SW 1/4, SE 1/4, sec. 21, T19S, R15E. Limestone bed, grades downward into very calcareous sandstone, total thickness about 2', at ~1166'; about 3' of thin bedded (<2 cm), ripple-marked, bioturbated siltstone/sandstone at ~1177' Hartford/ Curzon Limestone at ~1185' (all elevations hand level to spot elevation).

12. Good exposure of Hartford/Curzon on north and south roadcuts of east-west road along north edge, NE 1/4, NW 1/4, NE 1/4 and NW 1/4, NE 1/4, NE 1/4, sec. 16, T19S, R15E, at ~1170' (hand level from spot elevation).

13. Upper Calhoun Shale-Hartford/Curzon Limestone exposed along north-south road on west edge, NW 1/4, SW 1/4, sec. 16, T19S, R15E. Sandstone (about 1' thick) overlain by about 1' of dark, conglomeratic, echinodermal, coated-grain grainstone (all in Calhoun Shale) at ~1142'; Hartford/Curzon Limestone (about 5' thick) at ~1162' (both hand level to spot elevation).

14. Exposure on south side of stream valley, along north-south road, on west edge SW 1/4, NW 1/4, NW 1/4, sec. 21, T19S, R15E; Hartford/Curzon at ~1175' (hand level from topographic line).

15. Hartford/Curzon Limestone exposed in ditch on south side of east-west road, along north edge NW 1/4, NE 1/4, NE 1/4, sec. 29, T19S, R15E; limestone is about 5' thick, base at ~1171' (hand level to topographic line).

16. Poor Hartford/Curzon exposure at ~1167' (hand level to topographic line). Exposure along east-west road on hill on north edge NE 1/4, NW 1/4, NE 1/4, NW 1/4, sec. 29, T19S, R15E.

1-14-90

17. Fair-poor exposure of Hartford/Curzon Limestone on south side of hill in north-south roadway about 100' south of midpoint, north edge SW 1/4, sec. 17, T19S, R15E, at ~1140' (hand level from topographic line); about 5' thick.

18. Good exposure of limestone in Calhoun Shale along west side of north-south road (partly in ephemeral stream cut), about 400'-600' south of midpoint, west edge sec. 20, T19S, R15E. Limestone is single bed about 9" thick, sandy in lower part; dark, coated-grain grainstone in upper part; myalinids common; base of limestone at ~1135' (hand level from spot elevation).

19. Poor exposure of Hartford/Curzon on east side of hill along east-west road near midpoint, south edge, SW 1/4, SW 1/4, sec. 20, T19S, R15E, at ~1155' (hand level to spot elevation).

20. Fair-good exposure of upper 5'-7' of Calhoun Shale and Hartford Limestone on east side of creek cut bank about 100' north of east-west road near center S 1/2, SW 1/4, SW 1/4, SE 1/4, sec. 19, T19S, R15E, at ~1147' (hand level from spot elevation).

21. Poor-fair exposure of Hartford Limestone in cut bank on east side of north-south road about 500' south and 100' east of midpoint, west edge sec. 19, T19S, R15E, at ~1129' (hand level to topographic line).

22. Exposure along east-west road on northern edge W 4/5, NE 1/4, sec. 4, T19S, R15E. Avoca in creek valley about 400' east of where creek valley veers northward (this is on the Waverly NW Quadrangle); dark, massive limestone about 1.5' thick (Sample LEB22-1 is small syringoporoid from top of Avoca). Lower Ozawkie (so-called) is dark, fusulinid-rich limestone in lower part, upper part is light gray, phylloidal and fusulinid limestone; total thickness about 7'. Thin (<2'), yellowish, earthy wackestone with fragmental brachiopods and crinoids (so-called upper Ozawkie). Thin (<1'), light-gray, fine- to medium-grained sandstone is above "upper Ozawkie". Rock Bluff caps hill; light gray, micritic, hard, single bed of limestone less than 1' thick. Avoca at ~1047'; "lower Ozawkie" at ~1065'; "upper Ozawkie" at ~1080'; sandstone at ~1089'; Rock Bluff at ~1099' (all hand level to spot elevation).

23. Ervine Creek dug up by ditch-digging activity along east-west road north of barn and house, near midpoint, NW 1/4, sec. 4, T19S, R15E.

24. Fair-good exposure of limestone in Calhoun Shale-Hartford/ Curzon. Limestone in Calhoun is about 1' thick; lower part weathers into thin (<1"), argillaceous plates; upper part more massive; bioturbation and myalinids very common; potential crack-out brachiopod fauna can be collected here. Base of limestone at ~1126'; Hartford/Curzon at ~1146' (both hand level from spot elevation). Limestone in Calhoun is dark, coated-grain grainstone/packstone. Exposure in ditch on north side of east-west road along south edge SE 1/4, SE 1/4, sec. 32, T18S, R15E.

25. Poor-fair exposure of Hartford/Curzon Limestone on east side of hill along east-west road, near center, south edge SW 1/4, sec. 31, T18S, R15E, at ~1139' (hand level from spot elevation).

26. Sandy, argillaceous, thin (<1') limestone/calcareous sandstone exposed at top of hill near midpoint, south edge, SW 1/4, sec. 27, T18S, R14E; contains brachiopods, crinoid debris, coated grains; at ~1122' (hand level from topographic line); nice section in horizontal silos at top of hill. This probably is the Bachelor Creek Limestone Member of the Howard Limestone.

27. Bachelor Creek Limestone Member very poorly exposed on top of hill in east-west road on north edge NW 1/4, NE 1/4, sec. 34, T18S, R14E, at ~1121' (hand level from topographic line).

28. Two thin (<6") fine- to medium-grained sandstones; lower one in creek bed north of east-west road near midpoint, south edge SW 1/4, SW 1/4, SE 1/4, sec. 1, T19S, R14E, at ~1109' (hand level to spot elevation); upper one on south side of east-west roadcut about 100' west of midpoint, north edge sec. 12, T19S, R14E, at ~1126' (hand level from spot elevation). [NOTE: The spot elevation shown on the map is 1020'. It should read 1120'.]

29. Sandstone, fine- to medium-grained, 1'-2' thick, cross bedded. Exposed on north creek cut, south of east-west road, near midpoint, north edge NE 1/4, sec. 12, T19S, R14E, at ~1118' (hand level to topographic line).

30. Hartford/Curzon exposed near top of hill near midpoint, west edge, NW 1/4, NW 1/4, sec. 7, T19S, R15E, at ~1118' (hand level from spot elevation). Here the Hartford is orangish, earthy, and sparsely fossiliferous. The Curzon is very light gray and phylloidal in part.

31. Fair-poor exposure of Hartford/Curzon in east-west road on both sides of hill along northern edge NW 1/4, NE 1/4, sec. 7, T19S, R15E, at ~1120' (hand level from topographic line).

1-15-90

32. Sandy, dark, coated-grain packstone in Calhoun Shale (about 1' thick) at ~1104'. Hartford/Curzon very poorly exposed at ~1125' (both hand level from topographic line). Exposures on hill west of north-south road in N 1/2, SE 1/4, NE 1/4, sec. 7, T19S, R15E.

33. Fair-poor exposure of Rock Bluff-Ervine Creek Limestone members in and north of east-west road near midpoint, about 100' north of south edge, sec. 5, T19S, R15E. Rock Bluff at ~1071'; Ervine Creek at ~1075' (both hand level to spot elevation).

34. Good exposure of so-called "upper Ozawkie Limestone," southeast and below road in SE 1/4, SW 1/4, SE 1/4, SE 1/4, sec. 5, T19S, R15E, in cut bank of Frog Creek. Ozawkie here weathers earthy yellow with common fossil fragments scattered throughout; about 2.5' thick; at ~1063' (hand level from spot elevation).

35. Very poor exposure of Rock Bluff-Erving Creek Limestones on abandoned north-south road near east edge, SE 1/4, sec. 5, T19S, R15E. Rock Bluff at ~1085; Ervine Creek at ~1088' (hand level from spot elevation).

36. Good-fair exposure of Rock Bluff at ~1081' and Ervine Creek at ~1084' (both hand level from spot elevation) on east side of north-south road about 200' south of northwest corner sec. 9, T19S, R15E.

37. Fair-poor exposure of Hartford/Curzon on west side of north-south road near midpoint, east edge, SE 1/4, NE 1/4, sec. 24, T19S, R14E, at ~1136' (hand level to spot elevation).

38. Light gray, earthy, argillaceous, siltstone (about 1'-1.5' thick) exposed about 150'-300' north bridge over drainage near midpoint, south edge SE 1/4, SW 1/4, sec. 22, T19S, R14E, at ~1118' in newly straightened/dug channel for drainage. Siltstone contains common, very small (<4 mm), planispiral gastropods. (Sample: LEB 38-1). This may be one of the thin, calcareous siltstone beds near the base of the Severy Shale reported by O'Connor (1955).

39. Very poor exposure of brownish-weathering, mollusc-dominated, dark (where fresh) grainstone/packstone. Abundant Thallansinoides-like bioturbation at base of unit. This layer is about 3" thick; thinner (about 1") layers are scattered about and generally are the same, only finer grained. Exposure in east-west road near midpoint, north edge, NE 1/4, NE 1/4, sec. 10, T19S, R14E, at ~1181' (hand level to spot elevation).

    (Revisited - 1-16-90) - This lithology corresponds with all the exposures of Utopia Limestone Member I've seen so far. I have yet to see fusulinids in the Utopia.

40. Atchison, Topeka, and Santa Fe railroad cut near midpoint, east edge, SE 1/4, SE 1/4, sec. 3, T19S, R14E. Very difficult to tell what is in place and what is float. Limestone, very argillaceous, medium- to dark-gray, crinoidal, oncolitic limestone (about 1.5' thick); large brachiopods in places; potential crack-out fauna; weathers reddish brown. Several trilobite bits seen along with several large gastropods. As best as I can tell, this limestone is at ~1181' (hand level from topographic line). [COLLECTION:LEB40-1-brachiopods(2), a gastropod, and one trilobite pygidium].

(Revisited - 1-16-90) - This is Church Limestone Member.

41. Essentially some limestone as on railroad cut at MS40. Exposure on west side of north-south road, intermittently, for about 600' south from midpoint of north edge sec. 10, T19S, R14E. Uppermost part of limestone is dense, hard, dark, and micritic-appearing where fresh. Exposure at ~1169' (hand level from topographic line).

(Revisited - 1-16-90) - This is Church Limestone Member.

1-16-90

42. Very poor exposure of Church Limestone at ~1144' (hand level to topographic line). Exposure along east-west paved road about 900' west of Lebo city limits near center, E 1/2, NW 1/4, sec. 9, T19S, R14E.

Lebo NW Quadrangle
DATE?

1. Exposure in new stream cut about 100' south and 50' west of northeast corner, sec. 20, T19S, R14E. Orangish, earthy, fine- to medium-grained sandstone (about 1' thick) with layers of rounded, rip-up clasts. Uppermost 1 cm of unit is conglomeratic with some brachiopods and clams seen. [COLLECTION: LEBNW 1-1 is several of these 1-cm slabs]. Sandstone at ~1101' (hand level to topographic line). The sandstone is overlain by about 1'-2' of shale and thin siltstone, which is overlain by about 2' of chert gravel. Shale is cream-colored to yellowish.

1-16-90

2. Abandoned strip pit (now filled with water) in Nodaway Coal. Black shale (=Shanghai Creek Shale Member?) common in recent bulldozer grading; shale has typical Dunbarella, inarticulate brachiopod, smooth-shelled clam fauna. Church Limestone Member about 2' above water level; about 2' thick; very hard, dense, dark where fresh; yellowish-brown to orange, a bit more noticeably argillaceous, with oncolites and large, white-weathering, Antiquatonia-like brachiopods visible; uppermost 1" or so is more argillaceous, slabby, and contains a more diverse fauna with obvious fenestrate bryozoans. Uppermost part of highwall contains a dark, hard, dense grainstone (about 6" thick) that weathers dark brown to dark yellow. This probably is the Utopia Limestone Member. The 9' (approximate) covered interval between the Church and Utopia Limestone Members would encompass the Winzeler Shale Member; however, the uppermost 3' or so of this covered interval has thin, slabby limestone float similar to the overlying Utopia. Section is about 1300' due south of midpoint, north edge, sec. 5, T19S, R14E; Church at ~1120'; Utopia at ~1131' (both hand level from spot elevation).

3. About 2' of dark-blue-gray to drab-olive, slightly silty shale/mudstone exposed at creek level on west bank south of bridge; about 100' south of midpoint, north edge, NW 1/4, sec. 5, T19S, R14E. Shale contains rare clam molds as smashed productid brachiopod fragments. Exposure at ~1078' (hand level to topographic line); probably Severy Shale.

4. Church Limestone exposed at water level in abundant strip pit in E 1/2, NW 1/4, NW 1/4, NW 1/4, sec. 5, T19S, R14E, at ~1101'. Utopia Limestone exposed in east-west roadway due north of abandoned strip pit near midline, north edge, NE 1/4, NW 1/4, NW 1/4, NW 1/4, sec. 5, T19S, R14E, at ~1110' (both hand level from spot elevation). Church is about 2' thick; Utopia is about 1' thick.

5. Church Limestone in ditch on east side of north-south road at, and about 300' north of midpoint, west edge, sec. 5, T19S, R14E, at ~1109' (hand level to spot elevation).

6. Excellent exposure from about 5' below Nodaway Coal to Utopia Limestone. Exposure in spillway cut for Lebo Lake dam in NW 1/4, NW 1/4, NE 1/4, SW 1/4, sec. 5, T19S, R14E. Section below coal is tan to gray silty shale; Nodaway Coal is about 1' thick, underlain by about 3" of yellowish clay shale; shale overlying Nodaway Coal is silty and gypsum-rich; no black shale or limestone seen, but rare Lingula occur in shale about 1' above coal; shale above coal is about 8' thick, overlain by Church Limestone (about 2' thick); Church here is dense, dark, weathers dark orange and has a thin (<2") fossiliferous grainstone at the top; the Church is overlain by about 8' of gray, green, and yellowish, slightly silty clay shale; common, first-size, micritic septarian concretions occur near the base of this shale; overlying this shale (Winzeler) is about 1' of thin bedded (<5"), dark, dense, coated-grain grainstone with abundant molluses in the lower part (Utopia Limestone Member). Nodaway Coal at ~1100'; Church Limestone at ~1109'; Utopia Limestone at ~1119' (all hand level to topographic line). Much erosion has occurred since map was made. Major joint direction in Church is ~N70°E.

6. (Revisited - 2-11-90) - Bachelor Creek Limestone Member exposed approximately 6' below Nodaway Coal in gulley north from Nodaway exposure; Bachelor Creek here is sandy, about 1' thick; lower 8" is massive, upper 4" is platy with abundant productids on bedding surfaces; Bachelor Creek base at ~1094' (hand level to topographic line). Collected for conodonts bly Scott Ritter (Oklahoma State University). Three 7" x 12.5" bags, one each from Bachelor Creek, Howard, and basal Winzeler.

7. Church Limestone Member exposed at water level about 50'-100' south of near midpoint NW 1/4, sec. 8, T19S, R14E, on east side of arm of Lebo Lake, at ~1116'; Utopia Limestone Member along east-west road on north edge of sec. 8, T19S, R14E, about 200' east (uphill) of Church exposure; Utopia at ~1130' (both hand level to topographic line). Church is about 2' thick; Utopia is about 1' thick.

8. Poor exposure of very weathered, plowed, Nodaway Coal and yellow underclay in farmer's field about 100' east of midpoint, SW 1/4, sec. 4, T19S, R14E, at ~1127'. Church Limestone Member poorly exposed near top of hill west of north-south road near midpoint, SE 1/4, sec. 5, T19S, R14E, at ~1139' (both hand level from spot elevation).

9. Good exposure of Utopia Limestone Member in creek bed about 100' west and 100' north of the southeast corner of sec. 6, T19S, R14E, at ~1124' (hand level to spot elevation). I can't tell if some structural deformation is present here or if some very large blocks have been moved by local farmers. Certainly another 200' downstream (north) the top of the Utopia is present at ~1122' (hand level to spot elevation).

10. Fair-good exposure of Church-Utopia Limestone Members, 200'-300' east of northeast corner sec. 6, T19S, R14E. Church at ~1101'; Utopia at ~1111' (both hand level from spot elevation).

1-20-90

11. Exposure along east side of Coal Creek about 300' south of new bridge on east-west county-line road in SW 1/4, NE 1/4, NW 1/4, NE 1/4, sec. 6, T19S, R14E. Church Limestone Member, about 1' thick, at ~1094' (hand level to topographic line).

12. Utopia Limestone Member exposed in east-west county-line road, near midpoint, north edge, sec. 6, T19S, R14E, at 1098' (hand level to topographic line).

13. Excellent exposure of Utopia Limestone Member (about 7' thick: ~1' coated-grain grainstone/packstone with bedding planes of common, small myalinids; ~3' shale/siltstone; ~3" mollusc-dominated limestone; ~1.75' shale; ~6" coated-grain grainstone/packstone; ~3" shale; ~3" dark, fusulinid, coated-grain packstone/grainstone) at ~1094' (hand level to topographic line). Exposure in S 1/2, NE 1/4, NW 1/4, NW 1/4, sec. 6, T19S, R14E, on north side of Coal Creek.

14. Exposure in ditches and along north-south field-access road along west edge, SW 1/4, SW 1/4, sec. 36, T18S, R14E. Earthy, boxwork, yellow, sandy unit about 6" thick at ~1162'; greenish, fossiliferous, sandy, argillaceous unit about 3" thick at ~1165'; limestone, yellowish-orange to reddish-brown weathering echinoderm-fusulinid-mollusc-brachiopod packstone/grainstone, weathers into thin (<2") slabs, thickness about 3', at ~1222' (all hand level to spot elevation).

    (Revisited - 1-20-90) - Upper limestone here probably is the Burlingame Limestone Member of the Bern Limestone. The Lower limestone may be the Rulo Limestone Member of the Scranton Shale.

15. Limestone, about 2' thick, nodular, micritic, oncolites in packstone; fossils decrease upward; becomes more sandy upward. Exposure on east side of intermittent stream, about 700' east of midpoint, north edge, sec. 2, T19S, R13E, at ~1172' (hand level to spot elevation). Weathers poorly into thin (<2") slabs.

    (Revisited - 2-11-90) - Rulo Limestone collected for conodonts by Scott Ritter (Oklahoma State University). One 7" x 12.5" bag collected.

    (Revisited - 1-20-90) - This may be the Rulo Limestone Member of the Scranton Shale.

16. Exposure in east-west county-line road about 300'-400' west of midpoint, north edge, sec. 2, T19S, R13E. Dense, earthy, boxwork unit (about 6" thick), very sandy, at ~1211'; limestone, weathers into very thin (< 1") slabs, argillaceous, becoming coated-grain packstone upwards, at ~1214' (both hand level from spot elevation).

(Revisited - 1-20-90) - This probably is the Burlingame Limestone Member of the Bern Limestone.

17. Brownish weathering, echinodermal and coated-grain grainstone about 2' thick at ~1219' (hand level to topographic line). Exposure near center, west edge, SW 1/4, NW 1/4, SW 1/4, sec. 2, T19S, R13E.

(Revisited - 1-20-90) - This is the same limestone as at MS16 and MS18; probably the Burlingame Limestone Member of the Bern Limestone.

18. Limestone, about 1' thick, lowermost 1" is molluscan (especially myalinid) wackestone/packstone, otherwise remainder of unit is brachiopod, echinoderm, coated-grain grainstone; weathers yellowish, dark blue to red where fresh. Exposure on west side of hill, along east-west road, about 200' east of northwest corner sec. 11, T19S, R13E, at ~1233' (hand level from spot elevation). This probably is the Burlingame Limestone Member of the Bern Limestone.

18. (Revisited - 2-11-90) - Burlingame Limestone collected for conodonts by Scott Ritter (Oklahoma State university). One 7" x 12.5" bag collected.

