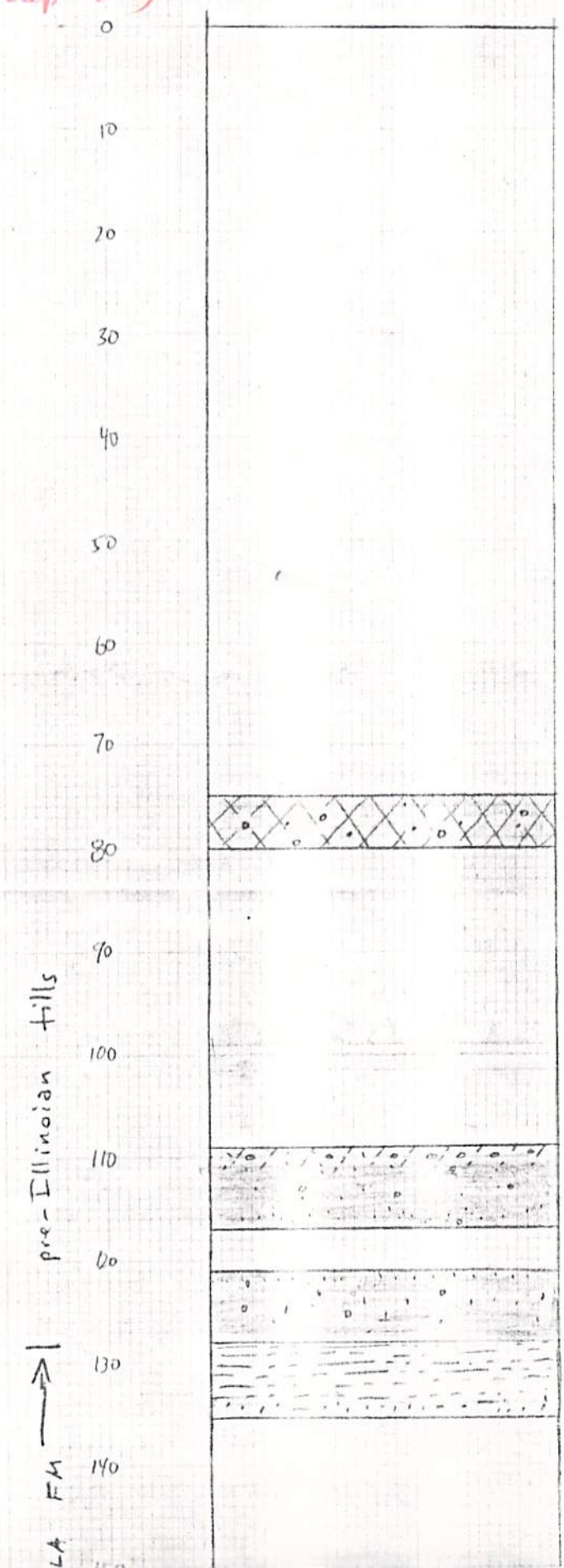
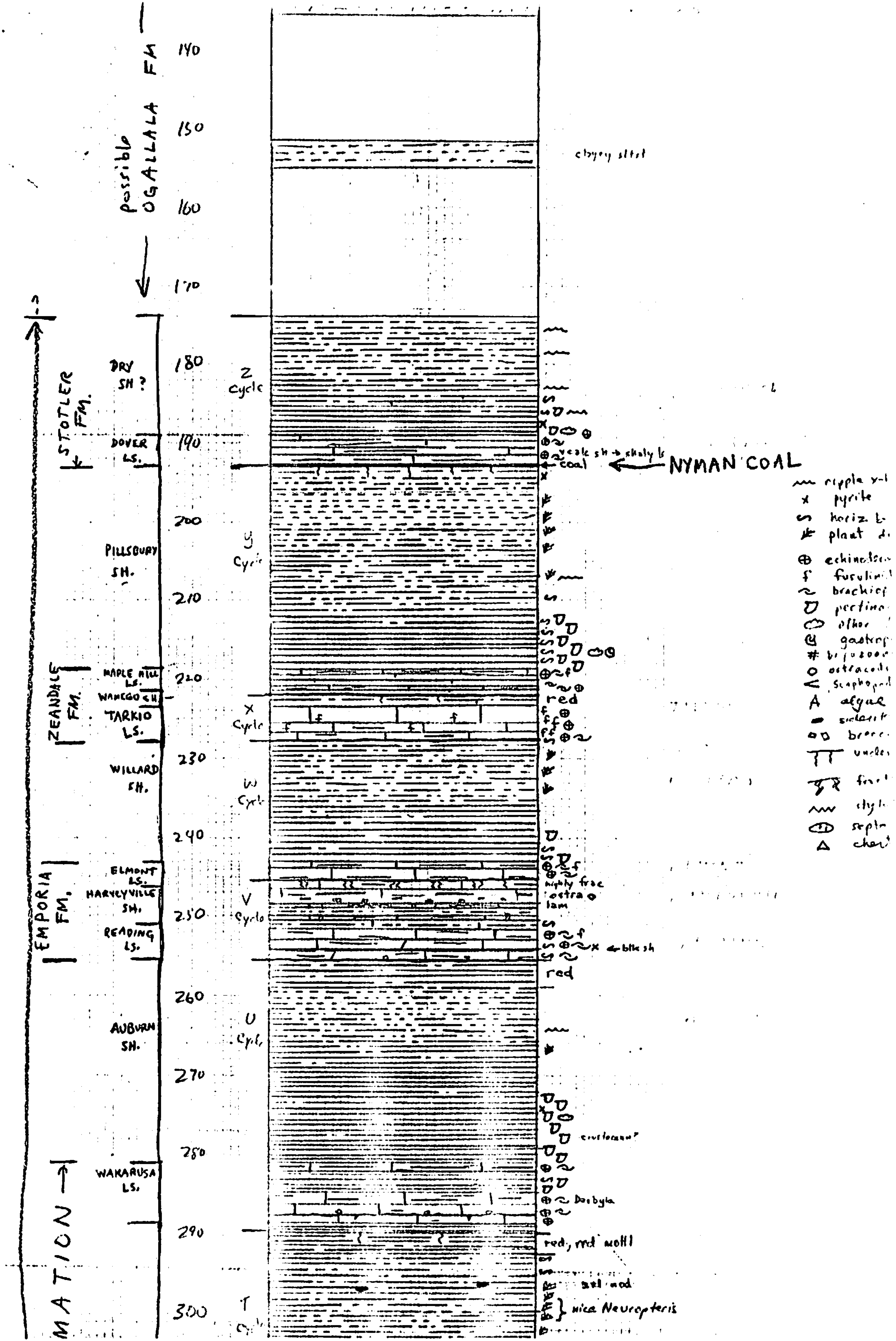
Riverton core SW-4 (W-27556)