1-21-90

19. Exposure along creek in N 1/2, SW 1/4, SW 1/4, SW 1/4, sec. 32, T18S, R14E. Sandstone, about 2' thick, fossiliferous (brachiopods, clams, echinoid spines); grades into very sandy limestone in part; at ~1076'; Church Limestone Member at ~1095' (both hand level to spot elevation). The fossiliferous sandstone probably is the Bachelor Creek Limestone Member of the Howard Limestone.

20. Excellent exposure of Utopia Limestone Member along both sides of north-south road on south side of Coal Creek, near midpoint, west edge, NW 1/4, sec. 6, T19S, R14E. Lower part of Utopia consists of thin (< 2"), molluscan (especially bellerophontids and myalinids) limestones separated by thick (< 2') shale, uppermost limestone is about 1' thick and fusulinid-choked. Total thickness of Utopia here is about 11'. Base of Utopia, taken at lowest molluscan limestone, at ~1104' (hand level to topographic line). Lowermost limestone bed is about 6" thick.

20. (Revisited - 2-11-90) - Utopia LImestone Member collected for conodonts by Scott Ritter (Oklahoma State University). Three 7" x 12.5" bags collected, one from lower part, one from middle molluscan-rich part, one from upper fusulinid-rich part.

21. Shale, silty shale, and thin (<3") sandstone beds (total exposure about 12'-15') exposed in AT&SF railroad cut near center, S 1/2, NE 1/4, sec. 20, T19S, R13E. Base of exposure at ~1138' (hand level to topographic line).

1-21-90

22. Uppermost, fusulinid-profuse part of Utopia Limestone Member exposed at ~1118' (hand level to spot elevation). Exposure on north side of creek, west of north-south road about 300' south of northeast corner sec. 23, T19S, R13E. Base of Utopia estimated at ~1110'; top of Utopia estimated at ~1120'.

23. Poor exposure of Church Limestone Member in east-west road near midpoint, south edge, SE 1/4, SE 1/4, sec. 23, T19S, R13E, at ~1109' (hand level to spot elevation).

DATE????

24. Exposure about 200' north of midpoint, east edge sec. 32, T18S, R14E, along north-south road. Fair exposure of Church and Bachelor Creek Limestone members. Church at ~1114'; Bachelor Creek at ~1101' (both hand level to spot elevation).

LeRoy Quadrangle Chris Maples 11-9-91
Map Sta:

1) Sandstone in Lawrence Shale exposed on both sides of north-south highway US75. Exposure along west edge SW 1/4, NW 1/4, NW 1/4, sec. 26, T23S, R15E.

2) Shale with abundant small chips of siltstone/fine-grained sandstone exposed on both sides of north-south highway US75; abundant trace fossils on chips. Exposure on west edge NW 1/4, NW 1/4, SW 1/4, sec. 26, T23S, R15E.

3) Upper Lawrence-Toronto exposed on both sides of north-south highway US75 along west edge NW 1/4, NW 1/4, sec. 35, T23S, R15E. Fossiliferous (Juresania, clams, bryozoans--all sparse) sandy interval (Amazonia equivalent?) overlain by interval of calcareous, micritic, yellow-weathering, septaria-like nodules (reminds me of the yellow carbonate in the King Hill Shale, but not as weathered) at ~1071'; Williamsburg coal poorly exposed at ~1075'; Toronto Limestone Member at ~1082' (all hand level from spot elevation).

LeRoy Quadrangle Chris Maples 11-7-92
Map Sta:

4) Toronto Limestone Member poorly exposed in graded roadway at ~1100' (hand level to spot elevation). Exposure in northeast corner sec. 24, T23S, R15E.

5) Shale and sandstone/siltstone exposed in roadcut on north side of east-west road in southeast corner sec. 27, T23S, R16E.

6) Sandstone and shale exposed along N-S road from midpoint east edge sec. 27 to midpoint east edge SE 1/4 sec. 22, T23S, R16E.

7) Sandstone and shale exposed along east-west road on south edge sec. 28, T23S, R16E.

8) Sandstone and shale exposed along north-south road on east edge sec. 29, T23S, R16E.

9) Toronto Limestone Member exposed on east side of north-south road at ~1118' (hand level to spot elevation). Exposure about 200' south of midpoint west edge NW 1/4, sec. 36, T23S, R15E.

10) Questionable occurrence of Toronto float at ~1134' (hand level from topographic line) in NE 1/4, NE 1/4, sec. 36, T23S, R15E.

11) Toronto Limestone Member exposed in east-west roadway at ~1108' (hand level from spot elevation). Exposure about 100' west of southeast corner sec. 26, T23S, R15E.

12) Toronto Limestone Member exposed in east-west road at ~1100' (hand level from spot elevation). Exposure near midpoint, south edge, SW 1/4, SE 1/4, sec. 26, T23S, R15E.

LeRoy Quadrangle Chris Maples 11-27-92
Map Sta:

13) Sandstone of Lawrence Formation exposed in north-flowing creek in south side of east-west road in NW 1/4, SW 1/4, SE 1/4, sec. 27, T23S, R15E.

Neosho Falls Quadrangle Chris Maples 11-29-92
Map Sta:

1) Sandstone and shale exposed on north side of east-west road along SE 1/4, SW 1/4, SW 1/4, sec. 23, T23S, R16E.

New Strawn Quadrangle Chris Maples 5-20-89
MAP STA:

1. Fair-good exposure of Leavenworth-Heebner-Plattsmouth interval. Leavenworth at ~1178', Plattsmouth at ~1183'; abundant Heebner float (hand level to topographic line). Section along both sides of road for ~300' at approximately the mid line of the southern boundary of the SW 1/4, SE 1/4, sec. 33, T20S, R16E.

2. Plattsmouth limestone exposed in gulleys N and S of E-W road for ~200' east from mid-point of northern boundary sec. 4, T21S, R16E, at ~1067' (hand level to spot elevation). Top of Plattsmouth roughly equal to black-red color change in plowed fields (black=Plattsmouth, red=sandy Heumader).

3. Good exposure of Leavenworth-Heebner-Plattsmouth section on north side of creek valley (SW 1/4, NW 1/4, SW 1/4, SW 1/4, NE 1/4, sec. 4, T21S, R16E). Leavenworth at ~1068', Plattsmouth at ~1073' (both level to topographic line). Abandoned pit west of road may have measurable highwall, but not checked (SE 1/4, NW 1/4, sec. 4, T21S, R16E). Landowner says no highwall remains, pond there instead.

12-18-90

4. Exposure on south side of hill along north-south US75 near midpoint of eastern boundary NE 1/4, sec. 27, T19S, R15E, at ~1154' (hand level from topographic line). Looks like Ervine Creek.

5. Sandstone (about 2' thick, crossbedded generally northward) overlain by 1'-2' thick limestone, yellowish brown, crinoid-rich. These two units are within the Calhoun Shale. Exposure on east side of north-south roadcut on access-road parallel to US75, near point, west edge NW 1/4, SW 1/4, NW 1/4, sec. 35, T19S, R15E. Limestone at ~1203' (hand level from topographic line).

6. Excellent exposure of Rock Bluff and Ervine Creek Limestone members along north-south US75, near midpoint, eastern boundary SE 1/4, SE 1/4, sec. 34, T19S, R15E, at ~1164' and 1168', respectively (hand level from spot elevation). Rock Bluff is only about 6" thick here.

7. Fusulinid-rich limestone, 2'-3' thick, beds 6" or less thick, weathers yellow. Looks like the upper Ozawkie Limestone (as opposed to Ervine Creek) because (1) abundant fusulinids and (2) not as thick (2'-3') as Ervine Creek (4'-5'). Exposure near midpoint, east edge sec. 3, T20S, R15E, along north-south US75, at ~1154' (hand level from spot elevation).

8. Upper part of Ozawkie Limestone exposed in roadcut along north-south US75, about 200'-400' south of midpoint, west boundary sec. 11, T20S, R15E, at ~1178' (hand level from spot elevation). This upper Ozawkie is yellow, earthy, and has scattered echinoderm and brachiopod fragments in it. Where are the fusulinids?

9. About 3' of cross-bedded, very fossiliferous (fossils very highly abraded), limestone. Crossbedding generally towards the north. Exposure at ~1105' (hand level to spot elevation), along east side of north-south US75 about 400' south of northwest corner, sec. 2, T21S, R15E. I don't know yet what this unit is.

10. Same unit as MS9, exposed at intersection of 3rd St. and Lake Rd., in New Strawn, Kansas (near midpoint, southern edge, SW 1/4, SE 1/4, SW 1/4, sec. 34, T20S, R15E), at ~1101' (hand level from topographic line). Limestone is about 3' thick, cross-bedding generally toward north.

4-1-90

11. Spring Branch float at top of hill at ~1191' (hand level from spot elevation). Most float on south side of east-west road along north edge NE 1/4, NE 1/4, NW 1/4, sec. 34, T19S, R16E.

12. Spring Branch Limestone Member exposed in ditches along east-west road at ~1171' (hand level from spot elevation). Abundant myalinids weathering free from shale about 2' below Spring Branch. Exposure near midpoint, south edge, SE 1/4, SE 1/4, sec. 28, T19S, R16E.

13. Yellow, dense, earthy layer commonly seen near the top of the King Hill Shale Member exposed in ditch on north side of east-west road at ~1187' (hand level to spot elevation). Exposure on north side of east-west road near midpoint, south edge, SW 1/4, SE 1/4, sec. 28, T19S, R16E.

14. Yellow-weathering limestone float; large fusulinids very common. Looks like Ozawkie to me. Float blocks along east-west road near midpoint, south edge, SE 1/4, SW 1/4, sec. 28, T19S, R16E. Ozawkie at ~1208' (hand level from spot elevation).

4-7-90

15. Exposure of Ozawkie Limestone Member along north side of east-west road, near midpoint, south edge, SW 1/4, SE 1/4, SE 1/4, sec. 29, T19S, R16E, at ~1198' (hand level to spot elevation). Some brachiopods (mostly chonetids) and limestone-filled burrows weathering out of shale below.

16. Exposure of Avoca Limestone Member along north side of east-west road on south edge SW 1/4, SW 1/4, SW 1/4, SE 1/4, SW 1/4, sec. 29, T19S, R16E at ~1062'; this is the lower Avoca. Dense, dark-gray, weathers light-yellow limestone with some large fusulinids and common, small zoophycos on upper surface (very similar to middle limestone bed of Avoca at MS2, John Redmond Dam Quadrangle). Upper Avoca at ~1070' (both hand levels from topographic line) very well exposed in creek flowing north from near midpoint, south edge SE 1/4, SW 1/4, sec. 29, T19S, R16E. Upper Avoca has common syringoporoids and oncolites. Both Avoca beds are about 1' thick.

17. Exposures of upper part of King Hill Shale and lower Avoca Limestone along north-south road on west edge NW 1/4, SW 1/4, sec. 29, T19S, R16E. Excellent exposure of upper 5'-8' of King Hill Shale in S 1/2, SE 1/4, NE 1/4, NE 1/4, SE 1/4, sec. 30, T19S, R16E in creek cut bank. Yellow, earthy layer in upper King Hill at ~1149'; lower Avoca at ~1152' (both hand level from topographic line).

18. Lowermost Avoca about 1' above the dense, yellow, earthy bed in King Hill Shale; exposed on south side of creek valley along north-south road near midpoint, west edge SW 1/4, NW 1/4, SW 1/4, sec. 30, T19S, R16E. Lower Avoca at ~1136' (hand level to spot elevation). Top of bed bioturbated with small Zoophycos and normal-sized Chondrites. Lower limestone about 2' thick; major joint set trends N65°E. Upper Avoca Limestone poorly exposed at ~1152'. Ozawkie Limestone exposed on east side of road at ~1167' (both hand level from spot elevation).

19. Avoca-Ozawkie interval exposed in creek about 70' west of midpoint, east edge, sec. 36, T19S, R15E, continuing along north-south road southward to midpoint SE 1/4, Sec. 36, T19S, R15E. Lower Avoca Limestone very well exposed in creek at ~1136' (hand level to spot elevation). Top of bed bioturbated with small Zoophycos and normal-sized Chondrites. Lower limestone about 2' thick; major joint set trends N65°E. Upper Avoca Limestone poorly exposed at ~1152'. Ozawkie Limestone exposed on east side of road at ~1167' (both hand level from spot elevation).

20. Ozawkie Limestone exposed along east side of north-south road about 100'-300' south of northwest corner of sec. 6, T20S, R16E, at ~1171' (hand level from spot elevation). Some brachiopods and stick bryozoans in shale beneath Ozawkie.

21. Ozawkie Limestone Member exposed on east side of north-south road, 0-50' north of southwest corner, NW 1/4, sec. 6, T20S, R16E, at ~1182' (hand level from spot elevation).

22. Dense, yellow, earthy layer in King Hill Shale exposed in ditches on both sides of north-south road, about 20'-150' south of northeast corner sec. 12, T20S, R15E, at ~1155' (hand level to spot elevation). Base of Avoca not seen, but estimated to be at about 1158', based on previously documented stratigraphic relationship to this yellow, earthy bed.

23. Thin bedded (<4") sandstone exposed along east edge, SE 1/4, NE 1/4, SE 1/4, sec. 12, T20S, R15E, at ~1141' (hand level to spot elevation). This probably is in the King Hill Shale.

24. Mostly sandstone and shale exposed along east-west road to break in slope, where Spring Branch Limestone Member is exposed at ~1163'. Profuse myalinids at ~1160'. Lowermost sandstone at 1132' (all hand level from spot elevation). Chonetids common between myalinid zone and Spring Branch Limestone. Exposure along south edge, SE 1/4, SW 1/4, SW 1/4, sec. 7, T20S, R16E.

25. Spring Branch Limestone with poorly exposed myalinids below exposed along east-west road near midpoint, south side, sec. 7, T20S, R16E, at ~1173' (hand level to spot elevation).

26. Spring Branch Limestone Member (poor exposure) with common myalinids weathering out of shale about 2-3' below Spring Branch. Exposure on north side of east-west road about 200' west of southeast corner, sec. 7, T20S, R16E, at ~1178' (hand level from spot elevation).

27. Sandstone beds with abundant covered interval along east-west road, to top of hill along south edge, SE 1/4, SE 1/4, sec. 8, T20S, R16E.

28. Kereford Limestone Member exposed along east-west road on south edge, SE 1/4, SE 1/4, sec. 9, T20S, R16E. Kereford grades upward from thin sandstone/siltstone in shale, to sandstone with mollusks, to sandy oolite, to calcitites with oolites and mollusks, and is capped by an oolitic and coated-grain grainstone with moldic porosity. Base of unit at ~1120', top at about 1135' (both hand level from topographic line).

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29. Sandstones, shales, and (mostly) covered interval, same sequence as below Spring Branch Limestone Member at MS24, exposed along both sides of east-west road, east edge, NE 1/4, sec. 13, T20S, R15E.

30. Spring Branch Limestone Member with abundant myalinids about 3' below, exposed on east side of north-south road, about 200'-400' north of southwest corner, sec. 18, T20S, R16E. Spring Branch at ~1159' (hand level to spot elevation). Partial core of dense, somewhat dark, moderately fossiliferous limestone beside new phone pole about 80' south of northwest corner sec. 19, T20S, R16E. This may be Big SPrings at ~1171' (estimated depth to limestone after hand level from spot elevation).

31. Spring Branch Limestone MEmber with abundant myalinids about 3' below on both sides of north-south road near midpoint, west edge, NW 1/4, NW 1/4, sec. 19, T20S, R16E, at ~1159' (hand level to spot elevation).

32. Spring Branch Limestone Member with abundant myalinids about 3' below well exposed on east side of north-south road near midpoint, SW 1/4, SW 1/4, sec. 19, T20S, R16E, at 1164' (hand level from spot elevation).

33. Sandstone and shale (as below Spring Branch Limestone Member) to top of hill, along north-south road, near midpoint, west edge, NW 1/4, sec. 30, T20S, R16E.

34. Sandstone and shale (as below Spring Branch Limestone Member) to top of hill, along north-south road, near midpoint, west edge, SW 1/4, sec. 30, T20S, R16E.

35. Very poor exposure of Spring Branch Limestone Member about 700' east of midpoint, west edge, sec. 30, T20S, R16E, along east-west road, at ~1173' (hand level from spot elevation). Some myalinids weathering out of soil about 3' below Spring Branch.

36. Hartford/Curzon exposed on both sides of north-south road, about 300' north of southeast corner of sec. 28, T19S, R15E, at ~1214' (hand level to spot elevation). Some brachiopods and bryozoans weathering out of shale below limestone.

37. Hartford/Curzon poorly exposed along north-south road near midpoint, west edge, SW 1/4, NW 1/4, sec. 34, T19S, R15E, at ~1216' (hand level from spot elevation). The so-called "Tonovay Limestone Member" seems to be directly beneath the Hartford here, but it is hard to tell because of the exposure. Above the Hartford is float of white, phylloidal limestone. The Tonovay here seems to be a molluscan-coated-grain grainstone, but this is based on float.

38. Rock Bluff Limestone Member poorly exposed in ditch and along reek east and west of north-south road near midpoint, west edge, SW 1/4, sec. 34, T19S, R15E, at ~1150' (hand level to topographic line). Ervine Creek float in dam of pond in center, SE 1/4, NE 1/4, SE 1/4, sec. 33, T19S, R15E.

39. Rock Bluff Limestone Member exposed on east side of north-south road along west edge of SW 1/4, NW 1/4, NW 1/4, sec. 3, T20S, R15E, at ~1156' (hand level from bench mark and spot elevation).

40. Ozawkie Limestone Member exposed north and south of southeastward-flowing creek, along north-south road, abut 500' north and 600' south of midpoint, west edge, sec. 3, T20S, R15E. North exposure at ~1136'; south exposure at ~1124' (both hand level from spot elevation).

41. Avoca Limestone Member exposed along southeast edge of East Hickory Creek in SW 1/4, SW 1/4, SW 1/4, SW 1/4, SW 1/4, sec. 3, T20S, R15E, at ~1099' (hand level to spot elevation). Excellent bedding-surface exposure continues in creek bed southwest of bridge in N 1/2, NE 1/4, NE 1/4, NE 1/4, sec. 9, T20S, R15E. This probably is the lower Avoca because pieces of the yellow earthy bed in the upper part of the King Hill shale were found about 2' beneath the Avoca. Some brachiopods weather free; some slabs with productids seen.

42. Upper Avoca and Ozawkie Limestone Members exposed in dredged drainage way and across road along west edge, NW 1/4, SW 1/4, SW 1/4, sec. 3, T20S, R15E. Upper Avoca with syringoporoids at ~1104'; Ozawkie at ~1121' (both hand level from spot elevation).

43. Hartford/Curzon exposed along east-west road about 200' west of midpoint, south edge, sec. 27, T19S, R15E, at about 1223' (hand level to spot elevation). Sandstone in Calhoun Shale exposed at ~1213' (hand level to spot elevation). Once again, the "Tonovay" may be directly below the Hartford because oncolitic sponges do not occur until about 1'-2' above the limestone base.

44. Ervine Creek Limestone Member at ~1161' (hand level to spot elevation). Exposure in creek and along east-west road along north edge, NE 1/4, NW 1/4, NE 1/4, NE 1/4, sec. 34, T19S, R15E. Black shale chips scattered around base of new phone pole beside creek on east side of bridge.

45. Poor exposure of Rock Bluff Limestone Member near midpoint, north edge, NW 1/4, NE 1/4, NW 1/4, NW 1/4, sec. 35, T19S, R15E, at ~1166' (hand level from topographic line).

46. Exposures (poor) along east-west road north edge of NE 1/4, NW 1/4, sec. 36, T19S, R15E, of upper King Hill--Rock Bluff. Lower Avoca at ~1128'; earthy yellow bed in King Hill Shale about 2' below lower Avoca (well exposed in creek cut-bank about 200' south of road); upper Avoca at ~1136'; Ozawkie at ~1152'; Rock Bluff float at top of hill at ~1167' (all hand level to spot elevation).

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47. Clay Creek Limestone exposed on south side of east-west road at ~1137' (hand level from spot elevation). Abundant sandstone (very poorly exposed) both above and below Clay Creek. My hunch now is that the Clay Creek was cut out at several other localities by sandstone. Exposure here is poor, in ditch, near midpoint, south edge, SE 1/4, SE 1/4, NE 1/4, sec. 30, T20S, R16E. Highly bioturbated (?Macaronichnus) sandstone about 2' thick exposed at ~1130' (hand level from spot elevation).