SE SE SE SW sec 20, T67N, R41W Fremont Co., Iowa

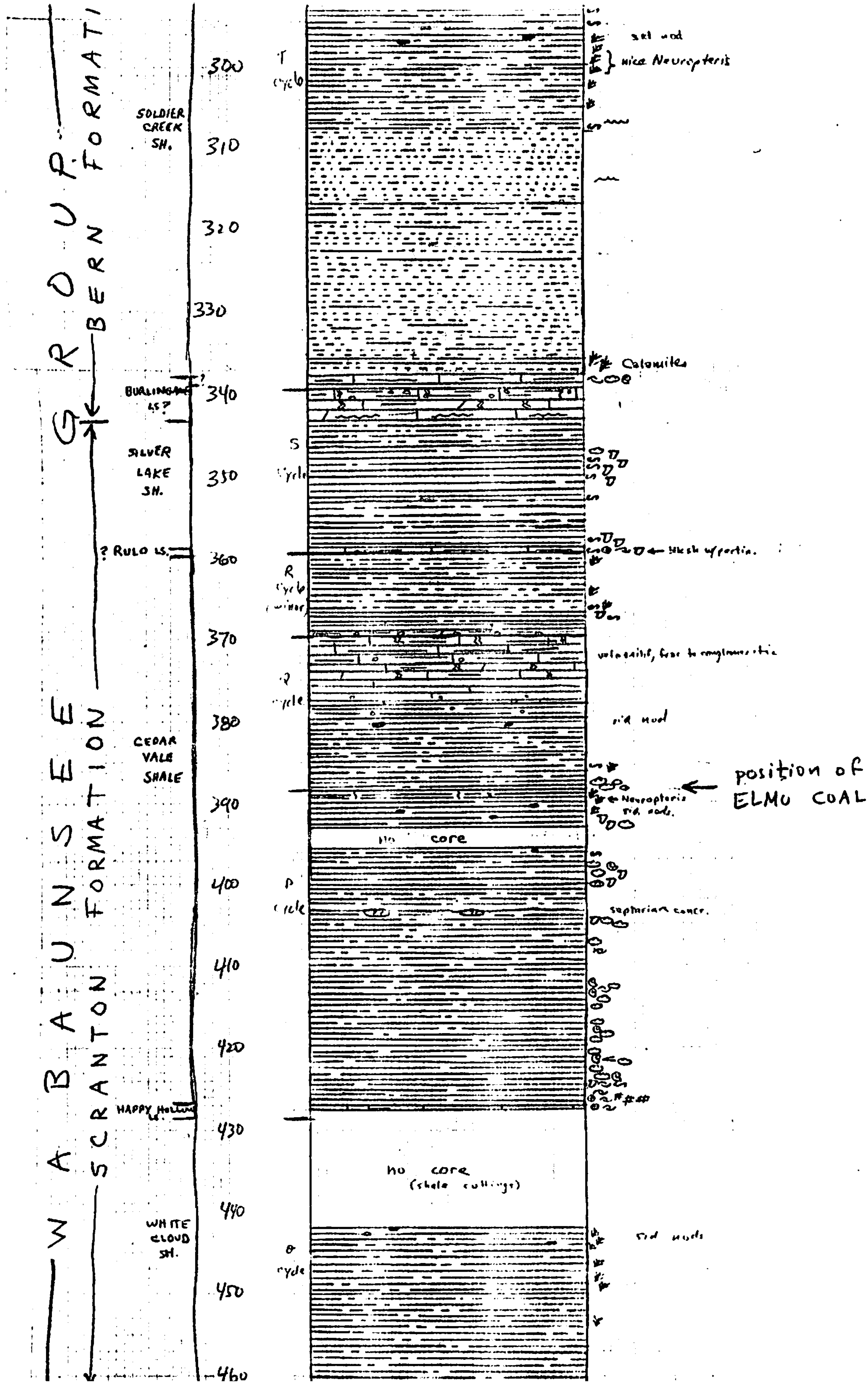
B. Witzke, R. McKay

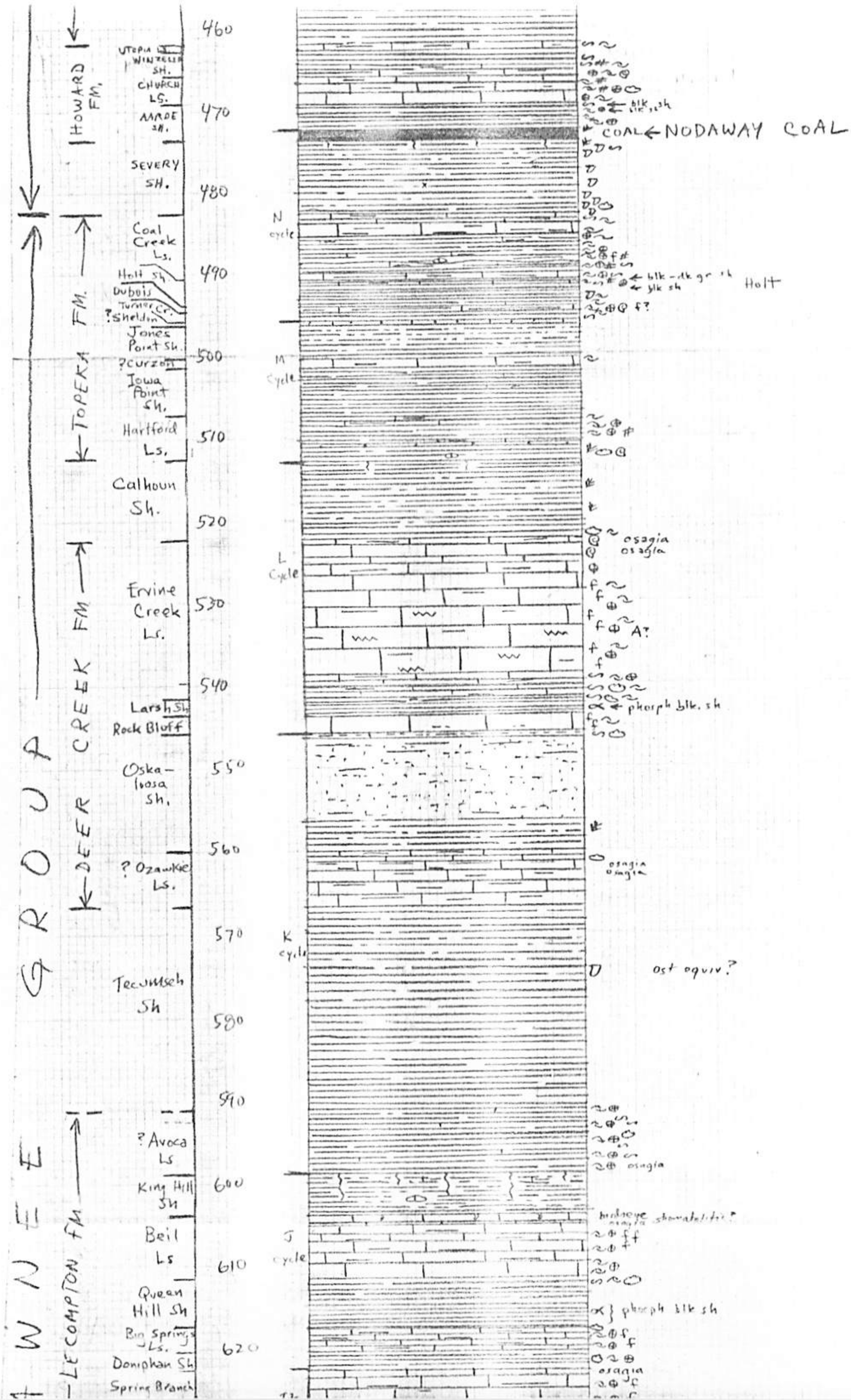
1986



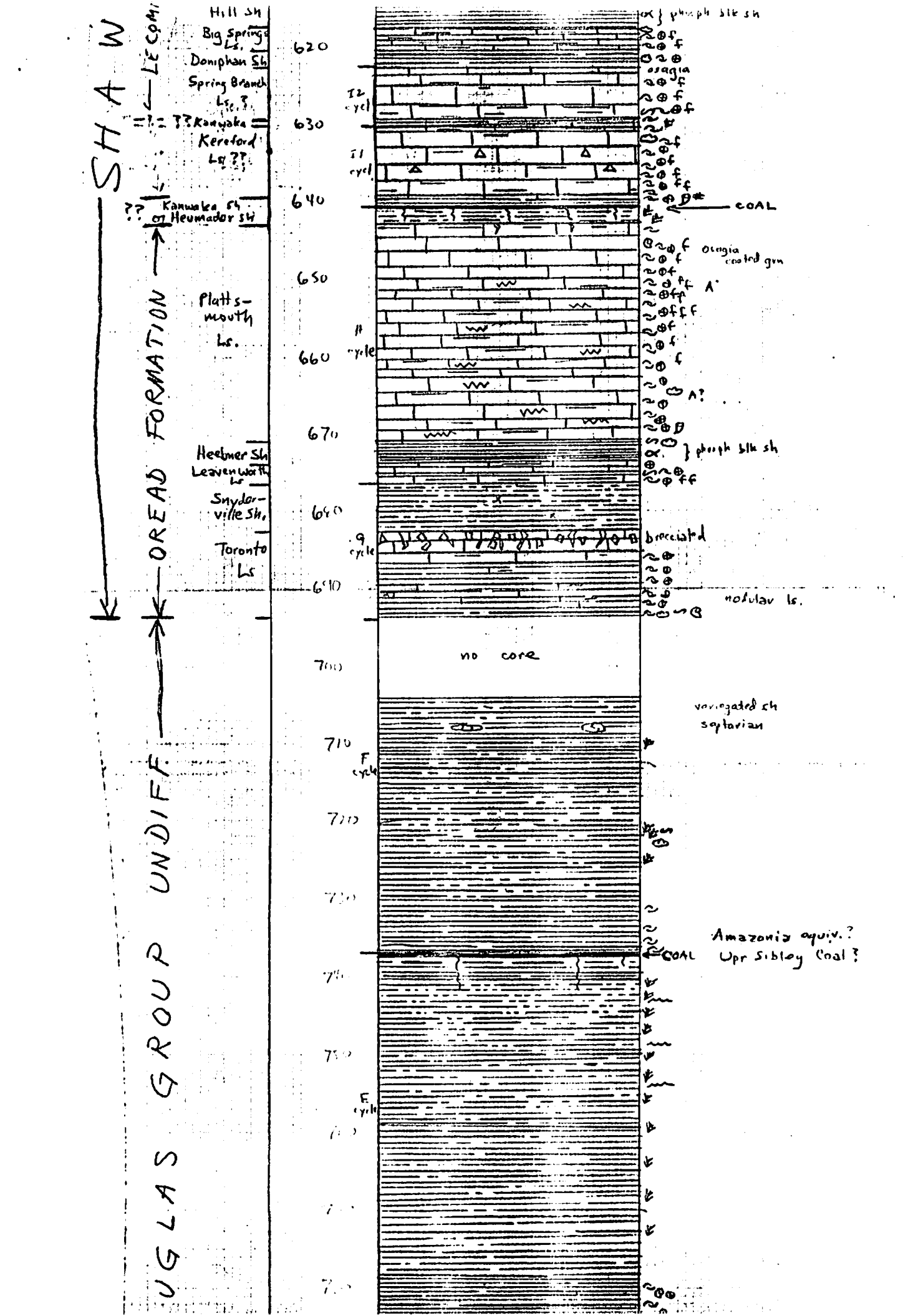


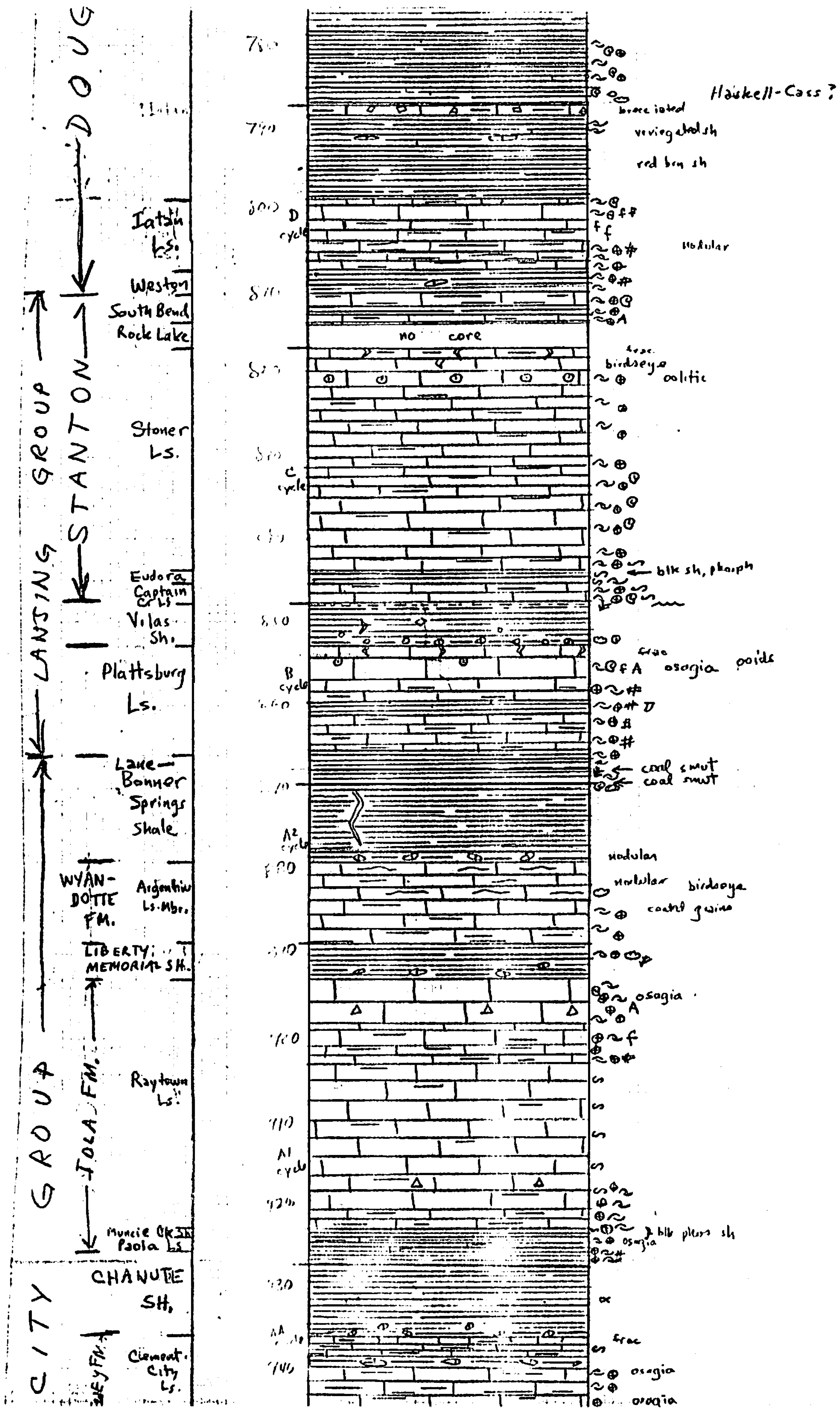
possible OGALLALA FM
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
clayey siltst
STOTLER FM.
DRY SH ?
DOVER LS.
Z Cycle
NYMAN COAL
coal
PILLSBURY SH.
Y Cycle
ZEANDALE FM.
MAPLE HILL LS.
WAMEGO SH.
TARKIO LS.
X Cycle
red
WILLARD SH.
W Cycle
EMPORIA FM.
ELMONT LS.
HARVEYVILLE SH.
READING LS.
V Cycle
highly frac
ostra
lam
red
AUBURN SH.
U Cycle
WAKARUSA LS.
Derbyia
red, red mottl
T
nice Neuropteris
MATION
ripple
pyrite
horiz.
plant
echino
fusulin
brachiop
pectino
other
gastrop
bryozoa
ostracod
Scaphopod
algae
siderit
brecc
chert


WABAUNSEE GROUP
BERN FORMATI
SCRANTON FORMATION
SOLDIER CREEK SH.
BURLINGAME LS?
SILVER LAKE SH.
? RULO LS.
CEDAR VALE SHALE
HAPPY HOLLOW LS.
WHITE CLOUD SH.
300
310
320
330
340
350
360
370
380
390
400
410
420
430
440
450
460
T cycle
S cycle
R cycle
P cycle
O cycle
sid nod
nice Neuropteris
Calamites
no core
no core
(shale cuttings)
septarian concr.
Neuropteris
sid nods.
sid nod
sid nods
position of ELMO COAL