48. Very poor exposures of sandstone and shale along length of east-west road on south edge, SW 1/4, sec. 20, T20S, R16E.

49. Sandy, ?oolitic, molluscan limestone (top of Kereford Limestone Member), beds <2" thick, about 1' thick total, exposed along east-west road near midpoint, south edge, SE 1/4, SE 1/4, sec. 20, T20S, R16E, at ~1106' (hand level from topographic line). This is the same as the base of the Jackson Park Shale Member. Dense, limonitic concretions up to 10 cm across at ~1101'.

50. Abundant limestone float in creek north of east-west road near center, S 1/2, SW 1/4, SE 1/4, sec. 27, T20S, R16E. I assume this is Plattsmouth float, but I'm unsure how far upstream the exposure is.

51. Abandoned quarry (water-filled) in Plattsmouth Limestone Member, plus exposures along road leading to low-water crossing, both in N 1/2, NE 1/4, NE 1/4, sec. 32, T20S, R16E. Top of Plattsmouth (base of Heumader) at ~1077' (hand level to spot elevation). Plattsmouth here is at least 10' thick, but exposure along roadway is poor, so this is very approximate.

    (Revisited - 4-23-90) - Quarries in the Plattsmouth extend into center NE 1/4, sec. 32, T20S, R16E and along W 1/2, SE 1/4, NE 1/4, sec. 32, T20S, R16E.

52. Leavenworth-Plattsmouth, poor/fair exposure, along north-south road, near midpoint, west edge, NW 1/4, SW 1/4, SW 1/4, sec. 34, T20S, R16E. Leavenworth at ~1082', Plattsmouth at ~1084' (both hand level from topographic line).

53. Sandstone, mostly poorly exposed, along north-south road, east edge sec. 28, T20S, R16E. About 2' massive sandstone bed (similar to uppermost sandstone on Waverly SE, MS 75) exposed near midpoint, east edge, NE 1/4, NE 1/4, sec. 28, T20S, R16E, at ~1130' (hand level from topographic line).

54. Very poor exposure of sandstone to top of cut bank on west edge creek about 100' north of midpoint, south edge, SE 1/4, SE 1/4, sec. 16, T20S, R16E.

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55. Exposure of lower Avoca on south side of creek along north-south road near midpoint, west edge, sec. 10, T20S, R15E, at ~1113' (hand level from spot elevation). Yellow earthy layer in King HIll present about 2' below Avoca.

56. Exposures in creek and along north-south road from SW 1/4, SW 1/4, SW 1/4, NW 1/4, SW 1/4 sec. 10 to about midpoint, west edge SW 1/4, SW 1/4, sec. 10, T20S, R15E. Lower Avoca Limestone in creek at ~1113', common bioturbation on upper surface; upper Avoca Limestone at ~1123,', syringoporoid corals common at this horizon (SAMPLE: NS 56.1); Ozawkie Limestone at ~1142' (all hand level to spot elevation).

57. Exposures along west edge, NW 1/4, NW 1/4, sec. 15, T20S, R15E. Yellow earthy layer in uppermost King Hill Shale at ~1118'; lower Avoca at ~1120'; Ozawkie at ~1146' (all, hand level to spot elevation).

58. Exposures along west edge, SW 1/4, sec. 15, T20S, R15E. Lower Avoca Limestone at ~1128'; upper Avoca Limestone at ~1136'; Ozawkie Limestone at ~1150' (all hand level to spot elevation). Upper Avoca is dark, dense, fusulinid- and mollusc-common limestone.

59. Lower Avoca Limestone exposed in east-west road near midpoint, north edge, NW 1/4, NE 1/4, sec. 22, T20S, R15E, at ~1146' (hand level to spot elevation). Yellow earthy layer is about 2'-3' below lower Avoca.

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60. Lower Avoca at ~1131'; upper Avoca at ~1137' (both hand level from topographic line). Yellow earthy layer is about 3' below lower Avoca. Abundant syringoporoids in upper Avoca. Exposure along west edge SW 1/4, SW 1/4, NW 1/4, NW 1/4, sec. 22, T20S, R15E. (SAMPLES: NS60.1 and NS60.2).

61. Fair-poor exposure of Spring Branch-Beil along north-south road near midpoint, west edge NW 1/4, SW 1/4, sec. 22, T20S, R15E. Spring Branch at ~1123'; Big Springs at ~1127'; Beil at ~1129' (all hand level from spot elevation). Common myalinids overlain by chonetid-rich shale in 3' interval below Spring Branch (SAMPLES: NS61.1 and NS61.2).

62. Fair-poor exposure of upper King Hill Shale-Ozawkie Limestone. Lower Avoca Limestone at ~1146'; Ozawkie Limestone at ~1176' (both hand level from spot elevation). Exposure along west edge, NW 1/4, NW 1/4, sec. 27, T20S, R15E.

63. Sandstone exposed by construction at intersection of sec. 27, 28, 33, and 34, T20S, R15E, at ~1120' (hand level to spot elevation). Sandstone is about 4'-6' thick.

64. Thin (< 1'), coated-grain grainstone at ~1140'; earthy yellow layer in upper King Hill Shale at ~1148' (both hand level to spot elevation). Lower Avoca assured to be 2' above yellow layer. Exposure on north-south road along east edge, NE 1/4, SE 1/4, sec. 28, T20S, R15E.

65. Upper Avoca Limestone exposed on both sides of US75 in SE 1/4, NW 1/4, SE 1/4, sec. 22, T20S, R15E, at ~1154' (hand level to topographic line).

66. Upper Avoca Limestone exposed about 250' west of southeast corner sec. 22, T20S, R15E, at ~1169' (hand level from spot elevation).

67. Thin (< 1), yellowish-orange weathering, fossiliferous wackestone; fossils weather in relief; upper surface of one bed is a Curythyris packstone. Exposure near midpoint south edge SE 1/4, SW 1/4, SW 1/4, sec. 23, T20S, R15E, at ~1148' (hand level to spot elevation). Looks like Spring Branch, but no myalinids seen below limestone in ditch.

68. Sandstone and shale, poorly exposed along southern edge, E 2/3, sec. 23, T20S, R15E.

69. Excellent exposure of sandstone/shale in channelized creek in NE 1/4, NE 1/4, SE 1/4, SE 1/4, sec. 23, T20S, R15E. Lots of brachiopods in sandstone. What is this? For the moment, I will call it a marine interval (~7') in the Stull Shale. Myalinids common near top of exposure. Slabs collected for brachiopod project with T.W. Henry (USGS) COLLECTION: NS69). This could also be in the Jackson Park Shale.

(Revisited - 4-29-90) - Jewett et al. (in Zeller, 1968, p. 36) noted that the Clay Creek Limestone Member "is identified in Coffey, Greenwood, and Elk counties as a zone of limestone and fossiliferous, calcareous, sandy shale." This whole interval may be the Clay Creek Limestone Member, given Jewett et al.'s definition. The interval here at MS69 is similar to (although much expanded) several of the Clay Creek and underlying sand/shale intervals on the Waverly NW Quadrangle, especially in the following features: 1) interval of abundant Derbyia; 2) abundant Juresania brachial values on sandstones slabs; 3) interval of common chonetids; and 4) presence of myalinids near top of sequence (although not nearly as many as are usually present below the Spring Branch Limestone Member). The differences are: 1) no dark limestone seen at top of exposure; and 2) much thicker sequence. If this is part of the Clay Creek/Jackson Park interval, the limestone exposed along US 75 north of Burlington (again underlain by myalinids) may be Clay Creek as well.

4-29-90

70. Exposure of Spring Branch Limestone Member with common myalinids below in west bank of north-flowing creek in NW 1/4, NW 1/4, SW 1/4, NW 1/4, sec. 25, T19S, R15E, at ~1086' (hand level to spot elevation).

71. Lower Avoca Limestone poorly exposed on very small hill along north-south road near midpoint, NE 1/4, NE 1/4, sec. 35, T19S, R15E, at ~112' (hand level from spot elevation).

72. Earthy yellow layer in King hIll Shale, lower Avoca Limestone at ~1123', and upper Avoca Limestone at ~1131' (both hand level to topographic line) exposed along north-south road on east edge SE 1/4, SE 1/4, NE 1/4, sec. 35, T19S, R15E. Some yellow-weathering fossiliferous Avoca float seen in creek; although not seen in outcrop, it appears as though this facies is developing between what I refer to as lower Avoca and the yellow, earthy layer in the King Hill.

73. Ozawkie Limestone Member poorly exposed in ditch on west side of north-south road about 300' north of southeast corner NE 1/4, SE 1/4, sec. 35, T19S, R15E, at ~1149' (hand level from topographic line).

74. Yellow-weathering, fusulinid-rich limestone (Ozawkie?) exposed in north-south road at ~1183' (hand level from spot elevation), about 200' south of northeast corner NE 1/4, SE 1/4, sec. 2, T20S, R15E. This may be Ervine Creek instead, but no Rock Bluff float seen.

75. Ozawkie Limestone Member poorly exposed in north-south roadway near midpoint, east edge, SE 1/4, SE 1/4, SE 1/4, sec. 11, T20S, R15E, at ~1167' (hand level from spot elevation).

5-13-90

76. Exposure of Ozawkie Limestone about 200' west of southeast corner sec. 35, T19S, R15E, at ~1161' (hand level from spot elevation).

77. Upper Avoca Limestone exposed in ditch on south side of east-west road about 400-500' east of northwest corner sec. 1, T20S, R15E, at ~1143' (hand level to spot elevation).

78. Very poor exposure of Ozawkie Limestone on south side of east-west road about 75' west of southeast corner SW 1/4, sec. 31, T19S, R16E, at ~1183' (hand level from spot elevation).

79. Poor exposure of Ozawkie Limestone on north side of east-west road near midpoint, south edge SE 1/4, sec. 31, T19S, R16E, at ~1198' (hand level to topographic line).

80. Very poor exposure of Ozawkie Limestone along north-south road about 200' south of northeast corner SE 1/4, sec. 31, T19S, R16E, at ~1185' (hand level to spot elevation).

81. Very poor exposure of Ozawkie Limestone on east side of north-south road about 200' south of northwest corner sec. 32, T19S, R16E, at ~1183' (hand level from spot elevation). Good exposure at ~1180' (hand level from spot elevation) on south side of east-west road about 300' west of northeast corner sec. 31, T19S, R16E.

82. Lower and upper Avoca Limestone beds exposed in ditch on north side of east-west road from southeast corner to about 200' west of southeast corner sec. 25, T19S, R15E. Lower Avoca at ~1132'; upper Avoca at ~1139' (both hand level to spot elevation).

83. Lower Avoca (with earthy yellow layer about 3' below) and Ozawkie Limestones exposed along north edge NE 1/4, NW 1/4, NW 1/4, sec. 31, T19S, R16E. Lower Avoca at ~1133'; Ozawkie at ~1157' (both hand level to spot elevation).

12-2-90

84. Very poor exposure of Spring Branch Limestone with abundant myalinids beneath at ~1134'; upper Avoca Limestone with abundant syringoporoids at ~1157' (both hand level from spot elevation). Exposures along south edge SE 1/4, SW 1/4, sec. 27, T20S, R15E and NE 1/4, NW 1/4, sec. 34, T20S, R15E.

4-8-91

85. Ozawkie Limestone Member exposed in southwest corner of sec. 2 and northwest corner of sec. 11, T20S, R15E, at ~1176' (hand level to spot elevation).

86. Lower Avoca Limestone exposed in creeklet on west side of north-south highway near midpoint, east edge, NE 1/4, SE 1/4, se.c 3, T20S, R15E, at ~1140' (hand level to topographic line). Common, small Zoophycus on top of Avoca Limestone here.

87. Break in slope and Ozawkie float near west edge, mid-point, SW 1/4, sec. 5, T20S, R16E, at ~1195' (hand level to topographic line).

88. Poor exposure of Kereford Limestone Member on north side of east-west road about 150' east of center sec. 10, T20S, R16E, at ~1120' (hand level to topographic line).

89. Sandstone exposed on north side of east-west road near mid-point south edge SE 1/4, SE 1/4, SE 1/4, sec .5, T20S, R16E.

Ottumwa Quadrangle Chris Maples 3-19-90

1. Exposures along east-west dead-end road on north edge NW 1/4, NW 1/4, sec. 3, T21S, R14E. Ozawkie Limestone with some productid-rich layers (collect later for Virgilian brachiopod project) is about 3' thick at ~1098'; Rock Bluff Limestone Member at ~1110'; Ervine Creek Limestone Member at ~1113' (all hand level to spot elevation).

7-1-90

3. Fair-exposure of Curzon(?) Limestone (some Hartford float seen) on west side of north-south road at ~1188' (hand level from spot elevation). Exposure near midpoint, east edge SE 1/4, SE 1/4, sec. 29, T19S, R15E.

3. Fair exposure of Hartford/Curzon Limestone on west side of north-south road at ~1172' (hand level to spot elevation). Exposure about 200' south of northeast corner SE 1/4, sec. 31, T19S, R15E.

4. Poor exposure of Hartford/Curzon as thin veneer capping hill on north side of east-west road at ~1184' (hand level to spot elevation). Same sandstone float from underlying Calhoun Shale seen. Exposure along south edge SW 1/4, SE 1/4, SW 1/4, sec. 32, T19S, R15E.

5. Fair exposure of Ervine Creek Limestone on north side of east-west road at ~1145' (hand level to topographic line). Exposure along south edge SE 1/4, SW 1/4, SW 1/4, sec. 33, T19S, R15E.

6. Fair exposure of Rock Bluff Limestone on south side of east-west road at ~1152' (hand level from spot elevation). Exposure along north edge NW 1/4, NW 1/4, NE 1/4, sec. 9, T20S, R15E.

10-14-90

7. Hartford-Curzon quarry (listed incorrectly as gravel pit on quadrangle), abandoned, in S 1/2, SW 1/4, NW 1/4, sec. 33, T19S, R14E. Base of quarry floor on reddened, undulating (up to 2' of relief) Hartford Limestone Member with abundant paired tubes (pipe-rock like). Major joint set trends N55°-60°E. Base of Hartford estimated at 1085'. Curzon here is phylloidal and estimated to be 7'-15' thick (tops and bottoms observed by slumping and weathering).

10-21-90

8. Very poor exposure of Hartford Limestone Member examined with K.D. Newell at ~1102' (hand level from spot elevation). Exposure along south edge SE 1/4, SE 1/4, SW 1/4, sec. 4, T20S, R14E. Base of unit somewhat approximate owing to poor quality of exposure.

9. Calhoun Shale (upper part) and Topeka Limestone exposed along east-west road along south edge SW 1/4, SE 1/4, sec. 3, T20S, R14E. Limestone bed (dark, crinoidal and "osagite" grainstone with conglomerate at base) about 1'-2' thick in Calhoun Shale at ~1109'. Base of Topeka (Hartford) at ~1128' (both hand level from spot elevation). Hartford here is classic Amblysiphoid-oncolitic packstone/wackestone, overlain by phylloidal limestone. Exposure examined with K.D. Newell. Chert gravel contact at ~1144' (hand level from spot elevation). Phylloidal limestone here is about 5'-7' of 16' thickness of Topeka Limestone.

10. Fair-poor exposure of uppermost Calhoun Shale/lowermost Topeka Limestone at ~1136' (hand level from topographic line). Exposure examined with K.D. Newell along north-south road near midpoint, west edge SW 1/4, SW 1/4, NW 1/4, SW 1/4, sec. 2, T20S, R14E.

11. Chert gravel-Topeka Limestone contact at ~1150' (estimated from topographic map) seen with K.D. Newell in northwest corner SW 1/4, NW 1/4, sec. 11, T20S, R14E.

12. Creek-bed exposure of Rock Bluff Limestone Member examined with K.D. Newell on east side of north-south road, about 100' north of midpoint, west edge sec. 12, T20S, R14E, at ~1094' (hand level to spot elevation). Major joint set measured at about N40°W.

13. Calhoun-Topeka contact exposed along east-west road at ~1178' (hand level from spot elevation). Exposure, examined with K.D. Newell, in southeast corner SW 1/4, SE 1/4, sec. 12, T20S, R14E.

14. Calhoun-Topeka contact in fair-poor exposure on west side of north-south road at ~1173' (hand level from spot elevation). Exposure, examined with K.D. Newell, in northeast corner SE 1/4, NE 1/4, SE 1/4, sec. 12, T20S, R14E.

15. Calhoun-Topeka contact poorly exposed at ~1176' (hand level from spot elevation). Exposure, examined with K.D. Newell, on east side of north-south road near midpoint, west edge NW 1/4, SW 1/4, SW 1/4, sec. 6, T20S, R15E.

11-23-90

16. Rock Bluff-Ervine Creek exposed on east side of north-south road along west edge SW 1/4, SW 1/4, NW 1/4, sec. 33, T19S, R15E. Rock Bluff at ~1137'; Ervine Creek ~1139' (both hand level to spot elevation). Ervine Creek here estimated to be about 5' thick.

17. Rock Bluff-Ervine Creek exposed on east side of north-south road along west edge SW 1/4, SW 1/4, SW 1/4, NW 1/4, sec. 4, T20S, R15E. Rock Bluff at ~1132'; Ervine Creek about 5' thick at ~1134' (both hand level to spot elevation).

18. Avoca-Ozawkie exposed on east and west sides of north-south road. Lower Avoca exposed in creek bed in E 1/2, NE 1/4, SE 1/4, SE 1/4, sec. 8, T20S, R15E, at ~1099'. Upper Avoca (with syringoporoids) exposed in ditch on east side of road at ~1105'; Ozawkie exposed in ditch on east side of road at ~1121' (all hand level from spot elevation). Upper Avoca-Ozawkie exposures along west edge SW 1/4, SW 1/4, NW 1/4, SW 1/4 and NW 1/4, NW 1/4, SW 1/4, SW 1/4, sec. 9, T20S, R15E.

19. Exposures along abandoned north-south road on west edge N 3/4, NW 1/4, sec. 16, T20S, R15E. Sandstone is creek bed at ~1055'; sandstone at ~1068'; Beil at ~1080' (all hand level to spot elevation).

20. Big Springs-Beil exposed at ~1090' (hand level to spot elevation), with abundant myalinids, on both sides of east-west road about 300' west of midpoint, south edge, sec. 9, T20S, R15E.

11-24-90

21. Avoca-Rock Bluff interval exposed along eastern 2/3 of south boundary, sec. 5, T20S, R15E. Lower Avoca exposed in creek bed at ~1089'; Upper Avoca exposed at ~1094' in ditch on south side of east-west road; Ozawkie exposed at ~1115' in ditch on north side of road; excellent exposure of upper Tecumseh Shale in ditch and cutbank of creek north of road; Rock Bluff exposed at ~1042' in ditch on north side of road (Avoca elevations hand level to spot elevation; others hand level from spot elevation). The Ozawkie here is more argillaceous and fusulinid-poor than at other localities seen to date. It is dominated bly brachiopod debris and weathers yellow. The upper Avoca is more fusulinid-rich than generally seen elsewhere, but some syringoporoids are still present.

22. Rock Bluff Limestone exposed at ~1122' (hand level to spot elevation) in SW 1/4, SW 1/4, SW 1/4, SW 1/4, sec. 6, T20S, R15E, along north side of east-west road.

23. Ozawkie Limestone exposed at ~1095' (hand level to spot elevation) in east-west road near midpoint, south edge SE 1/4, SW 1/4, SE 1/4, sec. 6, T20S, R14E.

24. Ozawkie Limestone, more fusulinid rich and "normal" in appearance, exposed in ditch on north side of east-wets road near midpoint SW 1/4, SE 1/4, sec. 7, T20S, R15E, at ~1095' (hand level to spot elevation).

25. Lower Avoca Limestone exposed in ditch on east side of north-south road near midpoint, west edge NW 1/4, NW 1/4, NW 1/4, NW 1/4, sec. 17, T20S, R15E, at ~1081' (hand level to spot elevation). Lower and upper Avoca Limestone exposed south of east-to-west flowing creek near midpoint, west edge NW 1/4, NW 1/4, NW 1/4, sec. 17, T20S, R15E, at ~1082' and 1085', respectively (hand level to spot elevation). Abundant Rhyicoralliums.

26. Ozawkie Limestone exposed on east side of north-south road near midpoint, west edge SW 1/4, NW 1/4, sec. 17, T20S, R15E, at ~1079' (hand level to spot elevation).

27. Spring Branch-Beil interval exposed on west edge, NW 1/4, SW 1/4, sec. 17, T20S, R15E. Spring Branch here seems to be less than 6" thick. I would estimate the Doniphan Shale Member to be <2' thick. Abundant myalinids overlain by abundant chonetids, below the Spring Branch. Spring Branch at ~1084' (hand level to spot elevation).

28. Sandstone, very fine grained, bioturbated, at ~1090', in east-west roadway, about 100' west of northeast corner, NW 1/4, NW 1/4, sec. 29, T20S, R15E (hand level from spot elevation).

29. Very poor exposure of Spring Branch-Beil float along northern edge, NE 1/4, NE 1/4, NE 1/4, NE 1/4, sec. 29, T20S, R15E, at ~1126' (hand level to spot elevation).

30. Sandstone capping hill along east-west road near midpoint, south edge SE 1/4, SW 1/4, sec. 29, T20S, R15E.

31. Spring Branch-Beil interval exposed around corner of new road in NE 1/4, SW 1/4, NE 1/4, SE 1/4, sec. 32, T20S, R15E. Good exposure shows relationship of Spring Branch-Beil interval. Abundant myalinids about 3' below Spring Branch, abundant chonetids between myalinids and Spring Branch. Spring Branch here is about 4" thick, at ~1123'. Doniphan Shale here is about 3' thick. Big Springs-Beil is single massive bed of limestone 1'-1.5' thick, with thinner bedded limestone overlying it, at ~1127' (both hand level from topographic line). New construction has resulted in an open ditch, allowing accurate estimate of chert-gravel veneer at 2'-2 1/2'.

32. Very fine-grained, ripple-marked sandstone and shale in fair-good exposure associated with new road construction in SW 1/4, SW 1/4, SW 1/4, SW 1/4, sec. 28, T20S, R15E. Looks like Stull.

33. Limestone, medium-gray, argillaceous packstone-wackestone, about 4" thick, exposed on east and west sides of south-flowing creek, on north side of east-west road along south edge SE 1/4, SW 1/4, sec. 28, T20S, R15E, at ~1088' (hand level to spot elevation). Is this Clay Creek?

12-1-90

34. Exposure of Rock Bluff Limestone across north-south road near midpoint, west edge NW 1/4, SW 1/4, sec. 13, T20S, R14E, at ~1112' (hand level to spot elevation).

35. Poor exposure of Rock Bluff Limestone across north-south road near midpoint, west edge SW 1/4, SW 1/4, sec. 13, T20S, R14E, at ~1110' (hand level from spot elevation).

36. Poor exposure of Rock Bluff Limestone in roadcut on south side of east-west road near midpoint NE 1/4, NE 1/4, NW 1/4, sec. 23, T20S, R14E, at ~1105' (hand level from spot elevation).

12-2-90

37. Poor exposure of lower Avoca Limestone with large molluscs at ~1148' (hand level from spot elevation), exposed near midpoint, south edge SW 1/4, SW 1/4, sec. 21, T20S, R15E.

38. Spring Branch Limestone poorly exposed at top of road cut on east side of north-south road at ~1101' (hand level to spot elevation). Exposure near midpoint, west edge SW 1/4, NW 1/4, sec. 21, T20S, R15E. Abundant myalinids below Spring Branch in about 2' zone.

39. Spring Branch Limestone poorly exposed on south side of east-west road near midpoint, north edge NE 1/4, NW 1/4, sec. 21, T20S, R15E, at ~1100' (hand level from topographic line). Myalinids seen in ditch below limestone.

40. Lower Avoca and upper Avoca limestones exposed along east-west road near midpoint, south edge SW 1/4, SE 1/4, sec. 16, T20S, R15E, at ~1125' and at ~1130' (both hand level to topographic line). Upper Avoca with common syringoporoids.

41. Big Springs/Beil Limestone exposed in ditch on east side of north-south road near mid-point, west edge NW 1/4, sec. 28, T20S, R15E, at ~1127' (hand level to spot elevation).

12-7-90

42. Exposure of upper part of Topeka Limestone exposed on northwest side of creek near midpoint, east edge, SE 1/4, SE 1/4, sec. 28, T19S, R14E. base below water level. Contact of fusulinid packstone with phylloid algal facies below it at ~1097' (hand level to spot elevation).

43. Uppermost part of Topeka Limestone exposed on both sides of north-south road, especially western edge of SW 1/4, NW 1/4, NW 1/4, sec. 34, T19S, R14E.

44. ?Uppermost part of Topeka Limestone very poorly exposed as mollusc-rich packstone/wackestone underlain (about 2' below) by yellow-brown coated grain and molluscan wackestone. Exposure on east side of north-south road near midpoint, west edge NW 1/4, sec. 10, T20S, R14E. Limestone capped by chert gravel at ~1155' (estimated from topographic map).

45. Hartford Limestone Member exposed in roadcut on both sides of north-south road near midpoint, west edge sec. 10, T20S, R14E, at ~1125'. Exposure of Hartford also on north side of pond in SW 1/4, SW 1/4, NW 1/4, sec. 10, T20S, R14E, at ~1115' (both hand level to spot elevation).

46. Rock Bluff-Larsh/Burroak-Ervine Creek exposed on both sides of north-south road, south of creek, near midpoint west edge NW 1/4, sec. 15, T20S, R14E. Rock Bluff at ~1077', Ervine Creek at ~1080' (both hand level to spot elevation).

47. Rock Bluff-Ervine Creek limestones poorly exposed along north-south road, south of creek, near midpoint west edge NW 1/4, sec. 15, T20S, R14E. Rock Bluff at ~1077', Ervine Creek at ~1080' (both hand level to spot elevation).

47. Rock Bluff-Ervine Creek limestones poorly exposed along north-south road near midpoint west edge NW 1/4, sec. 22, T20S, R14E, at ~1083'; chert gravel at ~1103' (both hand level from topographic line).

48. Hartford Limestone with common amblysiphonid oncolites at ~1112'; chert gravel at ~1122' (both hand level to topographic line). Exposure along east-west road about 200' west of southeast corner SW 1/4, SW 1/4, sec. 9, T20S, R14E.

48. Coated-grain grainstone in Calhoun Shale at ~1113'; Hartford Limestone float at ~1123' (both hand level from spot elevation). Exposures along east-west road on south edge SE 1/4, SW 1/4, SW 1/4, SE 1/4, sec. 9, T20S, R14E.

50. Hartford Limestone exposed in east-west roadway at ~1117'; chert gravel at ~1128'. Exposures along south edge SW 1/4, sec. 3, T20S, R14E (hand level from spot elevation and estimated from topographic map, respectively).

51. Hartford Limestone poorly exposed at ~1124' (hand level to spot elevation). Exposure along east-west road along south edge SW 1/4, SW 1/4, SW 1/4, SW 1/4, sec. 35, T19S, R14E.

52. Hartford Limestone exposed in ditch on north side of east-west road at ~1161' (hand level from topographic line). Exposure near midpoint, south edge SE 1/4, SE 1/4, SW 1/4, SE 1/4, sec. 36, T19S, R14E.

53. Lower Avoca Limestone exposed on west side of north-south road near midpoint, east edge NE 1/4, NE 1/4, sec. 3, T21S, R14E, at ~1079' (hand level from topographic line).

54. Exposures along north-south road from creek bed in SW 1/4, SW 1/4, NW 1/4, NW 1/4, sec. 2, T21S, R14E, along east edge SW 1/4, NW 1/4, sec. 2, T21S, R14E. Zone of abundant myalinids in creek bed at ~1060'; lower Avoca Limestone at ~1085'; fusulinid packstone/grainstone (Ozawkie Limestone) at ~1109' (all hand level to spot elevation).

1-4-91

55. Fossiliferous wackestone/packstone, about 2'-3' thick, light gray, weathers light yellow, weathers into slabs less than 6" thick. Exposure along east side of East Hickory Creek along west edge SW 1/4, SW 1/4, SE 1/4, SE 1/4, sec. 17, T20S, R15E, at ~1049' (hand level to spot elevation). I think this is the Clay Creek Limestone.

56. Fossiliferous, coated-grain grainstone with some minor conglomerate and charcoal-rich layers about 3' thick, weathers into 2 main beds, which then weather into thin (<4") plates. Exposure about 1' above ice level (measured by Corps of Engineers at dam at 1039') at ~1040' near center sec. 25, T20S, R15E. This is the same limestone as at MS55, and I suspect it is the Clay Creek.

57. Sandstone, bioturbated, total about 2'-3' thick, individual beds <1' thick, ripple-marked, exposed near top of lake bank in N 1/2, NW 1/4, SW 1/4, sec. 25, T20S, R15E, at ~1058' (hand level from ice level, measured at 1039' at dam by Corps of Engineers).

58. Rock Bluff-Ervine Creek Limestone Members exposed on east side of north-south road about 1200' north of southwest corner, NW 1/4, sec. 3, T21S, R14E, at ~1140' (hand level from topographic line).

59. Lower Avoca Limestone(?) exposed south of east-west road, on east side of north-flowing creeklet, near midpoint north edge SW 1/4, sec. 33, T20S, R14E, at ~1052' (hand level to topographic line).

60. Rock Bluff Limestone Member exposed in north-flowing creeklet, north of east-west road, near midpoint, south edge SW 1/4, sec. 33, T20S, R14E, at ~1094' (hand level to topographic line).

61. Lower Avoca Limestone at ~1058' (hand level to topographic line), upper Avoca Limestone, with Syringoporoids, at ~1062' (hand level from topographic level). Exposure near center, N 1/2, SE 1/4, sec. 33, T20S, R14E.

62. Lower Avoca Limestone at ~1070' (hand level to topographic line). Exposure on west side of north-south road, near center, W 1/2, SE 1/4, sec. 33, T20S, R14E. The yellow earthy layer in the upper part of the King Hill Shale is directly below the lower Avoca at this locality.

Waverly Quadrangle Chris Maples 4-30-89
MAP STA.

1. Limestone [~2', fusulinid-echinoderm wackestone, weathers yellowish-brown, abundant bioturbation (open holes) in top(?) of lst.] exposed up slope from creek (~90' east, ~220' west of old wooden creek crossing) on road between sec. 22 and sec. 27, center of road on S side SE 1/4, sec. 22, T19S, R17E. Additional exposures seen in hillslopes along both sides of creek and under tree near west edge of stock pond NE SW SE sec. 22, T19S, R17E. Additional limestone on road ~900' west of creek along E-W boundary road between sec. 22 and sec. 27, T19S, R17E (possibly Plattsmouth). Same type of exposure approximately 380' east of next creek west along same road as above (~600' west of other exposure of ?Plattsmouth).

2. Section west in E-W road separating sec. 22 and sec. 27, T19S, R17E from ~2200' east of SW corner sec. 22 to ~1600' east of SW corner sec. 22. ~6' covered; ~2' dense, dark blue-gray limestone with conchoidal fracture (Leavenworth); ~3' covered; 2'+ flaggy, rubbly limestone weathering light-medium yellow (Plattsmouth).

3. Exposure on S side of creek at wooden creek bridge midway along N-S road separating sec. 21 and sec. 22, T19S, R17E. Slumped slabs of ?Plattsmouth over few blocks of ?Leavenworth.

4. Poor exposures in gulleys west of N-S road between sec. 22 and sec. 21, T19S, R17E. Base of Kereford Limestone Member, top of Heumader Shale Member. Exposures of Kereford in road at top of hill. Good partial sections of Heumader in pasture NE NE sec. 21, T19S, R17E. Heumader/Kereford contacts @~475' south of NW corner sec. 22, T19S, R17E and @~800' south of same corner.

5. Exposures west along road up east-facing hillside from Rocky Run along Anderson-Franklin County line 700'-400' east of Coffey County line (E-W road between sec. 14 and sec. 23, T19S, R17E). Lawrence-Toronto contact @~200' west of Rocky Run. Abundant Toronto debris dumped onto creekbank (probably from recently installed pipeline at top of hill).

6. Lawrence-Toronto contact poorly exposed in creek banks on west side of N-S road between sec. 14 and sec. 15, T19S, R17E, approximately 1500' S of NW corner sec. 14, T19S, R17E.

5-1-89

7. East-facing cutbank exposure on South Branch Tequa Creek (SW SE sec. 34, T18S, R17E) approximately 300' north of Coffey County line in Osage County. Toronto Limestone Member exposed over ~2-5' of Lawrence Shale. Toronto is ~9' thick at this locality; the lower 3'-4' is blocky and massive, the upper 5'-6' is very slabby. Plattsmouth Limestone Member is exposed in roadway ~300' west of west creek branch at elevation ~1,122' (hand level to topographic line).
8. Very poor exposure of Leavenworth--lower Plattsmouth limestone members in ditch/hillside north of Agricola-Williamsburg road and west of creek leading into South Branch Tequa Creek (center NE 1/4, sec. 3, T19S, R17E). Leavenworth exposed at elevation ~1120', Plattsmouth at elevation ~1125' (hand level/pace to topographic line).

9. Poor exposure in E-W road west of creek and in ditch/bank north of road west of creek (Kereford Limestone Member). Locality along E-W road between sec. 9 and sec. 16, T19S, R17E approximately 1800'-2200' east of northwest corner of sec. 16. Base of Kereford ~140' west and 180' east of creek/road intersection (pace).

10. Exposure of thin bedded (<2") bioturbated sandstone interlayered with thicker silty shale (<1') at low-water in cattle pond 100-200' east of N-S road between sec. 15 and sec. 16, T19S, R17E. This probably is the upper part of the Heumader Shale Member. Some Kereford float in field along road ~200' north of north edge of pond. Pond is situated SW NW SW NW sec. 15, T19S, R17E. Based on this locality, the Kereford-Heumader contact would be somewhere between 1170'-1180' (compare with MS9-Waverly Quad.).

11. Exposures of Kereford Limestone Member within 200' radius east and south of midpoint (elev. 1158) of E-W road separating sec. 16 and sec. 21, T19S, R17E. Kereford-Heumader contact at ~1163' (handlevel to spot elevation). Lowermost ~1' of Kereford is dense, dark-yellow weathering, laminated sandy dolostone/ dolomitic sandstone with some bioturbation and rare Wilkingia. This unit forms a very small topographic flat on top of the Heumader. This is followed upward by a 1'-2' interval of steepened slope and another flat. This higher interval is composed of slabby, gray, micritic limestone with some bioturbation.

12. Ditch exposures (both sides of road) of Kereford along N-S road separating sec. 16 and sec. 17, T19S, R17E begin 50' south of southeastern corner of NE NE sec. 17. This looks like the Kereford-Heumader contact. Dry pond that parallels road has some slabby limestone at high-water mark, but shale below. Small stock pond ~300' west has abundant Kereford slabs piled on dam. [Fossil Sample (productids)--WAV12/1] Recollected 6-24-89 WAV 12/2

13. Exposures/float in ditch on east side of N-S road separating sec. 9 and sec. 10, T19S, R17E. Heumader-Kereford contact approximately 550' north of section midline (pace). Contact based on relatively sharp change from yellowish, sandy soil to dark, relatively unsandy soil. North of this contact the Heumader is exposed in the east ditch (soft, thin (<1"), slabby, micaceous sandstone and sandy shale). South of this contact, Kereford slabs are relatively common.

14. Topeka-Lawrence contact is south-facing hillslope (SE SW SW, sec. 15, T19S, R17E) north of E-W road separating sec. 15 and sec. 22, T19S, R17E.

15. Heumader-Kereford contact estimated at ~1175' based on: 1) change in slope, 2) float, and 3) subtle change in soil type. Very thin, shaley sandstone outcrops in road ditches @~1170' (hand level to topographic line). Locality along E-W trending road separating sections 10 and 15, T19S, R17E, approximately 500-1000' west of midline.

16. Very poor exposures of Leavenworth and Plattsmouth Limestone members in roadway at elevations 1127' and 1131', respectively (handlevel to topographic line). Section in N-S trending road separating sec. 14 and sec. 15, T19S, R17E, approximately 100' north of midline.

6-24-89

17. Exposure of upper Snyderville through Plattsmouth in gulley south of I-35 entrance range, N 1/2, SW 1/4, SW 1/4, sec. 25, T18S, R17E. Approximately 5' of upper Snyderville exposed; Leavenworth is ~14"-18", wackestone with gastropods common in lower 6", lower contact with Snyderville sharp and undulating (burrowed?), upper contact with Heebner sharp, planar. Leavenworth-Heebner contact at ~1036', Plattsmouth-Heebner contact at ~1041' (both hand-level to spot elevation).

18. Fair exposure of ~1' of ?Kereford limestone on both sides of road and under road? at ~1091' (hand level to spot elevation). Section exposed 850'-950' south of NW corner sec. 36, T18S, R16E, along N-S road between sections 35 and 36. This probably is near the upper Kereford boundary. This map station is extended to midpoint on N-S road between secs. 35 and 36. Base of the Kereford is at ~1077' (hand level from topographic line). Top of Plattsmouth exposed on north side of creek, approximately 200' east of road, at ~1056' (estimated from topographic line). Good brachiopod fauna is collectable from limestone in places, especially at top ~6' above creek level.

19. Exposures along creek and road north and west of low-water bridge. Exposures in SE 1/4, SE 1/4, SW 1/4, sec. 36, T18S, R16E. Base of Kereford at ~1063 (hand level from topographic line). Basal Kereford is quite nodular and fossiliferous at this locality. COLLECTION WAV 19/1 from weathered rubble on southeast side of road, 500' northeast of point where road diverges from Coffey-Osage County line. Upper part of Plattsmouth exposed as 12'-14' cliff beginning at creek level. Top of Plattsmouth at ~1043' (hand level from topographic line).

    (revisited with T.W. Henry - 9-7-89). Collection of Henry 89-4. Linoproductus (a' la' Map Station WAV-12), Juresania, Antiquatonia, Straparollus, small high-spired gastropod, large trochospired gastropod, trilobite pygidium, Septimyalina, Composita, Phricodothyris, ?Girtyella, Wellerella, another terebratulid, Hustedia, Punctospirifer, Neospirifer, Meekella, pectinids, and rare crinoidal debris.

20. Basal Kereford Limestone exposed at ~1086' (hand level to spot elevation) on northwest side of Rock Creek in SE 1/4, SE 1/4, sec. 11, T19S, R16E.

21. Very thinly bedded, poorly cemented, medium-grained, moderately sorted, quartz sandstone with some muscovite and finely comminuted plant debris exposed along E-W road approximately 600' from midpoint between sec. 1 and sec. 12, T19S, R16E, at ~1065' (hand level to spot elevation). Probably a sand in the Heumader (Elgin equivalent?).

11-14-89

22. Dense, light gray, laminated, calcareous siltstone (="Waverly Flagging"), approximately 3' thick, beds less than 3" thick, exposed on W side of N-S road at ~1140' along E edge of NE 1/4, SE 1/4, SE 1/4, sec. 24, T19S, R16E. Kereford?

23. More "Waverly Flagging"; ~15'± exposed along N side of E-W road extending from SE 1/4, SE 1/4, SE 1/4, SE 1/4, sec. 12, T19S, R16E to SW 1/4, SW 1/4, SW 1/4, SW 1/4, sec. 7, T19S, R17E. Base of unit estimated at ~1107' (hand level to spot elevation).

24. Fair-good section along W side of N-S road, eastern boundary of SE 1/4, NE 1/4, NE 1/4, sec. 12, T19S, R16E. Syringoporoid zone in top of Plattsmouth exposed at ~1080'; thin limestone bed (~3") at ~1085'; base of "Waverly Flagging" at ~1093' (all elevations hand level from spot elevation).