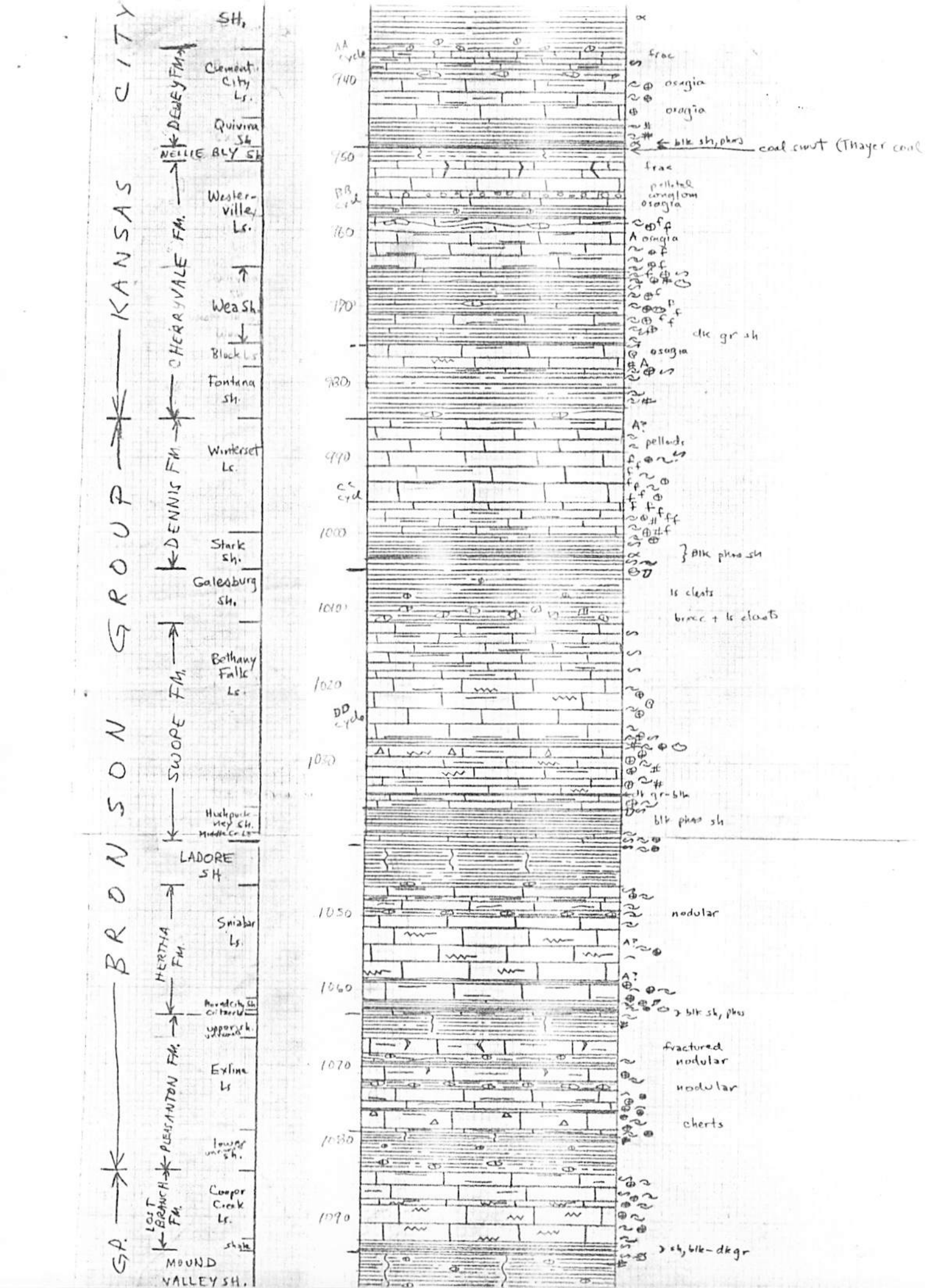


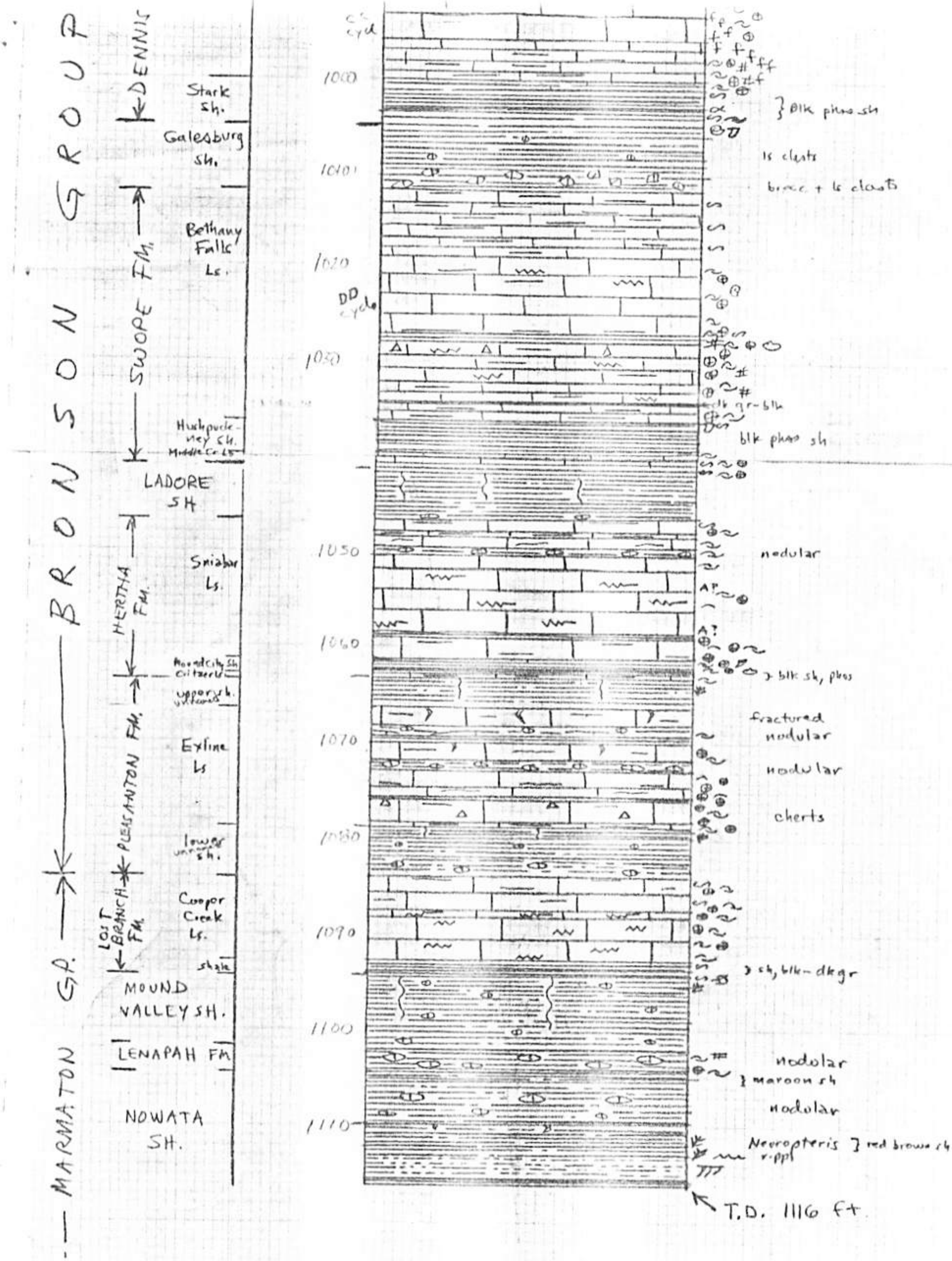
PAWNEE GROUP
HOWARD FM.
TOPEKA FM.
DEER CREEK FM
LECOMPTON FM
Utopia Ls.
Winzeler Sh.
Church Ls.
Aarde Sh.
Severy Sh.
Coal Creek Ls.
Holt Sh.
Dubois
Turner Cr.
?Sheldon
Jones Point Sh.
?Curzon
Iowa Point Sh.
Hartford Ls.
Calhoun Sh.
Ervine Creek Ls.
Larsh Sh
Rock Bluff
Oskaloosa Sh.
? Ozawkie Ls.
Tecumseh Sh
? Avoca Ls
King Hill Sh
Beil Ls
Queen Hill Sh
Big Springs Ls.
Doniphan Sh
Spring Branch
460
470
480
490
500
510
520
530
540
550
560
570
580
590
600
610
620
N cycle
M cycle
L cycle
K cycle
J cycle
blk sh
COAL ← NODAWAY COAL
← blk-dk gr sh
← ylk sh
Holt
f?
osagia
osagia
A?
← phosph blk. sh
osagia
osagia
ost equiv?
osagia
birdseye stromatolite?
osagia
phosph blk sh
osagia


SHAW
DOUGLAS GROUP UNDIFF.
OREAD FORMATION
LECOMPTON
Hill Sh
Big Spring Ls.
Doniphan Sh
Spring Branch Ls.?
?? Kanwaka
Kereford Ls??
?? Kanwaka Sh or Heumader Sh
Plattsmouth Ls.
Heebner Sh
Leavenworth Ls
Snydorville Sh.
Toronto Ls
620
630
640
650
660
670
680
690
700
710
720
730
740
750
760
770
12 cycl
11 cycl
11 cycle
9 cycle
F cycle
E cycle
phosph blk sh
osagia
COAL
osagia coated grn
A
A?
phosph blk sh
brecciated
nodular ls.
no core
variegated sh
septarian
Amazonia equiv.?
COAL Upr Sibley Coal?