11-19-89

25. Probably the Clay Creek Limestone Member of the Kanwaka Shale. Uppermost 9"-1' is dense, massive, light gray-blue mottled brown limestone that makes a prominent, albeit small, bench in roadways. Next ~4' below that is a zone of thin limestone beds (<2" thick) and fossiliferous, calcareous shale that weathers as slope. Exposures in N-S and E-W roadways, S and E of NW corner, sec. 2, T19S, R16E at ~1132' (hand level to spot elevation). This is the base of the massive limestone.

26. Clay Creek as in MS-25 at ~1133' (base of massive limestone; hand level from spot elevation). Reddish fine- to medium-grain sandstone, ripple-marked, some rip-up shale clasts, approximately 2' thick, exposed at ~1144' (hand level from spot elevation). Exposures in N-S roadway approximately 700' north of midline between sec. 2 and sec. 3, T19S, R16E.

27. Clay Creek Limestone Member at ~1140'; massive sandstone at ~1149'; thin sandy interval at ~1170'; Spring Branch Limestone Member at ~1178' (all elevations hand level to spot elevation). Clay Creek and sandstone same as MS-26; sandstone ~3'-4' thick. All Clay Creek exposures in this area have rare-common Orthotetes, Juresaria, Myalinids, chonetids. Spring Branch Limestone Member weathers yellow, platy; is gray where fresh; fusulinids common; shale below limestone has some myalinids and brachiopods.

    (Revisited - 12-2-89) - Spring Branch Limestone with myalinids below exposed in road about 1000' west of northeast corner sec. 10, T19S, R16E at ~1168' (hand level/pace to topographic line); and at ~1175' (hand level to spot elevation) approximately 200' west of same corner.

28. Poor exposure of Spring Branch Limestone at ~1180' (pace to topographic line) approximately 440' south of midline along N-S road between sec. 10 and sec. 11, T19S, R16E.

29. Sandstone (same as exposed above Clay Creek Limestone Member) at ~1154' in N-S road approximately 400' N of midline between NE 1/4 sec. 15 and NW 1/4 sec. 14, T19S, R16E. Field east of here may have good exposures.

30. Hard, thin (<6"), sandy, slightly conglomeratic in places, oolitic limestone in creek bed about 50' S of E-W road (NW 1/4, NE 1/4, NE 1/4, SW 1/4, sec. 14, T19S, R16E) at ~1106' (hand level to topographic line). This is the top of the Kereford and seems to be the most persistent unit towards the south. This marks the base of the Jackson Park Shale Member.

31. Kereford Limestone exposed in creek in W 1/2, NW 1/4, NE 1/4, sec. 23, T19S, R16E. No base or top found, but my gut feeling is that the exposure ~50' south of E-W road along northern edge of stream is closer to the base of the Kereford than the top.

32. Thin bedded (< 1"), ripple-marked, bioturbated, calcareous siltstone exposed in cutbank of creek at ~1148' (hand level to topographic line) in SW 1/4, NE 1/4, NE 1/4, NE 1/4, NW 1/4, sec. 30, T19S, R17W.

33. Exposures along abandoned E-W road along sough edge of eastern 3/4 sec. 21, T19S, R17E. Thin bedded (< 1"), commonly chipping siltstone/very fine grained sandstone about 5' thick overlain by blocky, fine-to medium-grained, dark yellow brown sandstone bed (~1' thick). Thick sandstone bed at ~1185' (hand level to topographic line).

34. Kereford limestone (as "Waverly Flagging") and thin bedded, bioturbated, siltstone/sandstone together; "flagging facies" above siltstone/sandstone and interfingering with it. Exposures along E-W roadway and in small valleys in and along south edge of SW 1/4, sec. 21, T19S, R17E. Base of Kereford and siltstone/sandstone at ~1068' (hand level to spot elevation). Total thickness is ~10-15'. Exposures across the same elevations west of here do not have the "Waverly flagging" facies, but do have the bioturbated siltstone/sandstone. This looks to be the eastern facies equivalent of the Kereford. Exposures around the pond at this locality have a few very well developed Taenidrina and Rhizocorallium and several poorly developed Psaminichoites. Excellent tidal-flat sedimentary structures (flat-topped ripples, wrunzle marks, etc.) exposed on sandstone surfaces. Base of limestone (=Kereford proper) at ~1080' (hand level to spot elevation). No limestone seen on east side of same hill.

35. Poor exposure of Clay Creek Limestone at ~1166', overlain by about 1-2' massive sandstone at ~1172' (both hand level from spot elevation). Exposure on south side of E-W road along southern border of SW 1/4, SW 1/4, sec. 23, T19S, R16E.

36. Kereford Limestone base at ~1095' (hand level to topographic line), based on poor outcrop, break in slope, and float from recently dug ditch along N-S road on north edge of Waverly, Kansas, about 900' north of midline between sec. 14 and sec. 13, T19S, R16E.

37. Kereford Limestone base at ~1124', top at ~1144' (both hand level to spot elevation). Base of Kereford is fossiliferous limestone ~6" thick; middle part is typical "Waverly flagging" (platy, silty to micritic, light gray limestone); upper ~1' is molluscan oolitic limestone with large rip-up clasts of typical "Waverly flagging" lithology. Exposures along E-W road on northern edge of NE 1/4, sec. 18, T19S, R17E.

38. Fossiliferous limestone similar to lowermost part of the Kereford Limestone poorly exposed in E-W roadway along northern edge of NE 1/4, NE 1/4, sec. 7, T19S, R17E at ~1111' (hand level from spot elevation).

39. Abundant Kereford slabs in dam and along north side of farm pond in NW 1/4, NW 1/4, NW 1/4, NE 1/4, sec. 7, T19S, R17E. Lithology looks like top of Kereford or near-top of Kereford. Slabs not present at ~1115 (hand level from spot elevation).

40. Base of Kereford Limestone at ~1072' (hand level to spot elevation). Basal bed ~9"-1' thick with brachiopods and clams; middle part typical "Waverly Flagging" extends to northwest corner sec. 6, T19S, R17E. Top lithology (mollusc-rich grainstone) not seen in place, but stacked in field in northwest corner sec. 6, T19S, R17E. Fair-good Kereford exposure along northern edge of NW 1/4, NW 1/4, NW 1/4, NW 1/4, sec. 6, T19S, R17E.

11-21-89

41. Thin (<4"), yellow-weathering (gray-fresh), fusulinid-rich limestone; platy; weathers into rounded, flattened plates and loaves. Abundant limestone-filled burrows weathered out from underlying shale. Abundant myalinids in underlying shale within 5' of limestone. I think this is Spring Branch Limestone Member of Lecompton Limestone. The shale below would be the Stull Shale Member of the Kanwaka Shale. Exposure on north side of E-W road near midpoint along northern edge of NE 1/4, sec. 3, T19S, R16E, at ~1165' (hand level to topographic line).

11-25-89

42. Basal part of Clay Creek Limestone Member (?) very poorly exposed in E-W road near midpoint of northern edge of NW 1/4, NE 1/4, sec. 34, T18S, R16E at ~1135' (hand level to topographic line).

    (Revisited - 12-2-89) - Looks a bit like Spring Branch instead of Clay Creek (even though no myalinids seen).

12-2-89

43. Clay Creek exposed in ditch on west side of north-south road about 100' south of midpoint between sec. 34 and sec. 35, T18S, R16E, at ~1143' (hand level to spot elevation). Exposure pretty poor.

12-4-89

44. Clay Creek Limestone poorly exposed in creeklet in NE 1/4, SE 1/4, SE 1/4, SE 1/4, sec. 22, T29S, R16E, at ~1150' (hand level to topographic line).

45. Sandstone--yellow-brown, medium-grained, bedded; very reminiscent of the sandstone above the Clay Creek Limestone (within 10' or so). Sandstone poorly exposed from ~1135'-1140' (hand level to spot elevation). Exposure in southwest corner, sec. 14, T19S, R16E.

1-6-90

46. Quarry exposure in NE 1/4, SW 1/4, sec. 25, T18S, R16E. Excellent exposure of thick (about 22') Plattsmouth, overlain by about 16' of Heumader Shale and about 1'-3' of Kereford Limestone. Base of Plattsmouth at ~1044'; base of Heumader at ~1066'; base of Kereford at ~1082' (all hand level to spot elevation). Fairly abundant atripid zone in basal Kereford; some chert seen in Plattsmouth; syringoporoid/oncolitic zone about 4' below top of Plattsmouth; this probably is one of the best Heumader exposures in the area.

4-1-90

47. Abundant Kereford float in farm-pond dam near center, SW 1/4, SW 1/4, SW 1/4, sec. 24, T19S, R16E.

THIS FILE NEEDS TO BE PROOFED

Waverly NW Quadrangle

11-19-89

1. Clay Creek Limestone Member poorly exposed in ditches on both sides of E-W road near midpoint of SW 1/4, SE 1/4, sec. 22, T19S, R16E, at ~1196' (hand level from topographic line).

   (Revisited - 12-3-89) -- This is Spring Branch member with abundant myalinids below.

11-21-89

2. Clay Creek Limestone member of Kanwaka Shale exposed in ditch on south side of east-west road near midpoint of NE 1/4, NW 1/4, sec. 3, T19S, R16E, at ~1138' (hand level to topographic line).

   (Revisited - 12-2-89) -- Looks like Beil Limestone Member (not Clay Creek).

3. Spring Branch Limestone Member exposed in unimproved roadway, about 300' west of northeast corner of sec. 4, T19S, R16E, at ~1179' (hand level from spot elevation).

4. Clay Creek Limestone Member exposed in creek cuts in SE 1/4, NE 1/4, SE 1/4, sec. 4, T19S, R16E at ~1141' (hand level to spot elevation). Some myalinids in shale below the limestone.

   (Revisited - 12-2-89) -- Spring Branch (not Clay Creek) with myalinids below.

   (Revisited - 12-2-89) -- Beil Limestone at ~1155' (hand level from topographic line). This probably makes MS12 the Avoca.

5. Clay Creek Limestone Member exposed in N-S roadway, about 350' north and 300' south of stream crossing near midpoint of east edge sec. 9, T19S, R16E, at ~1133' (south of creek) and ~1135' (north of creek); both elevations hand level from topographic line.

6. Sandstone in creek in SE 1/4, SE 1/4, SW 1/4, sec. 9, T19S, R16E; medium-grained, cross-bedded, about 15± exposed from creek floor to top of creek bank on north side of creek; creek-floor exposure at ~1081' (hand level to spot elevation).

7. Cross-bedded sandstone exposed in creek east of N-S road in SE 1/4, SE 1/4, SE 1/4, SE 1/4, sec .8, T19S, R17E, at ~1071' (hand level to spot elevation).

(Revisited - 12-3-89) -- Sandstone/shale extends to top of hill along west edge of NW 1/4, NW 1/4, NW 1/4, NW 1/4, sec. 16, T19S, R16E.

8. Clay Creek Limestone Member(?) exposed in ditch on east side of N-S road near NW 1/4, NW 1/4, NW 1/4, sec .9, T19S, R16E, at ~1118' (hand level from spot elevation). Another limestone, very poorly exposed but corresponding with a break in slope, exposed near midpoint of east edge of NW 1/4, sec. 9, T19S, R16E, at ~1138' (hand level from spot elevation). Fusulinids fairly common in this limestone; may be Spring Branch. Same unit exposed in ditch on north side of E-W road along southern boundary of SW 1/4, SE 1/4, SE 1/4, SE 1/4, sec. 5, T19S, R16E, at ~1120' (hand level from spot elevation). Abundant myalinids, common brachiopods seen in shale below ~1'- thick massive limestone that marks base of unit. Break in slope, but no outcrop seen at top of hill towards west.

   (Revisited - 12-11-89) - Unit I called Clay Creek earlier is Spring Branch; Spring Branch of earlier call is Beil. Abundant myalinids below Spring Branch.

9. Slight break in slope and poor exposure of sandstone in E-W roadway about 100' east of midline along southern boundary of sec. 4, T19S, R16E, at ~1115' (hand level from spot elevation).

10. Clay Creek Limestone Member exposed in E-W roadway near midpoint of northern edge NE 1/4, sec. 9, T19S, R16E, at ~1132' (hand level to topographic line). Massive limestone (~9" thick) underlain by fusulinid, packstone (~1" thick).

    (Revisited - 12-2-89) -- This is Spring Branch with myalinids below--not Clay Creek.

11-25-89

11. Clay Creek Limestone Member exposed in E-W road at ~1154' (hand level from topographic line). Lower layer ~6" thick, brownish, argillaceous; ~1 1/2' shale between lower limestone and upper limestone; upper limestone beds ~3" thick (3+ beds), weather yellow with brown patches. Shale below lowest limestone bed contains abundant myalinids and lesser amounts of other invertebrates. Exposure about 200' east of midpoint of south edge of SW 1/4, sec. 3, T19S, R16E.

    (Revisited - 12-2-89) -- Spring Branch (not Clay Creek) with myalinids below.

    (Revisited - 12-2-89) -- Clay Creek crosses road at base of hill; exposure at MS11 is Spring Branch; abundant myalinids in shale below limestone.

12. Spring Branch Limestone Member in old pig sty near silo, southeast of barn in SW 1/4, SW 1/4, NW 1/4, sec. 3, T19S, R16E at ~1164' (hand level from spot elevation).

13. Thin mantle of limestone at top of hill, ~1120' (estimated from topographic map) in N 1/2, NW 1/4, SE 1/4, NW 1/4, sec. 33, T18S, R16E. Abundant fusulinids, very small; weathers yellow/orange/brown. Clay Creek?

    (Revisited - 12-2-89) -- Limestone looks much like Spring Branch, but no myalinids found.

14. Exposure in N-S roadway near midpoint between NW 1/4, sec. 33 and NE 1/4, sec. 32, T18S, R16E at ~1116' (hand level from topographic line). Limestone, lower 1/2 slightly reminiscent of Leavenworth, upper half similar to Toronto in weathering. Clay Creek?

    (Revisited - 12-2-89) -- Beil (based in part on interstate cut about 600' northwest of MS14.

11-25-89

15. Thin (<1'), very yellow limestone exposed in N-S roadway about 600' south of midpoint between sec. 32 and sec. 33, T18S, R16E, at ~1140' (hand level to spot elevation). Spring Branch? Box-work weathering common; lot of light gray limestone with common large fusulinids and rare molluscs seen above yellow limestone layer.

    (Revisited - 12-2-89) -- Yellow, punky limestone is in top of King Hill; gray, fusulinid-rich limestone is Avoca.

16. Thin, bioturbated siltstone (<1") in mostly shaly section; thin (<1") molluscan limestone near top of roadcut on south side of WSW-ENE access road, on knob in SE 1/4, SE 1/4, NW 1/4, sec. 32, T18S, R16E at ~1090'; float similar to upper half of Clay Creek(?) at MS14 seen at ~1090' (estimated from topographic map).

    (Revisited - 11-26-89) -- Probable Clay Creek at ~1075' (hand level to topographic line). The implication of this unit here is that MS13, 14, and 15 may be miscorrelated.

    (Revisited - 12-2-89) -- Probably Spring Branch near top of hill.

11-27-89

General Thoughts --> Clay Creek-Avoca interval:

1) This entire interval seems a bit thin in northern Coffey Co. The Clay Creek Limestone Member (Kanwaka Shale) is ~1-2' thick, a single massive bed, overlying dark, chanetid-rich shale in places. The Clay Creek may be missing in places--either cut out by massive sandstones in the Stull Shale Member (Kanwaka Shale) or never deposited (my current guess is the former). Where absent, I will have to map Kanwaka Shale and not show any Clay Creek line.

2) The Spring Branch Limestone Member (Lecompton Limestone) is about 1' thick and consistently overlies a myalinid zone and a thin ($\leq$1") molluscan-sideritic zone in the upper part of the Stull Shale Member (Kanwaka Shale). Ball et al. (1963) noted that the Spring Branch Limestone Member superficially resembled the Toronto, except thinner and more fusulinid-rich crinoid-poor in nature. This seems true of the limestone over the myalinid bed in places--but not always. The yellowish, fusulinid-rich character does hold pretty well, however.

3) If the sequence is correct so far, the Doniphan Shale Member (Lecompton Limestone) is very thin in Coffey County (<5").

4) The Big Springs Limestone Member (Lecompton Limestone) is ~1' thick and "plastered against the bottom" of the Beil Limestone Member (Lecompton Limestone), separated from it by 1' or less of black shale (Queen Hill Shale Member of Lecompton Limestone).

5) Even the Beil Limestone Member seems a bit thin (4-5'), but at least it maintains its general character and a few exposures contain abundant Syringaporoids or Caninia thickets.

6) The King Hill Shale Member (Lecompton Limestone) seems to be a reasonable thickness (~15'-20'). Better yet, the thin, very yellow, boxwork, silty limestone bed (<1') is near the top and directly beneath the Avoca Limestone Member (Lecompton Limestone) or within 1-2' of it.

7) The Avoca Limestone Member is ~1'-2' thick and is light-to-medium-gray, fusulinid-bearing hard limestone; at least in northern Coffey County.

8) Total thickness of Lecompton Limestone is ~5+1+1+5+20+2 (~34'- max thickness) to ~4+1+1+4+15+1 (~26'- min thickness). Currently, I would guess the Clay Creek Limestone Member (where present) to base of Lecompton Limestone to be the most highly variable part of the sequence.

This entire interval remains a problem. Maybe things will straighten-out a bit tomorrow.

11-28-89

17. Excellent shale exposure along southwest side of Long Creek (SW 1/4, SW 1/4, SW 1/4, NE 1/4, sec. 31, T18S, R16E). Thin (<2'), dark, argillaceous, fusulinid-rich limestone at ~1027'. Thin (<3'), slightly less dark, yellow-brown weathering, fossiliferous limestone at ~1043'. Thin veneer (<1'?) of Toronto-like limestone caps hill at ~1088' (all elevations hand level from topographic line). Very steep slopes--exact elevations probably suffer from slumping problems. Lowermost ~15-17' of shale and lowermost of three limestones are only units that are very well exposed.

18. Excellent roadcut on north side of I-35 where it crosses old Highway 75, 2.3 miles north of old Beto Junction (SE 1/4, SE 1/4, NE 1/4, SE 1/4, sec. 36, T18S, R15E to SW 1/4, SW 1/4, NW 1/4, SW 1/4, sec. 31, T18S, R16E). Base exposes 1' of Big Springs, 1' of Queen Hill, and 7' of Beil. Big Springs is dark, massive, single bed, argillaceous, with some fusulinids and "osagia-coated" grains. Queen Hill is black platy shale at base, grading upward to gray shale. Beil is thin bedded (<4"), but massive in lower 5'. Upper 2' is more argillaceous and

19. Massive sandstone in approximately two, 5-foot units (10' total) overlying about 4' (exposed to water level) of silty shale. Base of sandstone is at ~1003'. Dark, slabby, fusulinid-rich limestone exposed above sandstone on south side of road. Limestone weathers flaggy and rubbly in ~2'-3' bed. Base of limestone at ~1025' (both, hand level to topographic line). Section continues from here (midline, north edge, sec. 31, T18S, R16E) eastward for ~1/4 mile. Thin (<6"), yellow, argillaceous limestone at ~1043'. Shale below has numerous chonetids and some Derbyia. Very thin (<1"), yellow, nodule limestone at ~1050'. Very common myalinids and thin (<1"), sideritic, fossiliferous beds (~3) over about a 1' interval at ~1061'. Siltstone bed (about 1'-2' thick) with diverse trace-fossil assemblage, overlain by yellow zone at ~1064'. Limestone, about 5' thick, looks like lower Beil, at ~1080' (all hand level from spot elevation).