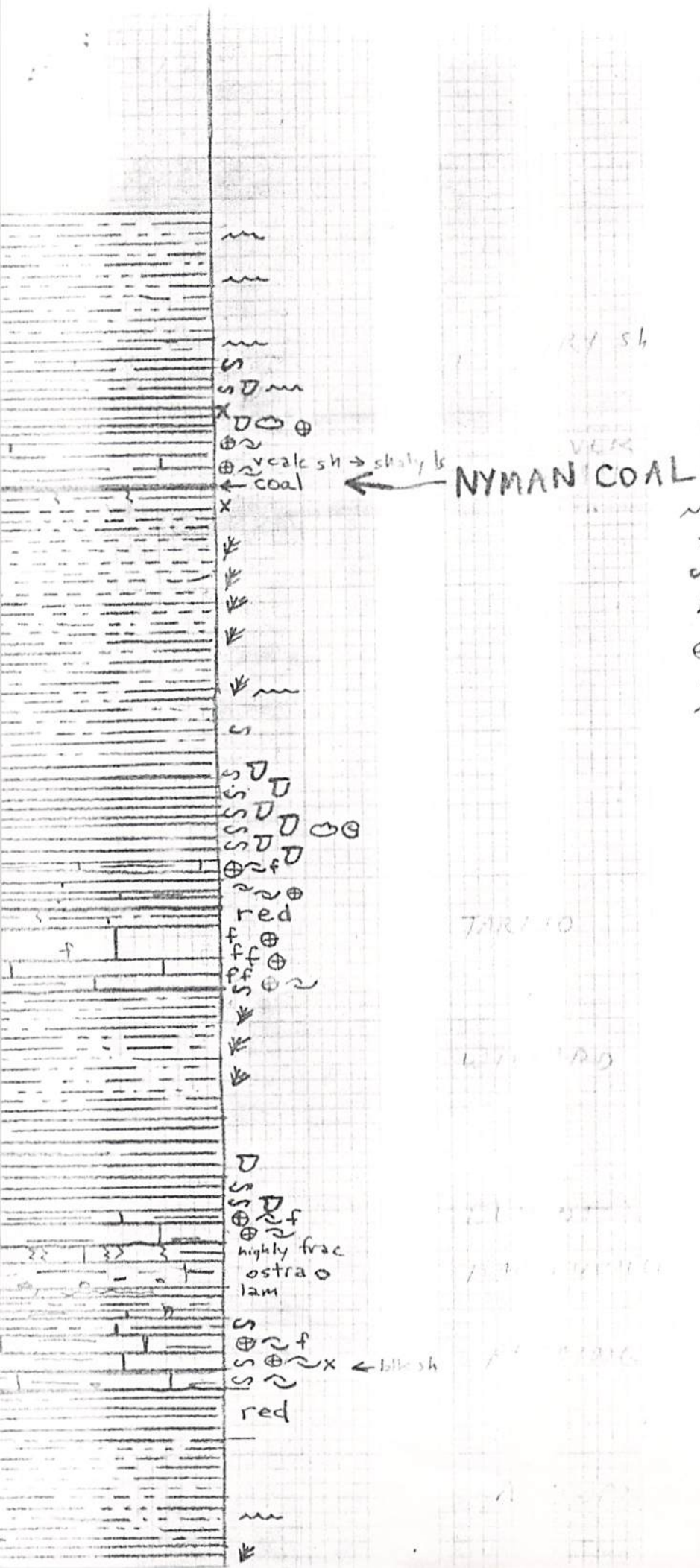


DOUG
STANTON
LANSING GROUP
CITY GROUP
WYAN-DOTTE FM.
IOLA FM.
Haskell-Cass ?
brecciated
variegated sh
red brn sh
Iatan Ls.
D cycle
nodular
Weston
South Bend
Rock Lake
no core
frac
birdseye
oolitic
Stoner Ls.
C cycle
Eudora
Captain Cr Ls
blk sh, phosph
Vilas Sh.
Plattsburg Ls.
B cycle
frac
osagia
ooids
Lake-Bonner Springs Shale
coal smut
coal smut
A2 cycle
nodular
Argentine Ls. Mbr.
nodular
birdseye
coated grains
LIBERTY MEMORIAL SH.
osagia
Raytown Ls.
A1 cycle
Muncie Ck Sh
Paola Ls
blk phos sh
osagia
CHANUTE SH.
AA cycle
frac
Clement City Ls.
osagia
osagia


KANSAS CITY GROUP
BRONSON GP.
SH.
Clement City Ls.
DEWEY FM.
Quivira Sh.
NELLIE BLY Sh.
Wester-ville Ls.
CHEROKEE FM.
Wea Sh.
Block Ls.
Fontana sh.
DENNIS FM.
Winterset Lc.
Stark sh.
Galesburg sh.
Bethany Falls Ls.
SWOPE FM.
Huckpuck-ney Sh.
middle Ls.
LADORE SH.
Spiabar Ls.
HERTHA FM.
upper sh.
Exline Ls
PLEASANTON FM.
lower sh.
Cooper Creek Ls.
LOST BRANCH FM.
shale
MOUND VALLEY SH.
AA cycle
BB cycle
CC cycle
DD cycle
740
750
760
770
780
790
800
810
820
830
840
850
860
870
880
890
900
910
920
930
940
950
960
970
980
990
1000
1010
1020
1030
1040
1050
1060
1070
1080
1090
1100
frac
oosparite
oosparite
blk sh, phos
coal smut (Thayer coal)
frac
pelletal conglom oosparite
A
oosparite
dk gr sh
oosparite
A?
pellets
blk phos sh
ls clasts
breec + ls clasts
blk phos sh
nodular
blk sh, phos
fractured nodular
nodular
cherts
sh, blk-dk gr



DENNIS
Stark Sh.
Galesburg Sh.
Bethany Falls Ls.
SWOPE FM.
Hushpuckney Sh.
Middle Cr. Ls.
LADORE SH
Sniabar Ls.
HERTHA FM.
Exline Ls.
PLEASANTON FM.
Cooper Creek Ls.
LOST BRANCH FM.
shale
MOUND VALLEY SH.
LENAPAH FM
NOWATA SH.
BRONSON GROUP
MARMATON GP.
1000
1010
1020
1030
1050
1060
1070
1080
1090
1100
1110
DD cycle
blk phos sh
ls clasts
brecc + ls clasts
dk gr-blk
blk phos sh
nodular
blk sh, phos
fractured
nodular
nodular
cherts
sh, blk-dkgr
nodular
maroon sh
nodular
Neuropteris
red brown sh
T.D. 1116 ft



KEY

- ripple x-lam + starved ripples
- x pyrite
- horiz. burrow
- plant debris
- ⊕ echinoderm debris, mostly crinoid
- f fusulinids
- brachiopod
- pectinacean bivalve
- other bivalves
- @ gastropod
- # bryozoans
- ostracods
- scaphopod
- A algae
- siderite nodules
- breccia
- underclay
- fractured
- stylolite
- septarian concr
- △ chert

IOWA DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY BUREAU

W-27556 -- Riverton Core (SW-4);
SE SE SW sec. 20, T.687N., R.41W., Fremont Co., Iowa
NX core; drilled by Darwin Evans, Oct-Nov. 1985 - and Sept. 1986
Surface Elevation: 1138 ft. (±5 ft.)
Logged By: Brian Witzke (0-511 ft., 1040-1116 ft.) and Robert McKay (511-1040 ft.)
Natural gamma log run 2/24/87 by T. McClain and L. Watney (Kansas Geol. Surv.) with U.S.G.S. logger from Lawrence, Kansas
Depths in feet

PENNSYLVANIAN SYSTEM

VIRGIL SUPERGROUP

Waubaunsee Group

Stotler Formation

Dry Shale Member

174-184	(7.4' recov.) Mudst/siltst interlaminated, micac., noncalc., laminae 0.05-10 mm, lt-m gr, oxidized org brn top 0.4'; thin siltst laminae in part lenticular with v low-angle ripple x-lam.; mudst increased downward, lam decrease down; bottom 1' is mudst, lt m gr, micac, with siltst ripple x-lam, siltst part calcareous cemented, trace hor. burrows.
184-189	(85% recov.) approx. top 1.3' is interlam mudst/ripple x-lam siltst, lt m gr, weakley calc siltst, good hor. burrows top; approx 185.3-188 mudst to clayst dominated, sl calc thru, sl micac, lt m gr, a few scatt thin siltst lam, sl calc, 185.7 sm pectinid, 186.2 silt-fille dhor burrow & 1 cm siltst ripple x-lam, 197 indet calc fossil frag, 188 pyrite nodules; bottom 1' is clayst/sh, lt m gr, sl calc, v sl micac, softer than above or below, 188.2, 188.5 small indet bivalves (2-5 mm) and indet calc skel fossil frag, 188.7 nice pectinid, scatt crin debris at base.

Dover Limestone Member

189-192.6	Sh, v calc, approaches v arg ls, lt gr, v fossilif, some shaly partings, scatt to common crin debris, large crin near base, scatt to abnt sm brachs, some large brachs.

Pillsbury Shale Formation

192.6-193	Coal, crumbly (*Nyman Coal*).
193-203	(8.6' recov) top 1', clayst, lt gr, soft, chuncky, underclay; next 2' siltst, arg. v. micac, noncalc, lt gr, part weakly lam, pyrite nodules 0.5' down; next 4.4' siltst, lt gr-lt brn gr, noncalc; v micac, faintly and finely lam, some thin arg lam, scatt fine plant debris; bottom 1.2' siltst, lt-m gr, arg, noncalc, v micac, with common arg lam, plant debris top.
203-213	(5.7' recov.) top 0.7' mudst, lt gr, with fine siltst lam, tr plant debris, irreg base; next 1.8' mudst, lt gr, with siltst lam and ripple x-lam, siltst pt sl calc, plant debris; bottom 1.9' (broken and rounded core chuncks) mudst, lt gr, silty some sm hor burrow mottles, pectinid frag near base, pt v sl calc.
213-217	Sh/clayst, lt gr, noncalc, with scatt calc skel debris, abnt v. sm hor burrows, pectinid at 214.1, 214.5, 215.3, 215.5, 215.7, 216, 216.2, 216.4, 216.5, 216.7, 216.8, bellerophontid and nuculid.

217-218.7	Sh/clayst, lt-lt m gr, abnt sm burrows top half, less below, abnt pectinids thru.

Zeandale Limestone Formation

Maple Hill Limestone Member

281.7-219.3	Ls, arg, lt m gr, skel wackst-packst, upper half with possible brachs and fusulinmids, lower part with gastropods, brachs, crin debris.
219.3-220.9	Mudst, lt gr, v calc, sl micac, scatt hor burrows, fossilif near base (bivalves & brachs?), sharp basal contact.
220.9-221.3	Ls, arg, lt gray, skel packst, with shaly partings, brachs 7 chino spines; intraclastic lower half, clasts to 2 cm.

Wamego Shale Member

221.3-222	Mudst, lt gr, v calc, silty.
222-223.5	Mudst/clayst, lt red brn with v lt gr-grn mottles, sl calc to calc at base, soft chunky, looks like underclay.

Tarkio Limestone Member

223.5-226.7	Ls, pale gr-pale brn gr, hard skel wackst, includes packst in bottom 1.7', becomes sl arg in lower 1', abnt fusulinids thru remainder with scat crin debris, grad below.
227.2-227.8	Ls, lt gr, hard, sl arg, scatt sm-lg crin debris, scatt brach, skel wackst (calcilut to fine calcarenite), v arg and burrowed at base.

Willard Shale Formation

227.8-230.2	Mudst, lt gr to org brn (ocis), calc to sl calc down, silty and micac, homogeneous and generally featureless; 229.3 plant debris?
230.2-235.2	Mudst interlam with siltst, lt gr-lt m gr, micac, scatt fine plant debris, finely lam, siltst lam sl calc, grad below.
234.2-243	Mudst, lt m gr, silty, micac sl calc, becomes more calc down, chunky, softer than above, generally featureless, bottom half less silty-micac; 239 calc skel frag, 239.3 pectinid, 242.8 pectinid; 242.2-243 scat hor burrows, va calc at base.

Emporia Limestone Formation

Elmont Limestone Member

243-243.9	Ls, arg-v arg, v lt gr, v shaly top and bottom, skel wackst, crin debris (lg crin lower 0.3'), sm brachs, fusulinids? near top.
243.9-244.95	Ls, v lt brn gr, dense, arg-sl, skel wackst, sm crin, sm brach.
244.95-245.3	Ls, v lt gr, v arg to shaly at base, brachs, burrowed at base.
245.3-246.5	Ls, v lt gr, arg, dense, unfossilif, finely lam, entire unit disrupted by complex network of vert and subvert fractures filled with lighter colored limestone.

Harveyville Shale Member

246.5-248.4	Grades downward from dense ls, v arg, to mudst, v lt gr-v lt grn gr, calc, dense, featureless, v sl silty, some irreg dark mottling; becomes greener down; nice ostracodes noted 247.5; basal 0.3' irreg and interswirled with underlying unit, brecciated to conglomeratic (clasts of underlying unit).
248.4-248.9	Ls or dol, pale gr, dense, sl arg, irreg lam at base, irreg mottles near middle; fractures infilled with green matrix in upper half.

248.9-250	Siltst to mudst, v lt grn gr, dense, arg, sl calc or dolc, sl micac, possible faint burrow mottles.