20. Clay Creek Limestone Member and upper 3' or so of Jackson Park Shale Member (Kanwaka Shale) exposed in creek bank is SW 1/4, NW 1/4, SW 1/4, SW 1/4, sec. 8, T19S, R16E. Map station continues south along north-south road between SW 1/4, SW 1/4, SW 1/4, sec. 8 and SE 1/4, SE 1/4, SE 1/4, sec. 7, T19S, R16E, then turns west along east-west road along northern edge of NE 1/4, NE 1/4, NE 1/4, sec. 18, T19S, R16E. Clay Creek Limestone Member is massive, fusulinid-rich limestone about 1' thick. Upper Jackson Park Shale Member is very thin-bedded, ripple-marked siltstone to fine-grained sandstone. Clay Creek Limestone Member is at ~1050'. Sandstone in the Stull Shale Member (Kanwaka Shale) is exposed along east side of north-south road at ~1078'. The Spring Branch Limestone Member 9Lecompton Limestone) weathers yellow to yellow-brown, is bout 1' thick, and forms a small bench at ~1089'. The Big Springs Limestone Member (Lecompton Limestone) is about 1' thick and exposed along the south side of the east-west highway between Waverly and Lebo at ~1115' (all elevations hand level to spot elevation, except Big Springs--hand level from spot elevation). Abundant myalinids below Spring Branch Limestone Member.

(Revisited - 2-10-90) - Spring Branch collected for conodonts by Scott Ritter (Oklahoma State University). One 7" x 12.5" bag collected.

(Revisited - 12-3-89) - The unit I called Big Springs may be Avoca instead.

(Revisited - 12-4-89) - Yellow earthy layer present about 3' below Avoca; exposure in NW 1/4, NW 1/4, NW 1/4, NW 1/4, sec. 17, T19S, R16E. This means the King Hill is very thin here.

21. & 22.

Exposures of Clay Creek, Spring Branch, and Beil Limestone Members along north-south road between NW 1/4, SW 1/4, SW 1/4, sec. 32, T18S, R16E and NE 1/4, SE 1/4, SE 1/4, sec. 31, T18S, R16E. Section extended to punky, earthy, yellow, silty carbonate in top of King Hill Shale Member and limestone float at base of Avoca Limestone Member, along north-south road (same one) between the NW 1/4, NW 1/4, sec. 5, T19S, R16E and the NE 1/4, NE 1/4, sec. 6, T19S, R16E. Clay Creek at ~1068'. Abundant chonetids in dark shale float at ~1064' in underlying Jackson Park Shale Member (much plow work along road so this chonetid-call isn't certain). Myalinids and thin, sideritic limestone (about 1' thick) at about ~1088' (Spring Branch, probably). Base of the Beil, forming noticeable bench at ~1105' (all hand level to spot elevation). Top of King HIll/base of Avoca at ~1134' (hand level from spot elevation). Abaca is light gray, fusulinid-bearing limestone float, weathering into small, flattened and rounded cobbles.

21. (Revisited - 2-10-90) - Dark shale below Clay Creek Limestone Member collected for conodonts by Scott Ritter (Oklahoma State University). One 7" x 12.5" bag collected. Abundant chonetid brachiopods collected for brachiopod study with T.W. Henry (USGS) and Ron West (KSU).

23. This is a really strange section. Exposures along north-south road from about 400' north of midpoint to about 1000' south of midpoint between sec. 5 and sec. 6, T19S, R16E. Spring Branch (thin, yellow-weathering, fusulinid-rich limestone, <6" thick) at ~1111', about 300' north and about 400' south of midpoint. Base of Beil at ~1112' about 300' north of midpoint. Beil is about 10' thick, capped by outcrops of the Caninia bioherm with some corals weathered free from matrix. Strange item #1 is the nearly complete absence of Doniphan Shale Member (it is 17' thick at MS21 about 0.8 miles north and only about 1' thick here). Strange item #2 is an apparent repeat of the Spring Branch Limestone Member at ~1102' (all elevations hand level from spot elevation). Two caveats about this apparent repeat of the Spring Branch Limestone Member: 1) the myalinids are not present in the ditches beneath the exposed limestone, although myalinids are very common on the dam and profuse at the other exposures of MS23, and 2) although there is a break in slope here, the limestone outcrop isn't the best, nonetheless I suspect it is real. Is this section faulted?

12-2-89

24. Ozawkie Limestone Member, Deer Creek Limestone exposed on west side of US75 in NW 1/4, NW 1/4, NW 1/4, sec. 2, T19S, R15E, at ~1100' (hand level to topographic line). Slabby, yellowish limestone about 4' thick; fossils generally sparse.

24. (Revisited - 12-11-89) - This is the same unit that is at the top of the top of the I-35 roadcut at MS58. For the moment, I'm calling it Ervine Creek (not Ozawkie).

12-5-89

17. Excellent, large, well-exposed quarry in Plattsmouth Limestone. Plattsmouth is about 8' thick here and overlain by about 7' of very fossiliferous shale. This fossiliferous shale probably is equivalent to the upper slabby Plattsmouth northeast of Waverly, but will be mapped as Heumader. This sequence is capped by about 1'-2' of chert gravel. Base of Plattsmouth at ~1044' (hand level to spot elevation). Quarry is in NE 1/4, NE 1/4, sec. 25, T21S, R15E.

18. Fair Plattsmouth exposure on both sides of east-west road along northern edge of NE 1/4, NE 1/4, NW 1/4, sec. 25, T21S, R15E, anat ~1024' (hand level to spot elevation).

(Revisited - 2-10-90) - Big Springs, Owen Hill, Beil collected for conodonts by Scott Ritter (Oklahoma State University). Four 7" x 12.5" bags and one Caninia-rich slab collected for conodonts by Scott Ritter (1 bag Big Springs; 1 bag dark [=lower] Queen Hill; 1 bag light [=upper] Queen Hill; 1 bag lowermost 1' of Beil).

25. Poor exposures along both sides of abandoned road along north edge NW 1/4, NE 1/4, sec. 4, T19S, R16E. Punky yellow limestone at ~1143'. Syringaporoid coral collected from exposure on east side of pond at ~1162' (WAVNW 25-1) (all elevations hand level from spot elevation). This looks like and Avoca-Severy-Ozawkie sequence. That means the syringoporoid is from the Avoca.

26. Spring Branch with myalinids below poorly exposed on south side of east-west frontage road in SE 1/4, NW 1/4, NE 1/4, sec. 33, T18S, R16E, at ~1131' (hand level/pace from topographic line).

12-3-89

27. Clay Creek-Big Springs/Beil exposed at old Beto Junction. Clay Creek forms limestone bench in creek in SW 1/4, SW 1/4, sec. 7, T19S, R16E, at ~1042'; excellent Stull Shale exposure in ditch along N 1/2, NW 1/4, NW 1/4, NW 1/4, NW 1/4, sec. 18, T19S, R16E with abundant myalinids and Spring Branch Limestone at ~1070'; basal Big Springs/Beil poorly exposed along SE 1/4, SE 1/4, Se 1/4, SE 1/4, sec. 12, T19S, R15E, at ~1076' (all elevations hand level to spot elevation).

27. (Revisited - 2-10-90) - Clay Creek collected for conodonts by Scott Ritter (Oklahoma State University). Two 7" x 12.5" bags collected.

28. Yellow, earthy layer at base of Avoca Limestone at ~1095' (hand level to spot elevation). Exposure in and along east side of north-south road about 250' north of midpoint between sec. 13, T19S, R15E and sec. 18, T19S, R16E. Nice tiered syringoporoids exposed near top of Avoca at this locality; collection: WAVNW 28-1 is one of these syringoporoids.

29. Thin (±1'), fusulinid-rich limestone in and along north-south roadway on both sides of hill between SE 1/4, SE 1/4, sec. 13, T19S, R15E and SW 1/4, SW 1/4, sec. 18, T19S, R16E, at ~1138' (hand level from spot elevation). This is the same unit as at MS3 and I'm not sure if this is Ozawkie or the thin limestone in the upper Tecumseh (~0 st. equivalent).

(Revisited - 12-12-89) - Upper Ozawkie in east-west road west of northeast corner sec. 24, T19S, R15E. Same on north-south road north of this locality.

12-3-89

30. Exposures along creek banks and in east-west road near midpoint between SW 1/4, SW 1/4, sec. 18, T19S, R16E and NW 1/4, NW 1/4, sec. 19, T19S, R16E, at ~1110' (hand level to spot elevation). This is the Avoca and the yellow, earthy limestone at base.

(Revisited - 12-12-89) - Lower Ozawkie at top of hill between MS50 and MS31, near midpoint of north edge NW 1/4, sec. 19, T19S, R16E, at ~1128' (hand level from spot elevation).

31. Avoca Limestone and yellow, earthy layer exposed at ~1113' (hand level from spot elevation). Looks like top of Beil exposed under tree near spot elevation. Pipeline dug through Beil has Big Springs and Queen Hill float. Exposure along east-west road on south edge of SE 1/4, SE 1/4, SW 1/4, sec. 18, T19S, R16E. Beil estimated at ~1085'--based on general thickness and float near pipeline.

31. Beil Limestone Member at ~1095'; Avoca Limestone Member and yellow, earthy layer at ~1117' (both hand level to spot elevation). Beil exposure looks like middle part of Beil. Exposure along north side of NE 1/4, NE 1/4, sec. 19, T19S, R16E on east-west road.

33. Thin (~2'), fusulinid-rich limestone (same as MS29 and MS3) exposed at ~1153' (hand level from spot elevation) on east-west road near midpoint, south edge SW 1/4, SW 1/4, sec. 17, T19S, R16E. I am calling this Ozawkie for the moment.

34. Exposure along north-south road on east edge NE 1/4, SE 1/4, sec. 17, T19S, R16E; Spring Branch Limestone Member with myalinids below at ~1121'; Beil Limestone Member at ~1128'; Avoca Limestone Member with yellow, earthy layer at ~1148' (all hand level from spot elevation).

35. Flat-topped, ripple-marked and wrinkle-marked, thin-bedded (<2"), fine- to medium-grained sandstone; much like that occurring under the myalinid bed west of Waverly (Waverly trace-fossil locality, Nebraska Geological Survey Guidebook, 1989) except few trace fossils (increased grain size?). Exposure in abandoned road near center sec. 22, T19S, R16E at ~1175' (estimated from topographic map).

36. Beil(?) Limestone very poorly exposed along northwest side of abandoned railroad grade is NE 1/4, NE 1/4, SE 1/4, sec. 21, T19S, R16E, at ~1204' (hand level to spot elevation).

37. Avoca(?) Limestone exposed in access road near midpoint of northern boundary NE 1/4, NW 1/4, sec. 21, T19S, R16E, at ~1196' (hand level from topographic line). Some bryozoans, brachiopods, and myalinids seen.

(Revisited - 12-4-89) -- This probably is Ozawkie Limestone (not Avoca).

38. Medium-grained, cross-bedded, slightly conglomeratic sandstone with casts of relatively large (>6" long) plant debris; sandstone fines and thins upward through about 10' of exposure on access road in SE 1/4, SW 1/4, SW 1/4, sec. 8, T19S, R16E, at ~1070' (hand level to spot elevation).

39. Avoca Limestone(?) exposed at ~1115';(?) Ozawkie Limestone exposed at ~1142' (both hand level from spot elevation). This could be Big Springs-Avoca sequence. Exposure along west edge of NW 1/4, SW 1/4, sec. 17, T19S, R16E.

12-4-89

40. Exposure one east side of creek, north of east-west road in SW 1/4, SE 1/4, SE 1/4, sec. 11, T19S, R15E of Clay Creek Limestone Member at ~1054' (hand level to topographic line).

41. Avoca Limestone as dense, dark limestone with syringoporoids, about 6' above the yellow, earthy layer, at ~1170' (hand level to topographic line). Exposure in gulley along W 1/2, SE 1/4, SW 1/4, SW 1/4, sec. 16, T19S, R16E.

42. Beil and Avoca extremely poorly exposed along east-west road on north edge NW 1/4, NW 1/4, NE 1/4, sec. 21, T19S, R16E, at ~1145' and 1170' (respectively; both hand level to spot elevation).

43. Avoca with yellow soil #3' below; Avoca is at ~1202' (hand level from spot elevation) about 250' east of midpoint of south edge sec. 21, T19S, R16E (exposure is very, very poor).

11-19-89

39. Abundant Kereford slabs in dam and along north side of farm pond in NW 1/4, NW 1/4, NW 1/4, NE 1/4, sec. 7, T19S, R17E. Lithology looks like top of Kereford or near-top of Kereford. Slabs not present at ~1115 (hand level from spot elevation).

40. Base of Kereford Limestone at ~1072' (hand level to spot elevation). Basal bed ~9"-1' thick with brachiopods and clams; middle part typical "Waverly Flagging" extends to northwest corner sec. 6, T19S, R17E. Top lithology (mollusc-rich grainstone) not seen in place, but stacked in field in northwest corner sec. 6, T19S, R17E. Fair-good Kereford exposure along northern edge of NW 1/4, NW 1/4, NW 1/4, NW 1/4, sec. 6, T19S, R17E.

12-4-89

44. Yellow soil and Avoca float at ~1200' (estimated from topographic map) on hill about 500' west of midline, southern boundary sec. 21, T19S, R16E.

45. Avoca Limestone with limestone float above exposed along east-west roadway on south edge of SE 1/4, SE 1/4, SE 1/4, SE 1/4, sec. 20, T19S, R16E, at ~1173' (hand level from spot elevation).

46. More Avoca with yellow soil/float below; Avoca at ~1165' (hand level topographic line), along southern edge of SW 1/4, SE 1/4, SE 1/4, sec. 20, T19S, R16E.

12-10-89

47. Avoca Limestone (dense, dark-brown/yellow weathering, fusulinid-rich limestone bed about 1' thick) with yellow soil about 3' below at ~1183' (hand level from spot elevation). Exposure along east-west road about 100' east of midline, south edge sec. 20, T19S, R16E.

    (Revisited - 12-10-89) - This is Ozawkie, not Avoca.

48. Stull-Avoca exposure along west side of north-south road. Ditch-digging activity has exposed, in order, Stull (with abundant myalinids and fine-grained, trace-fossil rich, ripple-marked siltstone), Spring Branch Limestone, Doniphan Shale (appears very thin here), Big Springs Limestone, Queen Hill Shale, Beil Limestone, King Hill Shale (with hand, earthy, yellow layer near top), and Avoca Limestone. Elevations are somewhat generalized (all hand level to spot elevation), but clearly within 5' of actual values. Exposure from about 800' north to about 200' south of midpoint, west boundary, sec. 20, T19S, R16E. Spring Branch at ~1110'; Big Springs-Beil at ~1114'; thin (<6"), slabby (<1"), mollusc-rich limestone in King Hill Shale at ~1129'; Avoca Limestone (about 3' thick) at ~1142', with hand yellow float below. Beil is about 5' thick at this locality.

49. Yellowish, fusulinid-rich limestone (estimated to be about 1' thick); very similar to Spring Branch in general character; some fusulinid-limestone-filled burrows seen in float. Limestone occurs as thin veneer on hill along west edge SW 1/4, NW 1/4, SW 1/4, sec. 20, T19S, R16E, at ~1158' (hand level from topographic line). Is this Ozawkie? Additional material along top of ditch, west of road, indicates the entire unit may be thicker than estimated, but individual beds are about 6" thick or less.

50. Avoca-Ozawkie; Avoca at ~1157', Ozawkie at ~1176'. Exposures along east-west road on east side of hill in SW 1/4, SW 1/4, sec. 20, T19S, R16E and NW 1/4, NW 1/4, sec. 29, T21s, R16E (hand level to spot elevation). Large, well-preserved pinnid and Wilkingia from Avoca (COLLECTION: WAVNW 50-1, 50-2).

51. Ozawkie Limestone, abundant yellow soil below, exposed on south side of east-west road, near midline of north boundary, sec. 30, T19S, R16E, at ~1162' (hand level from topographic line).

12-11-89

52. Clay Creek Limestone exposed at midpoint, east edge sec. 13, T19S, R15E, abundant float in SW 1/4, SW 1/4, SW 1/4, NW 1/4, sec. 13, T19S, R15E; outcrop poor, but good elevation possible, at ~1050' (stand on spot elevation).

53. Sandstone in creek and holding up hill along east-west road near midpoint, north edge, sec. 12, T19S, R15E. Some Clay Creek float seen, but its position is unclear (may be ~1035').

54. Sandstone (much like sandstone above Clay Creek) at ~1050', rare Clay Creek float below sandstone. Exposure on south side of east-west road, about 600' west of northeast corner, sec. 12, T19S, R15E.

55. Excellent exposure of about 15'-thick sandstone, massive, some crossbedding (dip toward northwest), base at ~1016' (hand level to topographic line).

56. Exposure of 20'-25'- thick sandstone, base at ~1047', along east-west road on north edge of NE 1/4, NE 1/4, NW 1/4, sec. 7, T19S, R16E (hand level to spot elevation).

57. Clay Creek Limestone and overlying sandstone exposed in and along north-south roadway near midpoint of east edge SE 1/4, sec. 5, T19S, R16E; Clay Creek at ~1092', sandstone at ~1106' (hand level to spot elevation). I'm suspicious that this sandstone in the Stull Shale cuts out the Clay Creek where the sandstone is thick (it is about 3' thick at this locality).

58. Excellent exposure of what I think is Avoca-Ozawkie along I-35 roadcut extending from bridge over Frog Creek (NW 1/4, NE 1/4, NE 1/4, SE 1/4, sec. 4, T19S, R15E) to about N 1/2, NW 1/4, NW 1/4, SW 1/4, sec. 3, T19S, R15E. Avoca Limestone at ~1063'; overlain by about 14' of shale; this is overlain by about 6' of yellow, earthy, sparsely fossiliferous, argillaceous limestone that weathers more like a shale; this may be the base of the Ozawkie at ~1079', if so, many of the other Ozawkie localities are taken on the upper limestone of 2 limestone beds, also exposed here at ~1104', and about 5' thick. Interval between two Ozawkie beds has about 4' thick lenticular sandstone and shale (all elevations, hand level to spot elevation).

(Revisited - 12-11-89) - Section along north-south road (SW 1/4, NW 1/4, .SW 1/4, sec. 3, T19S, R15E) exposes sandstone in Oskaloosa, Rock Bluff Limestone Member, a covered interval, and then Ervine Creek Limestone member. The Ervine Creek is what I called the upper bed of Ozawkie at MS58 (on I-35). Rock Bluff at ~1096 (hand level to spot elevation).

(Revisited - 12-12-89) - Unit I called Avoca is lower Ozawkie; unit I called Ozawkie is upper Ozawkie.

59. Sandy shale and sandstone exposed along east-west road on northern edge of NW 1/4, NW 1/4, sec. 10, T19S, R15E (no limestone seen but dark, non-sandy soil seen at ~1151' estimated from topographic map).

60 Whitish, slightly fossiliferous limestone; weathers into slope, at ~1126' (estimated from topographic map), near midpoint, eastern boundary sec. 10, T19S, R15E, along new north-south US-75. Ervine Creek?

61. Hartford/Curzon at ~1176' (hand level to bench work) exposed in east-west roadcut near midpoint of northern edge of sec. 15, T19S, R15E. The Curzon here certainly doesn't have the profuse fusulinids it has near Lebo, Kansas. This requires some serious rethinking of MS58.

62. Exposure on hill near center, northern line of NE 1/4, NW 1/4, sec. 3, T19S, R15E, along east-west road. Same dark, large-fusulinid-rich limestone (about 1'-2' thick) overlain by dense, very sparsely fossiliferous, earthy, yellow limestone as seen at MS58 on I-35. Dark limestone at ~1064', earthy; yellow limestone at ~1075' (hand level to topographic line). For the moment, I will call these Avoca-Ozawkie (as before), but others report these two to be Ozawkie. This may require a change on my part later.

(Revisited - 12-12-89) - Unit I called Avoca is lower Ozawkie; unit I called Ozawkie is upper Ozawkie.

63. Excellent Ervine Creek exposure on US75, near midpoint of west edge of SW 1/4, SW 1/4, sec. 14, T19S, R15E, at ~1110' (hand level from topographic line).

(Revisited - 1-2-90) - I goofed. When I first visited MS63, I didn't take into account the new road-bed buildup (not reflected on map). Also, because of the snow cover, I missed the upper Ozawkie limestone, the Rock Bluff, and the Larsh-Burroak Shale. Ervine Creek at ~1124'; Rock Bluff at ~1116'; upper Ozawkie at ~1106' (hand level from topographic line).

(Revisited - 2-10-90) - Rock Bluff, Larsh-Burr Oak, Ervine Creek collected for conodonts by Scott Ritter. 7" x 12.5" bags collected (1 bag each from Rock Bluff, Larsh-Burr Oak, and lower part of Ervine Creek).

64. Massive, 2-foot limestone exposed at ~1075', this limestone is dark, weathers yellow, and generally devoid of fossils. Another dark, dense limestone occurs at ~1087', this one has black clasts(?) in it (hand level to spot elevation for both). Exposure in creek and along east-west road on northern edge of NE 1/4, NW 1/4, sec. 23, T19S, R15E. Dense, yellow-weathering, fusulinid-rich limestone and yellow soil at ~1104' (hand level from spot elevation); the limestone here is seen only in float. Is this the Avoca-Ozawkie interval?

65. Beil, hand, yellow, earthy unit in King HIll; and Avoca; all very poorly exposed in north-south road near midpoint of eastern boundary NE 1/4, sec. 14, T19S, R16E, at ~1066', 1072', and 1080', respectively (hand level from topographic line).

66. Avoca Limestone (dense, medium-dark to light colored, fusulinid-rich limestone), exposed on both sides of valley along north-south road on west edge of NW 1/4, NW 1/4, SW 1/4, sec. 13, T19S, R15E, at ~1083' (hand level to spot elevation).

67. Hard yellow layer in King Hill Shale; Avoca Limestone; and overlying, thin, dense limestone (< 1'), at 1080', 1084', and 1091', respectively. Exposure along west edge of SW 1/4, SW 1/4, SW 1/4, sec. 13, T19S, R15E (all hand level to spot elevation).

(Revisited - 2-10-90) - Avoca and Ozawkie limestones collected for conodonts by Scott Ritter (Oklahoma State University). Three 7" x 12.5" bags collected, 1 each from Avoca; lower Ozawkie and upper Ozawkie. Syringoporoids seen in both layers of Ozawkie. WAVNW 64-1 is syringoporoid from upper Ozawkie.

General Thoughts: Ok, time to try to straighten this mess out. Both O'Connor (1955) and Stallard (1966) report a double limestone for the Ozawkie. O'Connor noted that the upper limestone typically is "...2 to 6 feet of light-buff to yellow-brown somewhat impure massive limestone that weathers in irregular shelly slabs" (O'Connor, 1955, p. 15). Stallard noted the upper unit was "...buff to brown, impure limestone..." (Stallard, 1966, p. 27). I have no problem with the yellowish, earthy limestone being Ozawkie. The key is whether or not the dark, large-fusulinid-rich limestone 10'-15' below it is also Ozawkie or is the Avoca.

O'Connor noted that the lower limestone was "...5 to 7 feet of light gray-white, gray, or blue-gray massive limestone" (O'Connor, 1955, p. 15). Stallard noted that the basal limestone was 2 to 7 feet thick and light gray, massive, and dense. Clearly, I need an exposure of Beil-Ozawkie to straighten this out (because I'm just too damn stupid otherwise).

12-12-89

68. Yellow, fusulinid-rich/abundant limestone exposed in east-west road near midpoint of south edge SE 1/4, sec. 23, T19S, R15E (same limestone as uppermost bed at MS64), exposed at ~1123' (hand level from spot elevation). Dark, dense, fusulinid-very-poor, yellow-weathering limestone about 1' thick at ~1103' (hand level from spot elevation). Ok, I'm convinced. These two limestones are the Ozawkie.

69. Lower Ozawkie Limestone exposed in north-south road near midpoint, west boundary, SW 1/4, sec. 24, T19S, R15E, at ~1100' (hand level from topographic line).

70. Avoca-Ozawkie Limestones exposed in creek and along east-west road along southern edge of SE 1/4, SE 1/4, SW 1/4 and SW 1/4, SW 1/4, SE 1/4, sec. 13, T19S, R15E. Top of Avoca at ~1098'; lower Ozawkie at ~1108'; upper Ozawkie (fusulinid-rich limestone) at ~1131' (all hand level to or from spot elevation).

71. Exposure in east-west road near midpoint of northern boundary NW 1/4, NE 1/4, sec. 36, T18S, R15E. Limestone is about 6' thick, looks like Beil, base at ~1045' (hand level to topographic line).

72. Exposure of 12-15-foot-thick sandstone and shale along creek and east side of north-south roadway on north side of small bridge near midpoint, west boundary, SW 1/4, NW 1/4, sec. 1, T19S, R15E; has at ~1034' (hand level to spot elevation).

73. Avoca Limestone exposed on north-south road in gulley on northwest side of bridge (exposure in NE 1/4, SE 1/4, SE 1/4, SE 1/4, sec. 33, T18S, R15E), at ~1146' (hand level to spot elevation - benchmark not found).

1-1-90

74. Poor exposure of Ervine Creek(?) Limestone exposed on south side of east-west road near midpoint of north edge of NE 1/4, sec. 22, T19S, R15E, at ~1134' (hand level to topographic line).

75. Sandstone, about 6" thick, in Calhoun Shale at ~1109'; Hartford/Curzon at ~1175' (both hand level to spot elevation). Exposure in ditch on south side of east-west road near midpoint of north edge of NW 1/4, NW 1/4, sec. 22, T19S, R15E.

76. Thin (about 6"), bioturbated sandstone exposed in roadway at at ~1160' (sandstone in Calhoun Shale). Exposure about 200' south of midpoint, eastern edge, sec. 16, T19S, R15E (hand level to spot elevation).

77. Hartford/Curzon exposed in ditch on west side of north-south road at ~1191' (hand level from spot elevation), near midpoint, east edge, NE 1/4, sec. 21, T19S, R15E.

1-2-90

78. Exposures (generally poor) of thin (<5'), thin-bedded (<6"), yellowish-weathering, light-gray grainstone; looks like Ervine Creek, at ~1142' (hand level to topographic line). Several exposures in east-west roadway along southern edge of SW 1/4, SE 1/4, SE 1/4, sec. 22, T19S, R15E.

79. Hard, dense, single bed of limestone about 9"-1' thick; fusulinids common; some coated grains; small phylloidal texture; medium-gray color; my current guess is that this is the Rock Bluff. Exposure in east-west road near midpoint of south edge SE 1/4, SW 1/4, sec. 22, T19S, R15E, at ~1135' (hand level from topographic line). The Rock Bluff superficially resembles the Leavenworth, but contains more fusulinids, coated-grains, and "phylloidal fragments", and in lighter colored than the Leavenworth (and Big Springs, Avoca, or lower Ozawkie).

80. Dark, fusulinid-rich limestone at ~1102'; light-gray yellow-weathering, fusulinid-rich limestone at ~1135' (both hand level from topographic line). Exposure in east-west road along southern edge of SW 1/4, SW 1/4, sec. 24, T19S, R15E. The lower limestone could be the Avoca and the upper one the upper Ozawkie. If so, I've screwed the pooch at MS68 and 69. For now, it's lower and upper Ozawkie.

81. Upper Ozawkie limestone at ~1140' (hand level from spot elevation); poorly exposed in east-west road near midpoint, southern boundary, sec. 24, T19S, R15E.

82. Fair-poor exposure of Ervine Creek Limestone, mainly on east side of US75, near midpoint of west boundary of SW 1/4, SW 1/4, sec. 23, T19S, R15E, at ~1146' (hand level from topographic line).

5-13-90

83. Upper Avoca and Ozawkie limestones on east side of US 75, along west edge SW 1/4, NW 1/4, sec. 23, T19S, R15E. Upper Avoca at ~1090' (hand level to topographic line); Ozawkie at ~1115' (hand level from topographic line).

83. (Revisited - 5-13-90) - This continues to be part of that same Avoca-Ozawkie problem I've been having. Currently, this is the sequence as I understand it (from top downward):

9) Rock Bluff Limestone
8) shale (< 10')
7) yellow, earthy limestone with Linoproductus (< 3')
6) shale (< 20')
5) yellow-weathering, fusulinid-rich limestone (< 3')
4) shale (< 20')
3) dark, fusulinid-rich limestone with syringoporoids (< 2')
2) shale (5-20')
1) dark, fusulinid-bearing limestone (< 2')
0) yellow, earthy limestone (< 1') overlain by 3-5' of shale

Units 1-3 are the Avoca; 4 is the _____; 5 is the Ozawkie; 6-8 is the _____(?). Unit 7 is rarely seen, but is almost exactly like the limestone in unit 0 (King Hill Shale), except with numerous Linoproductus. A major question for me at the moment is whether to call unit 7 part of the Ozawkie. Basically, I have 5 limestones and 2 names.

Waverly SE Quadrangle Chris Maples

4-30-89

1. Base of Plattsmouth Limestone Member exposed in road south of lowest spot. Locality is ~800' north of center of section line between sec. 26 and sec. 27, T19S, R17E. Handlevel from low spot in road (and pace). Plattsmouth underlain by ~18' green-gray silty shale with thin (<6") sandstone layers that weather brick red (exposed in rill in road)--?Snyderville--> if so, where is Leavenworth? Same sequence exposed in road (not as well) ~1200' north of MS1. *This sequence may be Toronto-Lawrence instead.

2. Top of change in slope is base of Toronto Limestone Member at approximately 100' north of small pond on east edge of road (along boundary road between sec. 26 and sec. 27, T19S, R17E, approximately 1800' north of SE corner of sec. 27).

3. Thin limestone veneer float at top of steep slope near old house and barn--> Toronto/Lawrence contact (~800' west of SE corner section 27 on E-W road between sec. 27 and sec. 34, T19S, R17E).

5-1-89

4. Abundant limestone float in road gulleys and adjacent pasture land approximately 150' south of creek crossing (pace) at elevation ~1125' (hand level from topographic line). Probably Toronto-Lawrence contact. Locality is approximately 1700' north of southwest corner sec. 27, T19S, R17E along N-S road separating sec. 27 and sec. 28, T19S, R17E.

5. Exposure on steep, north-facing hill along N-S trending road separating sec. 33 and sec. 34, T19S, R17E, approximately 600' north of midline. Exposure is in relatively freshly scraped, ungraveled road. Section extended approximately 500' downstream (east) to pick up top of Toronto Limestone Member at elevation ~1120' (hand level to topographic line). Toronto is overlain by greenish, clayey Snyderville Shale Member (~8' very poorly exposed), 2' of Leavenworth Limestone Member (elev. ~1128'), ~3' of Heebner Shale Member (some black shale fragments in road debris), and 3' to top of hill Plattsmouth Limestone Member (elev. ~1133').

6. Next creek valley due south from MS5. Poor exposures of upper Snyderville, Leavenworth, and Plattsmouth on both sides of creek valley approximately 400'-800' north of southwest corner of sec. 34 along N-S trending road separating sec. 34, T19S, R17E. Base of Plattsmouth at elevation ~1145'; base of Leavenworth at elevation ~1140' (hand level from topographic line). Double check with pacing indicates that road-level at creek crossing is now ~1134' (not ~1125' as shown on topo).

7. Toronto-Leavenworth contact at elevation ~1115' (hand level and pace from creek and topographic line). Very poor exposure and change of slope in road between sec. 3, T20S, R17E and sec. 34, T19S, R17E, approximately 500' east of midline. Change in color from sandy yellow to light gray in road ~8' below estimated contact.

8. Toronto-Lawrence contact in roadway based on: 1) change in slope, and 2) Lawrence exposure in creek cutbank north of road. Exposure in E-W trending road separating sec. 34, T19S, R17E and sec. 3, T20S, R17E, approximately 900' east of southwest corner of sec. 34. Elevation estimated to be 1120'.

9. Sandstone hill in Lawrence Shale (Ireland?) in NE NW sec. 2, T20S, R17E.

5-2-89
Hand level was out of whack, but pacing, back-leveling, and correction for topography corrected for bad level.

5-12-89
10. Very poor exposures along freshly dozed field-access road (east boundary, NE 1/4, SE 1/4, sec. 3, T20S, R17E). Highest definitive sandstone outcrop at ~1097' (hand-level to topographic line), sandstone float and sandy soil to base of hill (Ireland?). Shale?/covered interval for next 43' (hand level to topographic line); possible very thin limestone bed (extra float in an odd place) at ~1111' (hand level to topographic line). Base of limestone (Toronto) at ~1140' (hand level/pace to topographic line).

11. Toronto Limestone Member at ~1128' (hand level from spot elevation) poorly exposed in roadway ~320' north of southwest corner, sec. 2, T20S, R17E.

12. Coal smut/highly weathered coal (~9" thick) at ~1103' (hand level to spot elevation). Exposure on dozed hillside in SW 1/4, SE 1/4, SE 1/4, SE 1/4, sec. 3, T20S, R17E (see general station 26-coal called "Upper Williamsburg," sampled in 1955 for germanium study).

13. Fair exposure in N-S road and adjacent gullies of Lawrence Shale-Toronto Limestone Member contact at ~1128' (hand level from topographic line for all elevations at this map station). Badly topographic line for all elevations at this map station). Badly weathered coaly smut at ~1102'. Very poorly exposed nodular limestone at ~1110'. Leavenworth Limestone Member exposed in gulley at ~1152'. Plattsmouth Limestone Member very poorly exposed in roadway (as abundant float) at ~1156'. Section is along east boundary between NW sec. 11 and NE sec. 10, T20S, R17E. Lawrence Shale fairly well exposed in west gulley along road-clayey shale with thin siltstone/sandstone stringers.

14. Exposure along E-W road between sec. 3 and sec. 10, T20S, R17E beginning ~700' of southeast corner of sec. 3 and extending ~2,700' to top of hill. Toronto Limestone Member exposed at ~1130' (hand level to topographic line). Leavenworth Limestone Member exposed at ~1146', Plattsmouth Limestone Member exposed at~1150' (hand level from topographic line). Sandstone float and sandy soil exposed from ~1170' to top of hill (~1202'). Thin-medium bedded sandstone caps hill-->1200'-1202' (hand level from topographic line).

Random Thought-->So far, based on where I am able to recognize a big slug of sandstone in the Lawrence Shale, the overlying Toronto Limestone Member is 10-25' higher than in sections where sandstone has not been seen. The next series of map stations will test this idea a bit.

15. E-W road between SW 1/4, SW 1/4, sec. 11, T20S, R17E and NW 1/4, NW 1/4, sec. 14, T20S, R17E. Plattsmouth limestone (at ~1156') appears to be holding up the hill. Grubby, very poor exposure of Toronto limestone in road at ~1135' (hand level to spot elevation). Leavenworth at ~1152'.

16. E-W road along middle 1/2 mile between sec. 10 and sec. 15, T20S, R17E. Steam cuts on west edge of MS16 expose Lawrence Shale. Toronto limestone at ~1128' (hand level to spot elevation). Leavenworth limestone at ~1158' (hand level/pace from spot elevation). Plattsmouth limestone at ~1162' (hand level/pace from spot elevation).

17. Knuckleball. Very thin-bedded, nodular limestone (<2") with abundant bellerophontids (SAMPLE WAVSE 17-2). Very poorly exposed at ~1178'. This is overlain by conglomeratic, sandy limestone (~6" exposed in place). Top of hill with sparse float of conglomeratic limestone and dense, Leavenworth-like limestone but with reddened (slightly) fossils (SAMPLE WAVSE 17-2). Exposure along E-W road on south boundary of SW 1/4, SW 1/4, SE 1/4, sec. 33, T19S, R17E. Very sandy soil below the bellerophontid limestone bed. I think Leavenworth-like float is indeed weathered Leavenworth. But why up on this hill?

18. Leavenworth and Plattsmouth limestones at ~1139' and ~1144' (hand level from topographic line). Exposures in creek along N-S road 650'-750' south of northwest corner of sec. 3, T20S, R17E (poor-fair exposures).

19. Leavenworth and Plattsmouth limestones at ~1142' and ~1147' (hand level to spot elevation). Poor exposures along N-S road separating NW 1/4, NW 1/4, NW 1/4, sec. 10, T20S, R17E from NE 1/4, NE 1/4, NE 1/4, sec. 9, T20S, R17E.

20. Good exposure of Leavenworth/upper Snyderville at ~1139'. Plattsmouth float abundant, base of Plattsmouth estimated to be at ~1144'. Leavenworth exposed on northwest edge of low stock pond in NW 1/4, NW 1/4, SW 1/4, sec. 10, T20S, R17E.

21. Very good exposure of upper Lawrence Shale section from creek to top of hill on N side of E-W rod separating the NW 1/4, NW 1/4, NE 1/4, sec. 16, T20S, R17E from SW 1/4, SW 1/4, SE 1/4, sec. 9, T20S, R17E. Approximately 4"-6" coal smut and badly weathered coal at ~1094' (hand level to spot elevation). Toronto caps hill on N side of road (very thin veneer, elevation estimated to be ~1115').

22. Fair exposure of Toronto/Lawrence contact at ~1106' (hand level from spot elevation) exposed in NE 1/4, NE 1/4, NE 1/4, NE 1/4, sec. 17, T20S, R17E in roadways and on corner between E-W and N-S rods.

23. Toronto limestone at ~1111' (hand level to spot elevation) exposed in roads trending N and W from corner of secs. 9, 10, 15, and 16, T20S, R17W.

5-13-89

Random Thought--The "Leavenworth" at MS17 may be Clay Creek. The Clay Creek is suppose to look a lot like the Leavenworth and have a few bivalves (which that stuff did). Are the high hills in this area capped by Clay Creek? They are all ~1200'-1210'. On the Waverly Quadrangle (~3 miles north) the Kereford/ Heumader contact is ~60' above the base of the Toronto and ~40' above the base of the Plattsmouth. The high hills may be made of Jackson Park Shale Member of the Kanwaka Shale. They may be capped by a thin ledge of Clay Creek Limestone Member of the Kanwaka Shale. After spending more time looking over Manger's thesis on the Kereford (KGS OF 61-3), I'm convinced that the very thin molluscan limestone at ~1178' at MS17 is all that remains of the Kereford. I'll have to go back to MS14 and check carefully for any very thin limestone beds (but I don't expect to find any) because I may be on the edge of the Kereford.

5-14-89

24. Toronto-Plattsmouth limestone members in road trending from SE 1/4, NE 1/4, NE 1/4, NE 1/4, sec. 17, T20S, R17E to southeast corner of NE 1/4, NE 1/4, sec. 17, T20S, R17E. Toronto limestone at ~1107', Leavenworth limestone at ~1130', Plattsmouth limestone at ~1135' (all hand level/pace to topographic line).

25. Creekbed-road exposure of ~12' sandstone bed in Lawrence Shale; base at ~1098' (hand level/pace to topographic line). Exposures in SW 1/4, SE 1/4, SE 1/4, SW 1/4, sec. 17, T20S, R17E. If this is the Ireland, it is much higher than I expected.

26. Fair section in Lawrence Shale beginning at creek and continuing to top of 1st hill south (north of stock pond). Section continues to top of 2nd hill. Section begins ~470' due north of center of N-S road separating sec. 20 and sec. 21, T20S, R17E and continues southward to ~1200' north of th southeast corner of sec. 20, T20S, R17E. Approximately 6' of resistant, cross-bedded sandstone exposed at creek level, continuous upstream for ~200'. Four cross-bed dip measurements are: N20°W, N24°W, N21°W, N16°W. Toronto LImestone Member exposed at top of hill at ~1148' (hand level from creek level-assumed to be 1075'; old BR spot elevation no longer valid because of new bridge).

27. Toronto limestone at ~1122' (hand level to spot elevation). Section in road approximately 700' south of northwest corner sec. 21, T20S, R17E.

28. Toronto limestone at ~1136' (hand level to spot elevation). Section along E-W road separating NW 1/4, NW 1/4, NW 1/4, sec. 20, T20S, R17E from SW 1/4, SW 1/4, SW 1/4, sec. 17, T20S, R17E.

29. Leavenworth and Plattsmouth limestones at ~1161' and ~1166' (hand level/pace top topographic line). Some black shale exposed in gulley on south side of road directly on top of Leavenworth (Heebner). Section on east side of creek NE NW NW NE, sec. 19, T20S, R17E on E-W road between sec. 19 and sec. 18, T20S, R17E.