Reading Limestone Member

250-250.5	Ls, v lt brn gr, arg, with some green-gr fracture fills near top
250.5-251.6	Mudst, v valv, silty grades to Ls, arg, irreg burrows, indet fine skel debris.
251.6-253	Ls, v lt brn gr, sl arg to v arg or calc sh (middle 0.2' is least arg), dense wackst, part approaches packst; dk gr sh part at top; bottom 0.4' v arg lsd to calc sh with scatt skel debris (sm brachs and crin); above with common crin debris, some brachs, possible fusulinids.
253-254.1	Ls, part dolc?, arg above becomes less arg at base, v lt brn gr-v lt gr, top half with irreg burrow swirls; middle part with brachs; lower one-third with irreg burrow mottles and swirls, scatt crin near base; pyrite common near base; dense in upper half, includes pin-point porosity in lower half.
254.1-254.2	Sh, m dk gr to blk, very finely lam, pyrite streak.
254.2-255.4	Ls, dolc?, arg, dense, v lt brn gry, faint burrow mottles, lower half with calc-filled brach molds, scatt dolo? rhombs in denser portion, base irreg and highly fractured with dk gr clasts.

Auburn Shale Formation

255.4-255.9	Mudst, lt grn gr, noncalc.
255.9-259	Mudst, lt m red brown, irreg mottled with v lt grn gr, massive, blocky, silty, micac; grn-gr at base.
259-263	Siltst, v lt grn gr grades down to v lt gr, arg, v micac, noncalc, massive; some arg lam near base; calc void fill at 261.1.
263-265.8	Interlam mudst, v lt grn gr and siltst, v lt brn gr, micac part calc; some siltst lam display low-angle ripple x-lam; grad below.
265.8-269	Mudst, v lt gr, sl silty to micac, siltier and more micac near top; becomes v lt olive gr to grn gr clayst, sl micac, in lower half, tr sm plant debris.
269-271.3	Clayst, v lt olive gr to brn gr (oxide), sl micac, noncalc, grad below.
271.3-281	Clayst, v lt gr-lt m gr, v sl micac, part sl calc (especially down); pectinids abnt noted at 72.5, 72.8, 73.2, 73.7, 74.3, 74.6, 74.7, 75.6, 76, 76.4, 76.7, 78, 79.4, 80.8; non-pectinid bivalves at 74.7, 75.3; hor burrows tr at 72.8; 77.4 lg arthropod carapace.

Bern Formation Formation

Wakarusa Limestone Member

281-282.1	Shaly ls to calc sh, lt m gr, skel wackst (packed in places), scatt sm-lg brachs, crin debris.
282.1-284.8	Sh/clayst, lt m-m gr, scatt hor burrows, sl calc, soft bottom o.3'; pectinids at 83.2, 83.9, 84.3.
284.8-286.2	Ls, lt-lt m gr, v arg to shaly, skel wackst, sm to med crin debris, 4 cm Derbyia at base.
286.2-287.5	Ls, v lt brn gr, dense, sl arg, some brach debris; crin debris near base; intraclasts at base.
287.5-288.5	Ls, as above, irreg upper surface with swirled darker infill from above; more skeletal than above, common crin debris.

Soldier Creek Shale Member

288.5-289.7	Clayst, v lt gry-v lt grn gr, sl calc.
289.7-292.3	clayst, must, m red brn, mottled with lt me red brn top 0.5', mottled v lt grn gr below; soil fabric, fractures and fill-structures.
292.3-301	Mudst, v lt gr, massive, silty/micac, noncalc, bottom 3' become more coarsely micac; 293 and 294.7 faint hor burrows; 296.4 siderite nodules; Leisegang swirls and incipient siderite nodules at 294.7, 297.7, 299-201; plant debris at 296.5, 297.8; nice Neuropteris impressions at 298.1-298.4, 299.6, 300.1, 300.7, Lepidophloies at 298.1-298.4.
301-306.4	Mudst, lt gr, v silty, coarsely micac, noncalc, Leisegang and incipient siderite nodules scatt thru, scatt to abnt fine to leafy plant debris thru; lower 1' with faint hor lam.
306.4-307.5.	Mudst, lt gr- lt m gr, siltst lam and starved ripple x-lam thru, hor burrows at base.
307.5-316.9	Silst, approaches vf sandst, v lt gr, v micac (fine to coarse), porous, noncalc; siltst interlam with mudst at 309-309.2; 314.2 arg ripple x-lam.
316.9-319	Siltst interlam with mudst, v lt gr, micac top half; lower half is mudst, lt gr, with scatt silst lam; scatt fine plant debris.
319-335.4.	Siltst, approaches vf sandst, v lt gr, v micac (coarse micac), v porous, mostly massive but interlam with find mudstone lam, m gr, at 319.5-19.8, 22.4-23.8, 29.3-29.8, 31.7, 32.1, 33.1-33.3, 33.8, 34, 34.3-34.6; hor and irreg calcite cements basal 0.7;.
335.4-336.6	Silst to mudst, top 1.5' siltst as above, porous, sl calc; lower 0.7' mudst, lt m gr, v silty, micac, abnt sm plant debris.
336.6-337.2	Siltst as above, micac, v sl calc, but with abnt plant debris and coaly wood frag (Calamites).
337.2-337.7	Clayst/sh, lt m gr, sl calc, pectinid noted, skel debris as base.

Burlingame Limestone Member

337.7-338.8	Ls, lt gr, v arg to shaly, v fossilfi wackst, abnt sm to lg brachs; 338 lg bivalve; lower 0.3'; with brachs and snails.
338.8-339.5	Sh, lt-m gr, calc, finely lam, some v sm bivalves:, sharp base.
339.5-340.8	Ls, v lt gr, arg to shaly (top 0.3'), intraclastic top 0.3', unfossilif; irreg frac and/or sm intraclasts thru most, dk clasts (apatite?) 1-10- mm in basal 0.3 grad below.
340.8-343.2	Ls (or dol), pale gr-pale grn gr, weak fizz, xf, sl arg, unfossilif, generally featureless but vert fractures upper half filled with sl darker material; bottom 0.6' weakly lam.

Scranton Shale Formation

Silver Lake Shale Member

343.2-346.4	Mudst, v lt gr, silty, micac, softer than above, generally featureless, v faint hor lam.
346.4-357	Sh, lt m gr, v sl silty in part, part sl calc, dense; top 0.4' more silty/micac; 352.6-353 some micac lam and hor burrows; 353-357 scatt find silty/micac lam (no fossils noted); pectinid bivalves noted at 47.5. 348.5 (pyr), 49.1 (pyr), 49.6-50, 50.4-50.8, 51.3, 52; 347 sm nuculoid; 348.1, 349, 350.2-50.4 faint hor burrows; 351.5 pyrite nodule; grad below.
357-358.7	Sh, lt m-m gr, sl calc, part faintly and finely lam, a few hor burrows, scatt to common well-preserved pectinids.

Rulo Limestone Member

358.7-359.2	Ls, lt gr, v arg to shaly, skel wackst, productid brachs, crin debris common; base with thin dk gr to blk shale with lt gr horiz burrows and pectinids.

Cedar Vale Shale Member

359.2-359.3	Sh, Blk, slaty, organic, with abnt sm pectinids.
359.3-360.8	Interlam siltst/silty mudst, v lt-lt gr, siltst dominated, part sl calc, micac, some fine plant debris, grad below.
360.8-366.8	Mudst, v lt gr, silty, micac, with fine lam; lam silty/micac with scatt fine plant debris, noncalc; lower 1' with some cscatt coarse plant debris and scatt h or burrows; insipient siderite nodules 366.6.
366.8-367.4	Sh, m gr, part sl calc, with scattered pectinids.
367.4-367.9	Mudst, lt gr, with v silty mudst swirls to subvert burrow mottles.
367.9-369.8	Sh., v lt-lt gr, v calc, dense, arg, discontinuous fractures par targ filled, unfossilif, some pin-point porosity in lower part.
369.8-373	Sh, Calc, lt gr, grad to arg ls, unfossilif, pt fractured and infilled; sharp contact at top; lower 0.6' with arg swirls and irreg clasts, grad below.
373-375	Ls or dol (faint fizz), v lt gr, dense, arg, discontinuous fractures part arg filled, unfossilif, some pin-point porosity in lower part.
375-377	Sh, v lt gr-grn gr, dense, massive, generally featureless, sl calc, some scatt sm lt clsts in middle.
377-378.1	Sh, lighter than above, sl more calc, dense, generally featureless, unfossilif, a few scatt clasts (1-2 mm).
378.1-397.7	Sh, lt gr-grn r, lower 1.5' with scatt to common sm lt cladts 1-2 mm, some irreg swirls, grad below.
397.7-381.4	Sh, lt gr, noncalc, softer than above, sl silty, irreg-shaped concretions 380-80.9 (lt brn gr, siderite?), shale swirls around concretions, grad below.
381.4-384.2	Mudst, v lt gr, v silty/micac, calc; interbedded with arg siltst 0-2-2" thick, calc-cemented, part lensatic; some coarse hor lam; hor burrows or tool marks in mmiddle part; grad below.
384.2-387.4	Sh, lt m-m dk, silt-micac, scatt sm plant debris, tool marks and/or burrows common; interlam with silty mudst and arg siltst, lam 1-15 mm thick, lam spaced every 1-20 mm thur, calc, some part lensatic, scatt subvert burrows.
387.4-388	Sh, lt gr, sl silty-micac, som sl calc thin lam, calc at top and bott; scatt sm brqach or mollusc debris at top; bottom with common sm-lg brach or bivalve debris, common ostracodes.
388-388.4	Sh, lt m gr, part sl calc, with thin fossilif lam thru, scatt to abnt sm skel debris to large complete bivalves, common ostracodes.
338.4-389.3	Sh, lt gr, softern than above, noncalc, chunky, resembles underclay, pyritic streaks top half; common to abnt carbonaceous debris (including indet leaf debris 2"), coalified woody chuncks to 1/2"; grad below.
389.3-400.7	(no core recov 393-395.5). Sh, lt gr-lt m gr (grad thru lower half); v lt org brn sideritic streaks and nodules at 90.5, 91.5, 92.1, 92.5, 95.9, 99.1; pyritic lens at 89.5 and 90.9; scatt to common plant debris at 89.3-91.2, top 0.6' with wood impression (part coalified), nice Neuropteris at 89.7; silty/micac lam, part burrowed at 95.9-97.2; scatt pectinids at 91.7, 91.8, 91.9, 92.1, 92.3, 92.4, 98.9, 99.1, 99.2, 400.2, 400.4, 400.6; other bivalves noted at 92.3, 92.4, 97.6, 97.9 (with Worthenis), 98.1 (sm

nucuid), 98.6, 99.1, 99.3, 99.7, 400.6, 400.7 (shell debris abnt at base); 399.8 hor burrow; grad below.

400.7-403.2 Mudst, lt-lt m gr, v silty-micac, calc, with thin stringers or lenses or arg siltst, part finely lam; sharp irreg contact at base (1" relief).

403.2-406.3 Mudst/Sh, lt-lt m gr, v silty/micac, calc, part relatively dense and hard (indurated); become less silty down; some thin silty stringers top half; 404.2 pectinid and other bivalve; 404.6, 404.9, bivalves; grad below.

406.3-415.5 Sh, lt lt m gr, calc, blocky, sl silty-micac, becomes less silty down, generally featureless nonlam shale thru; scatt silty lam top 1.7'; sm bivalves or bivalvegrgs at 07, 07.4, 07.4, 12.5, 13.4, 14.1, 14.4, 15, 408.4 lens with abnt productids; hi-sprired gastros at 12.2, 12.8, 13.2, 13.4, 413 productid frag; grad below.

415.5-425.5 Sh, lt m gr, blocky calc, par sl silty, similar to above; scatt 2-5 mm pyrite blebs; sm bivalve or bivalve frgs at 17, 18.1, 19, 20.4, 21.8, 22.1, 22.5, 22.9; nice ribbed bivalves at 18.6, 23.1; 417.9 pyritized Worthenia, 21.2 ornamented hi-spire gastro and nice Plagioglypta (1"), 29.9 sm Plagioglypta, 23.7 sm gastro, 24.1 pectinid and productid frags, 24.6 hor burrow, 25.4 productid; grad below.

Happy Hollow Limestone Member

425.5-427.5 (in part poor recovery).Sh, lt-lt m gr, v calc, lower 0.4' is arg ls; blocky sh as above, fossilif, branching & fen bryoz and crin debris at top, remainder of shale with abnt complete sheeeets of fen bryoz (sm to lg fenestrae), a few scatt prductids, sm rhynch brach near middle; basal arg ls with crin debris (part lg) and productid-spiriferid-composita brachs.

White Cloud Shale Member (upper contact not recovered)

427.5-442 No core recovery, cutting sample from basal part in sh, lt m gr, calc.

442-450 Sh, lt m gr, blocky, part sl silty/micac some scatt v thin silt lam, sl calc; sideritic zones at top, 43, 43.9, 42.3; pyrite and sphalerite; fine carbonaceous debris at 421.5, 42.8, 43.6, 44.3, 46.5, 47.9, 48.6, 49.5; pyritized leaf or bivalve frag at 450; grad below.

450-452 Sh, lt m gr, sl calc, some silty/micac lam, becomes blocky and more micac in lower 0.5'; grad below.

452-461.7 Sh, lt-lt m gr, sl silty/micac, sl calc to calc, become more calc down; blocky; 453.5 fine carbonaceous debris.

Howard Limestone Formation

Utopia Limestone Member

461.7-462.6 Ls, arg, dense calcilutite, v arg at top; top 0.2' is sh, chunky, soft, calc.

Winzeler Shale Member

462.6-464.2 Sh, m gr, noncalc, abnt hor burrows, at top (calcitic burr in darker sh), scatt to common sm hor burrows filled with iron-oxides thru, shale is non-silty and v finely lam; shale becomes soft and calc at base; base sharp.

464.2-465.8 Sh, approaches arg ls in part, v lt gr-v lt grn gr, calc to v calc down; fine skel calcarenite lens at 465.6, becomes more skeletal down; dark hor burrows near top; top half with branching and fen bryoz, scatt brachs; lower half with crin debris, brachs (incl productid), scatt gastro.

Church Limestone Member

465.8-466.6	Ls, lt gr-v lt brn gr, skel calcarenite, sl arg, becomes v arg near base and top; indet brachs and fine skel debris, lg brachs near base, some branching bryoz.
466.6-469.1	Ls, arg to v arg, approaches shaly ls or v calc shale in top half; top 0.5' abnt brachs (productids & others), scatt bryoz and bivalves; 467.1-68.1 scatt brqachs, common crin debris, fen bryoz; 68.1-69.1 fine skel wackst to packst, common crin debris, other indet fine debris (much dk colored), lg brach near base.
469.1-469.4	Sh, blk, noncalc, vf lam, top half with calc hor burrows, pyritized hor burrows in middle. (*Aarde Black Shale*)
469.4-470.25	Sh, lt m gr-brn gr, calc, scatt sm brachs, to crin debris.
472.25-473.5	Coal (*Nodaway Coal*).

Severy Shale Formation

473.5-482.7	Sh, lt-lt m gr, pt sl silty-micac, pt with fine silty laminae esp in top half, calc to sl calc thru, shale is softer and chunkier in lower 1.7' (resembles underclay); top 0.5' chunky and soft, underclay, siderite streak, coaly plant debris; pectinids at 74.15, 74.9, 75.3, 77.2, 78.8, 80.3, 82.4; 74.9 hor burrows; 79 pyritic lam.

SHAWNEE GROUP

Topeka Limestone Formation

Coal Creek Limestone Member

482.7-483.9	Sh, lt gr, v calc, approaches arg ls, faint burrow mottles thru, abnt fine skel debris (bivalve-brach?) at 83.2.
483.9-485.3	Ls, v lt gr, agr skel wackst, become v arg lower 0.5', scatt brachs (indet whole-shell) thru but rare in lower 0.5'.
485.3-490	Sh, lt-lt m gr, v calc, with stringers of brach debris in sh, interbedded with thin nodular to lensatic limestones, v lt gr, arg, skel wackst-packst; top 0.6' with common brqachs; thin ls with brach, crin at 85.4; nodular brach-rich (scatt crin) ls at 85.6-85.7; brach-crin packst at 85.9; nodular brach-crin packst lenses at 86.1, 86.3; brach (mostly productids) stringers in sh 86.4-87.4; brach-crin packst at 87.7; fusulinid-crin-fe bryoz packst at 87.9, 88.2, nodular packst-wackst with fen-crin-brach; 89.5 burrows.
490-490.8	Ls, v lt brn gr, arg, wqckst, irreg burrow mottles; scatt crin debris and brachs (productids); packst at base.

Holt Shale Member

490.8-491	Sh, dk gr to blk, calc, thin lam with sm skel debris including sm brachs and bryoz (fen and branching).
491-491.3	Ls, v lt brn gr, arg, skel wackst, sm brach-crin, faint burrow mottles.
491.3-492	Sh, lt gr, v calc, fossilif thru, sm indet brachs, hor burrows.
492-493.15	Sh, m dk gr to blk, non calc top, sl calc below; 92-92.3 blk, orbiculoids noted; 92.3-93 m dk-dk gr (92.8 pectinid); 93-93.15 dk gr-blk, sl calc.
493.15-493.3	Sh, blk, noncalc.
493.3-493.5	Sh, dk gr-blk (top), calc, lam.
493.5-493.8	Sh, dk gr-lt m gr, sl calc to v calc, sm brachs noted in middle.

Du Bois Limestone Member

493.8-494	Sh, lt m-dk gr, v calc, approaches ls, scatt sm brachs.

494-494.8	Sh, v calc grad to ls, v arg, lt gr, top half packs with whole-shell brachs; middle with log productids, some crin debris, gastro, fusulinids; bottom half less skeletal, sm brachs, fuslinids?

Turner Creek Shale Member

494.8-495.2	Sh, lt gr, v calc; skel calcarenite stringers in lower half with sm brachs, gastro, indet debris.
495.2-495.7	Sh, lt-lt m gr, calc, hor burrow mottles, indet skel debris molds in lower half; sharp basal contact.

?Sheldon Limestone Member

495.7-496.3	Ls, v lt brn gr, part sl sandy, possibly burrow mottled, irreg sm calcite void fills.

?Jones Point Shale Member

496.3-500.4	Sh, silty grad to silst, v arg, v lt gr-lt org brn-brn gr, & lt grn gr; becomes less silty in lower half, nonsilty lower 0.5'; 96.8-97 with irreg calcareous nodular mass with lt grn gr shale fill in fracs at base; unfossilif thru.

?Curzon Limestone Member

500.4-501.5	Ls, pale brn gr, sl arg to arg, dense and featureless thru except top 0.2' with brach and irreg dark indet mottles in middle; grad below.

Iowa Point Shale Member

501.5-502.9	Sh, pale gr, v lt-lt gr, becomes darker hued down, calc to v calc, featureless, grad below.
502.9-504.1	Sh, lt-lt m gr, calc to v calc, dense, increasing numbers of sm (1/2 - 5 mm) v lt gr dense calcite mottles downward; grad below.
504.1-507.2	Sh, m gr, calc, nonsilty, homogeneous and featureless, blocky with v lt gr arg ls lenses (diffuse boundaries) at 04.9-05.1; sl more calc and lighter at 05.7; grad below.

Hartford Limestone Member

507.2-508	Sh, m-lt m gr, with dense lt gr arg ls at 07.4-07.6; some scatt brach debris; grad below.
508-511	Sh, v lt gr-v lt grn gr, v calc, approaches v arg ls in part; arg ls beds in top 0.3', 10.2-10.3; fossiliferous thru; top 0.6' nice brachs, some crin debris; 08.6-09.5 productid brachs, scatt crin; 09.5-10.4 sm productid brachs, lg spiriferid, bryoz?; 10.3-11 sm fossils in laminae, brachs, becomes silty-micac in lower part, sandy at base.

Chalhoun Shale Formation

512.8-514.2	Sh, md lt gry, mdstone w/slickenslides and disrupted laminae, flakey, non cal, non lty, greasy, underclay?, mottled inn color w/lt grn clay flakes in upper part, grades sharply to unit above.
514.2-520.8	Sh, md lt gry, w/lt gry sltst interlam, non-cal, micaceous, horz lam, monor carbonaceous material, sltst lam concentration increase upward.
520.8-522	Sh, md dk gry, cal, lam, foss w/brachs, clams, abundance of small clams at base, where grades to unit below.

Deep Creek Limestone Formation

Ervine Creek Limestone

522-522.2	Sh, lt grn gry, cal, clams, lam but mottled w/md lt gry patches, grades to dk sh above.

522.2-522.6	Ls, lt grn gry, barren mdstn, abun horz frac, horz lam, some interlam lt gry shale, grades to unit above sharply.
522.6-523.0	Ls, lt gry, shel wkstn, some osagia, gastropods, id.
523.0-524.3	Ls, v. lt gry, dns, grnstn, osagia coated grains, with common gastropods.
524.3-530.5	Ls, vlt gry, dns, shel wkstn-mdstn, gast?, algal blades? fus forams, brachs, ech in arg interval 26.3-26.6.
530.5-538.7	Ls, lt gry, dns shel wkstn w/some pkstn lenses, foss w/fus forams, brachs, ech, possible algal baldes, sli porous, common dk gry arg styolitic intervals 1-5 cm thick at 10-20 cm intervals.
538.7-541.3	Interbedded sh & ls, 4 interbeds of equal thickness, sh, md lt gry-dk gry, cal, lam, horz burr prominent, sparsely foss w/clam, brach, grades to ls above & below (resembles upper biot part of blk sh). Ls, lt gry, skel wkstn, brachs, ech.

Larsh Shale

541.3-542.2	Sh, md lt gry, slty, cal, horz burr, clam w/few brachs in upper part, upper .3' dk gry w/clam, inart brach and grn gry horz burr, grades quickly to unit above.
542.2-543.6	Sh, blk, lam, phosphatic fissile, fishscale, grades to gry sh above.

Rock Bluff Limestone Member

543.6-545.8	Ls, v lt tan gry, homogenous, uniform, sli slty, skel wkstn, fus formas, brachs, id, sharp upper contact w/overlying blk sh.

Oskaloosa Shale Member

545.8-546.3	Sltst, md lt gry, arg, cal, horz burr, clam molds, grades to ls above.
546.3-556.3	Ss, v lt gry, vf, slty to sltst, cal, micaceous, mod porous, mod friable, horz lam in lower part, homogenous & uniform in upper part, becomes more arg in upper part, sharp uppper contact. 2.0' lost core in this interval.
556.3-560.0	Sh, grn gry, mudstone, slty non-cal at base grading to sltst, sli cal at 558.0, poorly formed ls mdstn nodules at 57.5-58.0, where slst md lt gry-md gry, arg, mnor carbonaceous plant frags, grad upper contact.

Ozawkie Limestone member

560.0-560.5	Ls, wk - v lt grn gry, chalky mdstn, arg, nonfoss, mottled textured, sharp upper contact.
560.5-561.2	Ls, wk - v lt gry, grnstn, f-c grained pelletal, whole clams, some coated grains, grades to unit above.
561.2-561.6	Sh, vlt grn, v cal w/some osagia scattered.
561.6-562.3	Ls, wh - lt grn gry, grnstn, osaiga coated grain, v arg in basal .2'.
562.3-566.8	Ls, lt grn gry, arg v- arg, shaly, mdston, nodular, chalkey, grades to osagia grenstn lense at 62.8 then back to mdstn, sharp upper contact.