30. Leavenworth limestone only in float on top of hill on S side of E-W road between center of NE 1/4, sec. 19, T20S, R17E and center of SE 1/4, sec. 18, T20S, R17E.

5-15-89

31. Leavenworth limestone (abundant float) exposed along E-W road between the SW SW SE, sec. 20, T20S, R17E and the NW NW NE sec. 20, T20S, R17E at ~1175'. Abundant Plattsmouth float at ~1180' (hand level to spot elevation).

32. Toronto-Lawrence contact on north and south sides of E-W stream valley exposed in N-S road between NE 1/4, NE 1/4, sec. 29, T20S, R17E and NW 1/4, NW 1/4, sec. 28, T20S, R17E. Northern contact at ~1145' and southern contact at ~1147' (hand level to spot elevation).

33. Leavenworth-Plattsmouth poorly exposed in ditch on east side of n-S road between NW SW sec. 28, T20S, R17E and NE SE sec. 29, T20S, R17E at ~1166' and ~1170' (hand level to spot elevation).

34. Toronto-Lawrence contact on hill 100'-600' west of center sec. 33, T20S, R17E at ~1150' (hand level/pace to topographic line).

35. Jergin's Ford South Quick & dirty measured section:

FM-TD

0-1.5'	Thin bedded (0.1-1.0") ripple-marked, bioturbated sandstone (fine-grained); most ripple-marks symmetrical, some flat-topped; current indicators (apparently consistent from bed to bed) N50°E <--> S50°W.
1.5-3.5	Shale, gradational contact below with sandstone.
3.5-4.0	Fossiliferous limestone; contact sharp with shale below; crinoid debris, brachiopods, bryozoans; rd. large myalinids; bioeroded fossil fragments common. Collection: WAVSE 35-1; WAVSE 35-F. Packstone-grainstone; some pecterid bivalves.
	Transfer of section upstream ~350'.

FM-TO

4.0-7.0	Profuse fusulinid packstone-grainstone; contact with underlying limestone gradational over a distance of 2" at most; fusulinids somewhat less numerous in upper 1'. Collection: WAVSE 35-2 from middle, unweathered part of unit.
	Mostly packstone; rare echinoderm debris; rare molluscs (large?) near top (very badly weathered and difficult to tell with certainty).

Approximately 560' due west and 11' higher stratigraphically (through covered interval) is a poor exposure of limestone across the roadway. Collection: WAVSE 35-3 -- dense, dark blue-gray, finely fossiliferous packstone (~6-12" thick). Jergin's Ford South section is situated on Pottawatomie Creek ~SW 1/4, SW 1/4, SW 1/4, NE 1/4, sec. 27, T20S, R17E. Base of lower limestone is at ~1035'; second limestone is at ~1045' (hand-level to spot elevation).

35. Jergin's Ford North section - Large (~8000 ft^2 exposed) limestone surface. This is the lower ~1 1/2' of the limestone at the Jergin's Ford South section. One major, two minor joint sets: major-->N65°E, minor-->N15°E, minor--~N25°W. Top of limestone is at ~1042'. Jergin's Ford North is ~200' south of the center of the W 1/2, SW 1/4, sec. 27, T20S, R17E.

37. Toronto-Lawrence contact at top of hill in SW SW SW, sec. 33, T20S, R17E in E-W road between locality given and NW NW NE, sec. 4, T21S, R17E. Toronto limestone at ~1143' (hand level from spot elevation); present on both sides of road, does not cross road.

38. Poor exposures of Leavenworth-Plattsmouth at ~1177' and 1181' (hand level to spot elevation) exposed along E-W road ~100'-300' east of northwest corner sec. 4, T21S, R17E.

Random thought--Currently, I think there are only 3 possibilities for the Jergin's Ford North and South sections:

(1) Westphalia Limestone Member of the Stranger Formation overlain by the Vinland Shale Member (~10' covered zone at top of creek exposures), Haskell Limestone Member of Lawrence Formation.

Pros: 1) Correct stratigraphic thickness for sequence.
2) Near type area for Westphalia limestone.
3) Correct internal stratigraphy for Westphalia.
4) Generally correct lithotype for Haskell.

Cons: 1) Haskell doesn't look like "the most continuous marker bed within the Douglas Group" to me (at least based on this exposure, but thickness noted to be 0-12' in Zeller et al.).

2) This makes the Lawrence Formation ~105' which is a bit thin for the Lawrence.

(2) Haskell Limestone Member of Lawrence Formation overlain by Amazonia Limestone Member of Lawrence Formation.

Pros: 1) Better explains apparent discontinuous nature of upper limestone.
2) General description in Zeller et al. better fits lithology of upper limestone.
3) Haskell then would become the lower limestone and be a better marker.

Cons: 1) Lower limestone doesn't look like Haskell in Anderson Co.
2) Shale above "Amazonia" becomes upper part of Lawrence, ~90' thick (which is a bit thick for upper part of Lawrence).

(3) Amazonia Limestone Member of the Lawrence Formation, Vinland Shale Member of the Stranger Formation, and Westphalia Limestone Member of the Stranger Formation (top to bottom).

Pros: 1) Best lithotype matches.
2) Ireland Sandstone Member of Lawrence Formation known to chop out Robbins Shale Member and Haskell Limestone Member.

Cons: 1) Extremely thin stratigraphic interval for Amazonia-Westphalia sequence.
2) No thick Ireland Sandstone Member developed.
3) Lawrence still v. thin above Amazonia.

39. Dense, orangish-brown fusulinid-crinoid wackestone. Heavy, reminiscent of upper limestone at Jergin's Ford South (except for color) as abundant float associated with coal float in plowed field east of N-S road (NW SW NW NW, sec. 27, T20S, R17E). Collection: WAVSE 39-F. Elevation estimated at ~1059'.

40. Same slabby limestone exposed in tree roots in dry-creek bank at ~1056' (estimated from spot elevation) approximately 200' west of northeast corner sec. 28, T20S, R17E on south side of creek.

41. Same slabby limestone under north end of bridge over Pottawatomie Creek at midpoint between NE 1/4, sec. 21, T20S, R17E and NW 1/4, sec. 22, T20S, R17E and ~200' west on south bank of creek. None is in place, but there is a break in slope and abundant slabs are around at ~1162' (hand level to spot elevation). Rare high-spired gastropods in limestone. Some fresh material (and quite a few weathered slabs) in field ~200' north of bridge directly adjacent to road. Fresh material in dense, dark blue-gray with a light blue gray rind.

42. Toronto-Lawrence contact at ~1159' (hand level to spot elevation). The upper 1' or so of the Toronto (total thickness ~3') looks identical in hand sample with the low slabby limestone I've been chasing (see Collection WAVSE 39-F). Collection: WAVSE 42-1 from this upper Toronto. Lower Toronto is very fusuline-rich in beds, v. macrofossiliferous in other beds. Base of Toronto at ~1159' (hand level to spot elevation). Leavenworth float at top of hill in pasture (~1188', hand level from spot elevation).

43. Toronto-Lawrence contact at ~1160' (hand level from topographic line) on point situated in the SW 1/4, NW 1/4, sec. 23, T20S, R17E.

44. "Float-crop" in road of thin flaggy limestone ~300' north of midline on N-S road between sec. 26 and sec. 27, T20S, R17E at ~1068' (hand level to spot elevation). Are "ponds" in sec. 27 and 22 pools of water behind the limestones?

Random thought -- The type area for the Westphalia Limestone is ~2 miles southeast of Jergin's Fored at ~ the same elevation. Thus, the low limestone sequence probably is Westphalia-->Vinland-->Haskell.

45. Creek and ditch exposures in SW 1/4, NE 1/4, sec. 3, T21S, R17E. Probably Westphalia at ~1048' (in creek), Vinland (covered) and Haskell (6"-9" thick in ditch on east side of N-S mid-section road) at ~1057' (hand level to topographic line). Collection: WAVSE 45-1-probably Haskell Limestone

5-20-89

46. Poor-fair exposure of Leavenworth and Plattsmouth limestones in N-S road 1/4-1/3 side south of northwest corner sec. 6, T21S, R17E and northeast corner sec. 1, T21S, R16E, at ~1146' and 1149' (hand-level/pace from topographic line).

47. Toronto-Lawrence contact at ~1103' (sited from bench mark in concrete bridge rail). The Toronto here is ~5'-6' thick and well exposed northwest of bench mark (SW 1/4, SE 1/4, SE 1/4, SW 1/4, sec. 36, T20S, R16E).

48. Fair exposures of Leavenworth-Plattsmouth limestones at ~1028' and 1032' (hand-level/pace from topographic line). Exposures on north side of E-W road along southern boundary of W 1/2, SE 1/4, SE 1/4, SW 1/4, SW 1/4, sec. 36, T20S, R16E.

49. Section on north side of road along northern boundary of W 3/4, NW 1/4, sec. 1, T21S, R16E. Top of Plattsmouth exposed in creek (SW 1/4, SE 1/4, SW 1/4, SE 1/4, SE 1/4, sec. 35, T20S, R16E) at ~1120' (estimated from topographic map). Roadcut at mid point of southern boundary SE 1/4, sec. 35, T20S, R16E has shale/siltstone only. Roadcut along southern boundary of SE 1/4, SE 1/4, SE 1/4, SW 1/4, sec. 35, T20S, R16E (directly under powerline). Top of hill is held up by a thin (but very hard) sandy oolite/oolitic sandstone with reasonably common macrofossils (large myalinids, Juresania, and an encrusting bryozoan seen). Approximately 2'-3' below hilltop is abundant float (very small pieces) of highly bioturbated sand-/siltstone (good preservation). Sandy oolite at ~1179' (pace/hand-level to topographic line). Collection: 49-1, 49-F from sandy oolite. Is this the Clay Creek or base of the Kereford? My guess is Kereford (at least for now).

11-14-89

50. Same lithology as MS49 (Waverly SE) exposed on S side of road as float at ~1190' (hand level from spot elevation). I'm still not sure what this unit is, but I now think it is too high for Kereford. Thin, sandy grainstone (~2 cm thick); very hard, reddish color. Exposure at northern midline of NE 1/4, NW 1/4, NW 1/4, sec. 36, T20S, R17E in E-W road.

51. Top of Plattsmouth limestone in road at northern midline NE 1/4, NW 1/4, NE 1/4, sec. 36, T20S, R17E in E-W road at ~1155' (hand level from spot elevation). Base of Leavenworth poorly exposed in creek in SE 1/4, NE 1/4, NE 1/4, NE 1/4, sec. 36, T20S, R17E at ~1136' (hand level to spot elevation). Base of Plattsmouth estimated at ~1140'.

52. Abundant sandstone float capping hill in NE 1/4, SE 1/4, NE 1/4, sec. 25, T20S, R17E.

53. Rare sandstone float in E-W road near barn in NE 1/4, NW 1/4, NW 1/4, NW 1/4, sec. 19, T20S, R17E.

54. Approximately 4' of thin bedded (< 1") siltstone and a hard calcareous reddish sandstone layer (~1") exposed at ~1192' (hand level to spot elevation) on east side of NS road in SW 1/4, SW 1/4, SW 1/4, NW 1/4, sec. 7, T20S, R17E.

55. Dense, hard, marly limestone with fossil fragments and coated grains; associated with blocky sandstone and a few float pieces of "Waverly Flagging" at ~1213' (hand level from spot elevation) on hill along N-S road on eastern border of NE 1/4, NE 1/4, NE 1/4, sec. 1, T20S, R16E. Is this Kereford? Is the sandstone holding up hills south of here also Kereford or, at least, near Kereford? Based on the flaggy float, for now I'll say yes--but this clearly is subject to change.

3-31-90

55. (Revisited - 3-31-90) - This is the uppermost part of the Kereford, overlain by sandstone of the Jackson Park Shale.

57. Exposures along N-S road on west edge, SW 1/4, NW 1/4, sec. 26, T9S, R16E. Base of exposure is about 1'-2' of medium-grained sandstone at ~1165'. About a 1' interval of thin, slabby (<2"), hematitic and limonitic molluscan packstone occurs at ~1177'. For the moment, I'll refer to this as a limestone in the Stull Shale, although it may be the Clay Creek Limestone. This is overlain by another sandstone (as below) at ~1190' (all hand level to spot elevation). The Spring Branch Limestone occurs in float in a plowed field at ~1203' (hand level from spot elevation). Very common myalinids are weathering out of the soil in the northeast corner of this field (northeast corner SE 1/4, sec. 27, T19S, R16E) at ~1195' (hand level to spot elevation). Exposure generally poor.

58. Fair-good exposures along east-west road on north edge NE 1/4, NE 1/4, sec. 34, T19S, R16E. Sandstone (same as MS57 at ~1182'. Common myalinids weathering out of ditch at ~1195'. Spring Branch Limestone Member at ~1198' (all hand level to spot elevation).

59. Sandstone holding up hill crossed by north-south road on west edge NW 1/4, SW 1/4, sec. 35, T19S, R16E. No limestone float seen along road.

60. Fair-poor exposure along east-west road on south edge SE 1/4, SE 1/4, sec. 34, T19S, R16E. Sandstone at ~1160'; another sandstone bed at ~1187' (both hand level to spot elevation). No limestone float seen at top of hill.

61. Limestone, dense, white to gray, micritic, with erosive, oolitic, fine-grained fossiliferous contact at top; total thickness of limestone about 1', at ~1136' (hand level to spot elevation). Exposure in creek bed about 30' north of east-west road, near mid-point, south edge, SW 1/4, SW 1/4, SE 1/4, sec. 35, T19S, R16E. This may be the top of the Kereford Limestone Member. Joint set in limestone trends N60°E.

62. Kereford Limestone Member ("Waverly Flaggin") exposed in east-west road near midpoint, south edge SW 1/4, SE 1/4, SW 1/4, sec. 36, T19S, R16E, at ~1160' (hand level/pace to topographic line).

63. Sandstone, about 2' thick, exposed about 200' south of northeast corner NE 1/4, SE 1/4, sec. 32, T19S, R17E, at ~1165' (hand level from spot elevation).

64. Kereford Limestone Member, base at ~1175', top at ~1185' (hand level to spot elevation). Exposure at intersection of sec. 29, sec. 28, sec. 33, and sec. 32, T19S, R17E.

64a. Exposure (fair-poor) of Kereford Limestone along north-south road near midpoint, west edge SW 1/4, SW 1/4, sec. 11, T20S, R16E. Linoproductus coquina collected in float (WAVSE 64.1.1 and 64.1.2). Base of Kereford ta ~1128' (hand level to spot elevation). The Kereford here still hast he slabby bedding of the "Waverly Flaggin" but is coarser grained (recrystallized?) and more bioturbated.

65. Kereford Limestone very poorly exposed near top of hill along east-west road at ~1215' (hand level from spot elevation). Exposure is about 250' west of southeast corner sec. 7, T20S, R17E. A few large Linoproductus seen in float.

66. Top of Plattsmouth Limestone Member exposed in and along creek on both sides of north-south road near midpoint, east edge, NE 1/4, sec. 7, T20S, R17E, at ~1140' (estimated from topographic map). Same as base of Heumader.

67. Sandstone (about 1' thick, medium grained, orangish-brown) in Heumader exposed along north-south road at ~1175'. Kereford float at ~1190' (both hand level to topographic line). Exposures near midpoint, east edge, SE 1/4, SE 1/4, sec. 6, T20S, R17E.

68. Kereford float in field and farm-pond dam on east side of north-south road near midpoint, west edge, NW 1/4, sec. 29, T19S, R17E.

69. Sandstone, like one exposed at MS67, exposed along east-west road near midpoint, north edge, NW 1/4, NE 1/4, sec. 36, T19S, R16E, at ~1199' (hand level from topographic line). If the same relationship holds here as at MS67, the Kereford should be about 10'-15' above this sandstone.

70. Kereford Limestone Member exposed along east-west roadway (poor exposure) about 100' west of southeast corner of sec. 2, T20S, R16E, at ~1150' (hand level from spot elevation). I don't know where in the Kereford this exposure is.

71. Very poor exposure along north-south road about 100'-300' north of midpoint, east edge, sec. 11, T20S, R16E. Lowest definite exposure of Kereford Limestone Member is at ~1150' (hand level to spot elevation).

72. Thin bedded, highly bioturbated sandstone about 2' thick. Beautiful, large Palaeophycus striatus. This is in the Heumader, however uppermost bed (about 0.5" thick) is a very fine grained sandstone that looks a lot like Kereford. Exposure is near center E 1/2, E 1/2, NE 1/4, sec. 11, T20S, R16E, at ~1132' (hand level to spot elevation).

73. Sandstone float at top of hill along north-south road on west edge NW 1/4, SW 1/4, SW 1/4, sec. 12, T20S, R16E.

74. Orangish-brown sandstone (about 1'-2' thick) at ~1181' (hand level from spot elevation) along east-west road near midpoint, south edge, SW 1/4, SE 1/4, sec. 26, T20S, R16E.

75. Fair-good exposure of shales, siltstones, and sandstones (some bioturbated) of Heumader Shale from valley floor to top of hill along east-west road near midpoint, south edge, SE 1/4, sec. 27, T20S, R16E. Uppermost sandstone massive, about 1'-2' thick, weathers reddish brown, blocky.

76. Thin, bioturbated sandstone (<6") in thicker shale (?) overlain by abundant Kereford float. Estimated contact at base of Kereford is ~1205' (hand level from topographic line). Exposure is very poor, along north-south road near midpoint, west edge, SW 1/4, sec. 23, T20S, R16E.

77. Sandstone and shale from base of hill to top of hill near midpoint, west edge, NW 1/4, NW 1/4, sec. 23, T20S, R16E.

4-22-90

78. Sandstone/shale very poorly exposed from top of hill to creek level along north-south field-access road on east edge SE 1/4, SE 1/4, sec. 27, T20S, R16E.

Westphalia Quadrangle Chris Maples 8-27-89
MAP STA:

1. Pilgrimage to typical exposures of Westphalia limestone. Bill Johnson (USGS) has Jergin's Ford section mapped as Haskell, I tentatively have it as Westphalia, so I need to see the typical Westphalia exposures. Roadside exposures along northern part of sec. 12, T21S, R17E are poor (farm pond now north of road).

   (Revisited 8-27-89) Westphalia exposed in ditch on south side of road. Yellow-orange weathering fusulinid-rich limestone. Collection: WES 1-1 (bag of type Westphalia for conodonts, etc.). Base of Westphalia at elevation ~1044' (hand level from spot elevation). Thickness ~1-2 feet.

2. Thin (~1.5') dense bluish limestone in shale sequence. Does not have abundant fusulinids (like Westphalia is suppose to have). Exposed in ditches on east and west sides of N-S road ~1900' north of southwest corner sec. 12, T21S, R17E at elevation ~1064' (hand level/pace from topographic line). My guess for now is Haskell because 1) few fusulinids, and 2) bioturbation characteristic of Haskell is present on weathered blocks.

   (Revisited 8-27-89) Westphalia limestone (reddish, nodular, < 1' thick, fewer fusulinids than at "type section") poorly exposed in ditch on west side of road at elevation ~1055' (hand level to base of Haskell Limestone).

3. Sandstone hill (Tonganoxie) with ~1' coaly streak at ~1128' (hand level from topographic line). Exposures in roadcuts and roadway at mid-line of N-S road on west edge sec. 13, T21S, R17E.

4. Well exposed cut bank of Lawrence Shale (10-20' exposure) between ~1020' and 1040' (estimated from topographic map). No limestone seen. Section along SE edge of creek: NW 1/4, SW 1/4, NW 1/4, NE 1/4, sec. 12, T21S, R17E.

5. Westphalia limestone, base exposed at ~1046' (hand level/pace from topographic line). Very poor exposure in NE 1/4, NE 1/4, NE 1/4, SW 1/4, sec. 1, T21S, R17E.

4-26-90

6. About 4' of limestone exposed on south side of Cherry Creek about 500' south of northwest corner sec. 24, T21S, R17E. Lowermost bed is about 2' thick, pinkish and greenish, otherwise very Haskell-like in lithology, upper 1'-2' is orange-weathering, fusulinid-rich unit identical to type Westphalia (MS1). I think this is Westphalia. Base of unit at ~1057' (hand level from topographic line).