Tecumseh Shale Formation

566.8-569.2	Sh, lt grn gry, lam, slty, non-cal, non-foss, grades up to unit above.
569.2-591.0	Sh, md gry - md dk gry, v. sli cal, lam, smooth, non-foss except scallop @ 74, minor sltst lam from 69.2-74.0, micaceous.

Lecompton Limestone Formation

Avoca Limestone Member

591.0-598.7	Sh, md lt gry to lt gry, very ofss intervals top -93.1, 95.1-95.3, 96.7-97.1, 97.8-98.8, slty, brachs, ech, horz burr common, clam, Erosion, surface at base w/grnstn from 98.4-98/7 w/ls clsts, osagia, algal? grains, brach, id.

King Hill Shale Member

598.7-600	Sh, lt grn gry, v slty, v cal to slty ar g ls mdstn, barren of foss but well developed vert -subvert clay filled rootings.
600-603.8	Sh, lt grn gry, v slty, cal, rotted to mottled w/minor ls mdtn nodules at 602.

Beil Limestone Member

603.8-604.6	Ls, v lt grn gry, mdstn, barren of foss, birdseye spar, sharp upper contact with overlying shale, minor amounts of ls incorporated in base of overlying shale, minor clay filled fractures.
604.6-604.8	Ls, vlt grn gry, mdstn, stromatolitic lam, birdseye, arg, slty, sharp upper contact.
604.8-605.1	Ls, v lt gry, grnstn, osagia, coated grains, fine grained, id fos, sharp upper contact.
605.1-611.5	Ls, lt gry - v lt gry, nshel wkstn-mudstn, w/v arg-shaley layers 05.2-06.1, 06.5-07.1 9green), 08.0-08.5 (dk gry), 08.9-09.7 (md gry), barchs, ech, mollusc, id, us foram common in upper part.

Queen Hill Shale Member

611.4-614.7	Sh, md dk gry at base to md lt gry above, with md dk gry again from 11.8-12.5, la, cal, brachs, clams, horz bur 11.8-12.2, grades to unit above.
614.7-617.5	Sh, blk, fissile to nonfissile, phosphatic w/phos lam, clam & int brach near base, conodonts, fish scale, sharp grad contact.

Big Spring Limestone Member

617.5-620.2	Interbedded ls & sh, 5 beds total, 3 ls (70%), 2 sh (30%). Ls, lt gry, arg, skel wkstn, ech, brach, fus foram. Sh, md gry, cal, foss w/ech, brach, fus foram common, tip ls grades to black color in upper .1' w/brach hash at very top.

Doniphan Shale Member

620.2-622.5	Sh, md brn gry at base to md lt gry above, cal, dns, foss w/clam, brach, ech.

Spring Branch Limestone Member?

622.5-623.4	Ls, v lt gry, mod dns, grnstone, coated grains, osagia.
623.4-627.2	Ls, v lt gry, dns skel mdstn-wkstn, brach, ech, fus foram, md gry arg zone 24.6-24.9.
627.2-627.4	Sh, dk gry, cal, foss, brchs, eh, upper .1' md gry, grades to ls above.
627.4-629.1	Ls, lt gry, arg to v arg, v foss skel wkstn, brachs, ech, bioturbated, fus foram near top.

?Kanwaka Shale Formation

629.1-630.3	Sh, md gry, slty, cal, lam, at base w/clam grading up to md dk gry sh w/abun foss, brachs (whole valve), ech, cal, gradational upper contact. Carbonaceous plant fragments common in middle portion which is non-lam, non-cal, and possibly rooted claystone (possible underclay).

Oread Limestone Formation

?Kereford Limestone Member

630.3-630.7	Ls, lt gry, skel wkstn-pkstn, brachs, id, sharp upper contact.

630.7-630.9	Ls, md lt gry, skel grnstn, hash, brachs, id, arg at top and v pyritic, gradational upper contact.
630.9-637.1	Ls, lt gry, sli arg, skel wkstn, ech, brach whole valve, fus foram, grades to rexltd mdstone top w/whole large clam valves and then back to wkstn, black chert at 35.4, 34.1, 33.8, sharp upper contact.
637.1-639.1	Ls, lt gry, v arg, homogenous, skel wkstn w/whole valve, brachs, fus forams, ech, forams common in upper half.

?Heumader Shale Member

639.1-640.6	Sh, md gry in basal half grading upward to md lt gry, cal - v cal upward, sli foss in basal half w/brachs becoming more foss upward w/brachs, corals, bryz, minor ech, non-lam, slty w/minor slt lam, grades to arg ls above.
640.6-640.7	Sh, md dk gry, v cal, v foss - hash, mollusc, clam fragments abundant, also coal grags.
640.7-642.8	Coal.
642.8-642.9	Sh, lt gry to md lt gry, non-cal, silty - v. silty, homgenous, rooted, ls clasts and brach at base, common abund coalified and pyritized plant fragments throughout, (underclay).

Plattsmouth Limestone Member

652.9-644.5	Ls, lt gry, skel mdstn-wkstn, brach, id, become mdstn in upper part w/some nodules and broken fragments surrounded by gry sh.
644.5-650.0	Ls, v lt brn gry, porous, skel grnstn, osagia, fine grained at base grading to coarse upward, all grains coated, forams, brachs, ech, id, most porous at base, better cemented upward, large snails in upper part, grades to unit above.
650.0-652.5	Ls, lt gry, skel wkstn-pkstn, brachs, fus foram, algae, ech, forams abundant, dns, sli styolitic, one dk gry arg layer in middle, sharp upper contact w/fus rich dk gry arg ls @ top .1'.
652.5-662.5	Ls, interbedded arg and less arg beds at interval of 5-20 cm. Arg layers are md gry, styolitic as below, skel, wksstn-pkstn, with ech, brachs, large ovoid fus forams abundant; less arg layers lt brn gry, skel wkstn, forams, brachs, ech, id. Unit becomes progressively more foss upward and arg bands intensify in color to dk gry. Becomes pkstn-grnstn @ top with some algae (dasy?).
622.5-668.0	Ls, v lt gry, skel wkstn, dns, brachs, bivalve, ech, coral large rexltd molluscs id?, or algal blades?, dk gry arg and styolitic bands at 10-20 cm intervals.
668.0-670.7	Ls, lt gry, arg, skel wkstn-mdstn, ech, coarl, brach, becomes mose foss upward with pkstn layers, possible sponges?, prominent black styolites scattered throughout, large ech debris at top.

Heebner Shale Member

670.7-671.6	Sh, md gry at base grading upward to md lt gry, slty, sli micaceous, vertical and horz burrows, cal, pyritic at top, w/bivalve mold.
671.6-673.6	Sh, blk, fissile, phosphatic, fish scales, conodonts.

Leavenworth Limestone Member

673.6-674.9	Ls, lt gry, dense and non arg in lower, v arg in middle and non-arg in upper. Skeletal wkstn w/ech, large phylloid algal blades?, id, sharp upper contact.
674.9-675.4	Sh, lt grn gry, cal, biot, w/whole valve brach, ech, grades to ls above.

675.4-676.3 Ls, md lt gry, ext arg to shaley, ext foss, hash with brach (several types large and small), at base grading up to ext abundant but still arg fus foram hash, w/ech, brach.

Snyderville Shale Member

676.3-682.5 Sh, lt grn gry, cal, slty, pyritic, massive, uniform, nonfoss, grades to v cal sltst in upper 1.5'. Sharp upper contact.

Toronto Limestone Member

682.5-684.7 Ls, v lt gry, mdstn, highly broken to brecciated into variable size fragments with grn gry non-cal clay fills.

684.7-686.7 Ls, v lt gry-wh, dene, sli arg, skel wkstn at base w/brachs, ech, to dns mudstone above w/vert and horz grn gry clay filled fractures in upper .5'. V dense, overpacked v f grn peloid? grnstn w/intergranular spar from 685.4-685.7. Gradational upper contact.

686.7-692.6 Sh, lt grn gry, cal - v cal, w/ls nodules in lower half and abundant foss in upper half. Nodules aer skel wkstn w/brach, ech, mollusc, id, grades at 690 to v. foss sh, w/brachs, ech, v cal to v arg ls.

DOUGLAS GROUP
Undifferentiated

692.6-693.5 Sh, md lt gry, cal, slty, micaceous, foss w/snail (high spired), brach, pelycepod, tr horz burrows 9small 1 mm wide), grades abruptly to unit above.

693.5-704.0 No core recovery.

704.0-708.7 Sh, interlaminated vari colored from yel org to red brn, non-cal, appears lam except upper half which has some contortions , sli slty and micaceous, dense dol septarian concretion w/pk wh cal spar frac fills from 707.7-07.9. No upper contact

708.7-710.9 Sh, grn gry w/pale to dk yel org blotches and horz layers, sli cal but cal where yel org, minor carbonized plant material, transition to unit above.

710.9-715.3 Sh, md gry, sli slty, minor sltst interalm, in lower part sltst lam & lenses in upper part, sli cal-cal, smooth, uniform.

715.3-730.3 Sh, d lt gry w/lt gry sltst interlaminae and thin lenses, sltst is sli cal, micaceous, laminae & lenses usually 1-2 mm in basal half and sltst content increases upward, but less silty in middle, plant impression at 725.0 pelycepod at 22.7 (both valves), sh is smooth, uniform, slt filled horz burrows @ 21.5. Sltst @ 720.5-721.2 w/abundant carbonated plant debris, and well bioturbated, cal, arg, mkcaceous.

730.3-736.5 Sh, md lt gry to md gry, non-cal - sli cal, lam, sparse brach and inart brach, smooth, uniform.

736.5-736.9 Sh, dk gry at base immediately overlying coal to md dk gry above, thin .5 cm brach foss hash overlying coal, remainder of sh, cal w/small brachs, grades to lighter colored sh above.

736.9-737.4 Coal, blk, cal.

737.4-740.2 Sh, md gry to md dk gry, non-cal, non-lam, massive, w/small ls nodules, thin 1 cm coaly material at 738.0, somewhat interlam above, sharp upper contact with overlying coal.

740.2-759.1 Interlayered Sh and Sltst, sltst layers begin at <1 mm in thknss and increases in thkns and/or density up secton until 40% of secton is sltst lam. Sltst, v lt gry-lt gry, micaceous, non cal, abundant finely disseminated carbonaceous particles. Sh, md gry to md dk gry, micaceous, silty, non-cal, finely disseminated carbonaceous particles.

Lamination is horz mostly w/some sltst thickening to small lenses w/minor ripple x-lam, and some soft sediment deformation, 1 cm ls mdstn nodules from 740.2-40.6 where rooting of underclay begins to disrupt lamination.

759.1-778.8 Sh, md gry, sli micaceous, sli slty, some carbonaceous debris common, sli cal -non-cal, horz lam, dense, smooth, generally nonfoss.

778.8-785.0 Sh, varies in color from md lt gry to md gry, cal v. cal, variably foss throughout with, snails (high spired), brachs, ech, clam?

785.0-787.2 Sh, md gry, silty, micaceous, cal-v. cal, lam-blocky, foss w/gastropods, ostracode (very common)?, bivalve, minor thin shell acccumulations @ 785.6, 85.0, 84.9, 84.3. Color change at 785.0 to md lt gry sh above.

787.2-788.5 Ls, grn gry, ext arg, dense, uniform, non foss, lamier in upper half and brecciated texture. Sharp upper contact.

788.5-792.2 Sh, grn gry, cal, w/dk rad brown blothces, nodular ls mudstn 791.3-91.7, small brachs in shale @ 90.5, 89.8.

792.2-797.2 Sh, dk red brn (10YR 3/4), cal to non-cal, blocky fracture, slickenslides common, nonfoss.

797.2-798.8 Sh, grn gry, sli cal to non-cal, sli slty and micaceous, blocky fracture, grades rapidly to red shale above.

Iatan Limestone Member

798.8-801.5 Ls, v lt gry, dense, mudstone - wkstn w/rare gastropod (whole) and common large fuss forams, forams are scattered to concentrated in wkstn - pkstn lenses, esp @ base and 789.9. Highly irregular vertical contact from 789.4-89.8 w/overlying ls which is lt gry tan, mudstone, ext dense, lithographic w/v. sparsze shel grains, brach, gastropod (small high spired and larger) hyol molds?, ech. Green shale seams and lenticular ls in top .3', grades to unit above.

801.5-806.3 Ls, v lt gry in upper, lt gry in lower, lower half interbedded to nodular foss grn gry sh and skel wkstn, interbeds 5-15 cm thick, sh cal w/brachs (whole valve), ech, bryz? ls, wkstn w/ech, brachs, bryz?. Upper half dominated by ls, lt gry, sparse skel wkstn to mudstone w/minor shales and large fos forams appear scattered beginning at 803.0 and become more common upward.

806.3-807.3 Ls, md lt gry and arg at base grading to lt gry skeletal wkstn w/brach, ech, then grading sharply back to sh @ top.

Weston Shale Member

807.3-810.3 Sh, lt gry in upper and lower parts, md lt gry in middle, cal-v. cal, foss w/brach, ech, bry, ls wkstn nodule at 809.0 in mud lt gry sh, more foss in upper 1', grades slowly to ls above.

MISSOURI SUPERGROUP

LANSING GROUP

Stanton Limestone Formation

South Bend Limestone Member

810-811.9 Ls, lt gry, dense, arg in part esp in basal .5' and between 811.0-11.3 and 810.3-10.5 where it grades to foss shale w/ech, brach. Ls is wkstn w/ech, brachs, gast.

811.9-813.0 Sh, grn gry, cal, lam, sparse ech, brach, .05' md gry shale w/weakly developed small brach hash at 812.3' becomes more foss in upper part and grades into ls above.

813.0-813.8	Ls, lt gry, dense, arg, ext foss pkstn-wkstn w/large fossil fragments, brachs, mollusc, large dasy algal blades, sharp upper contact.

Rock Lake Shale Member

813.8-814.0	Sh, grn gry w/red stain @ base, cal, foss, w/ech, brach.
814.0-817.0	No core recovery.

Stoner Limestone Member

817.0-819.7	Ls, v lt gry to lt grn gry, barren mudstone, with prominent birdseye in lower .2' grading upward to mudstone w/common anastomosing green sh seams isolating ls into lenses, these grade upward to vetical to subvert clay and cal spar fill cracks w/red stain in upper 2mm, no upper contact due to lost core.
819.7-821.6	Ls, v lt gry, sparse skeletal peloidal to oolitic grnstn, brach, ech sparse, no dense, oomoldic to pelmoldic porosity well developed, sharp and irregular upper contact.
821.6-830.1	Ls, v lt gry, dense, skeletal mustone to wkstn, w/common lt gry arg to v arg shaley laminae anastomosing through every 1-10 cm. Divides ls into lenses in places. Sharp upper contact.
830.1-832.4	Ls, v lt gry, dense, skeletal wkstn, brach, ech, id, arg to v arg at 31.7, 30.8, 30.3-30.6.
832.4-841.0	Ls, v lt gry, skeletal wkstn-pkstn, ech, whole valve brach, abundant rxtle id mollusc, abundant brown cal spar throughout, large gastropods, spar filling fractures, plus arg to v arg layers which parts rock into convex chips, more arg chalky layers are sparse skel mudstone, these become more dominant in upper part w/dense whole valve brach & molusc wkstns (.3' avg) interbedded.
841.0-842.3	Ls, v lt gry, skeletal wkstn, dense, ech, brach, mollusc, id.
842.3-842.9	Ls and sh, ls , lt gry, skel wkstn, ech, brach, fine grained, grades to lt grey shale in upper half, cal, ech, brach.
842.9-843.9	Ls, lt gry, arg, v. slty dense, mdstn, sparse ech, brach, sparse dk gry horz to vert burrow spreite throughout, v biot in basal .1' w/sparse brach.

Eudora Shale Member

843.9-844.3	Sh, dk gry - blk, bioturbated w/horz and vertical burrows in lower .1' and upper .2', burrows lt gry, 844.1-44.2 is blk fissile phosphatic sh, phosphate as tan specks up to 2mm, fish scales, conodonts on lam planes, trace horz burrows.
844.3-845.4	Sh, dk gry at base grading to lt gry in upper .3', cal to v cal, small brach foss hash 45.0-45.2, grades up to lt gry sh w/small brachs and bivalves, cal, and then to horz burrowed lt gry sh w/sparse skeletal mat, sharp upper contact.

Captain Creek Limestone Member

845.4-846.5	Ls, md lt gry to dk gry, mudstone, arg in dk gry seams, bioturbated in part, sparse fine grained brach & ech debris. Nodular to lenticular lt gy ls within dk gry arg ls in middle.
846.5-847.1	Ls, md gry, skeletal wkstn, large gastropods, brachs, ech.
847.1-847.7	Ls, md gry @ base grading up to md lt gry, skeletal wkstn, w/brach, ech, bioturbated.

Vilas Shale Formation

847.7-847.9	Sltst, v lt tan gry, cal, horz - low angle planar x-lam, 1-2cm long x 1mm wide vertical cal spar filled cracks within, cracks initiating from upper surface are v-shapes, rextld md xtln ls fills nodular shaped volumn within siltstone, upper part lenticular within overlying ls.

847.9-850.3 Sh, md gry to md lt gry, sli cal - cal, horz lam, smooth, uniform, with many thin 1 mm or less interlayered cal and micaceous slty layers and microlenses. Minor amount of small (1-2 mm) carbonaceous flecks. 848.1-48.2 is sltst, v lt gry, cal, horz lam.

850.3-853.0 Sh, md lt gry at base to lt grn gry i nupper part, basal .3' and esp basal .1' has concentration of ls pebbles (sand to 3 cm) from ls below, pebbles have brown to blackened surface in shale matrix with small clams and small to large high spired snails. Ls clast concentration diminishes upward, shale clasts present, cal, rubbly, vertically orientated cal spar filled fractures extend from 51.3-51.7. From 51.0-51.3 these same fractures and clay filled. Shale has brecciated texture here. Upper .7' cal but not brecciated. Sharp color contact with overlying unit.

Plattsburg Limestone Formation

853.0-854.3 Ls, v lt pk gry, dense, mudstone, nonfoss, horz, vert and diag spar to clay filled voids common (1 mm wide, by several cm long), basal .1' has concentrated horz spar filled cracks with 2-3 cracks per cm density, upper .5' has horz-diagonal-vert anastomosing clay filled seams. Surface of isolated ls clasts is gry org pnk (4 YR 7/2), grades rapidly to unit above exposure surface.

854.2-854.5 Ls, v lt tan gry, dense, grnstn, all osagia (coated grain) to possible oolites.

854.5-857.0 Ls, v lt gry, dense mostly grnstn top pkstn w/minor wkstn, gast, fus foram, ech, abundant osagia, peloid, brach, some gast vugs, algae 9day) spar cmt.

857.0-859.6 Ls, lt gry, dense, mdstn-wkstn, arg, ech abund, brachs, bryz, dk gry @ 857.9' and shaly w/foss hash, very arg to lt grn shale 857.3-57.8', back to ls above.

859.5-861.2 Sh, dk gry from 860.1-61.2, lt grn gry from 859.6-860.1. 860.1-61.2 sh, dk gry, cal, fossil hash bands in lower 1/2 w/very small brachs, bryz, ech, fens bryz, fronds, large clam (pectin near top); lt grn gry sh, cal, fos, w/brach (whole valve), ech, grades to ls above.

861.2-865.5 Ls, lt gry-md gry in .5' layers, dense, arg, wkstn, ech, whole valve brachs, bryz.

KANSAS CITY GROUP

Lane-Bonner Spring Shale Formation

865.5-869.55 Sh, m dk gry - dk gry, cal, horz lam, foss w/whole valve brachs, bryz, carbonaceous debris, inart brachs, large carbonized wood frag (Megalopteris?) @ 868.0, brachs above & below, 1mm coaly smut at 867.85 w/carbonized plant material. Possibly allocthonous coal. Overlain by m gry, sh, v cal, w/ech, brachs. Grades to m gry sh., (867.3-67.8), w/abundant, ech, brach (whole valve), cal. From 866.2-67.8), w/abundant, ech, brach (whole valve), cal. From 866.2-67.3 is sh, m grey, cal, lam, sli slty, occ clam mold, inart brach, grades sharply to v foss lt gry sh from 865.5-66.2 where sh is v cal, w/ech, large whole valve brachs, grades to arg ls above.

869.55-877.7 Sh, grn-gy, sli cal - cal upward, pyritic, cal spar filled subvertical fractures from 870.6-75.0. From 71.0 up to 69.6 grdes rapidly to Sh, md gry, v cal, w/sparse clam, gast modl to 69.8. 69.55-69.8 gast (highspired) abundant in v cal brn-gry sh. Turns black in top 1 cm. Coal .2 cm. Coal and smut at 869.55, tr phosphate (AM test) immed above.

877.7-879.0 Sh w/ls nodules. Sh, grn gry, cal, surrounds ls nodules. Ls, nodular, dns, mdstn, w/abundant spar filled fractures throughout, nodules 1-5 cm, almost conglomeritic within some to highly brecciated.

Wyandotte Limestone

Argentine Limestone Member

879.0-883.5 Ls, v lt gry w/abundant horz to subhorz lt green shale stringers asnatomosing through ls & separating it into lenses and nodules. Ls, v lt grn gry, dns, arg, braren mdstn except for occasional clam mold, minor spar filled molds (birdseye).

883.5-889.8 Ls, lt gry - v lt gry, dns, arg, mdstn-wkstn, ech, brach, lt grn shale stringers in basal 1.5', grades up to variable wkstn-pkstn w/dasy algae, peloids, coated grains, spar cement.

Liberty Memorial Shale Formation

889.8-893.0 Sh, med lt gry, cal, blocky in lower part, lam above in middle part non-cal in middle, gradational from ls below, ls mdstn-wkstn nodules in basal half, in part fractured, foss above w/clam molds, brach, carbonaceous fragments, ech, brachs.

Iola Limestone Formation

Raytown Limestone Member

893.0-898.2 Ls, v lt gry, dns, mdstn, non arg, sparse fine grained ech, brach debris, some spar spots (mm), chert nodules @ 97.7, 97.9. Some wkstn layers @ 895, w/ech, dasy, osagia,?, large gastropod (4 cm) mold @ 94.3. Sharp upper contact.

898.2-899.0 Ls, v lt gry - wh, broken up interval, chalky, flakey, breaks, w/horz convex fracture, mdstn, non fos.

899.0-900.9 Ls, v lt gry, dense, arg, wkstn, ech, fus foram, brach grn arg shale streak, pyritic.

900.9-901.2 Sh, med gry, cal, foss w/ech.

901.2-901.4 Ls, lt gry a/a.

901.4-901.8 Sh, med gry, cal, foss w/whole fens bry, ech, brachs.

901.8-903.0 Ls, lt tan, dense, arg, mdstn, rare ech brach.

903.0-903.2 Sh, med gry, grad from arg ls below, cal, scattered ech, brach.

903.2-920.6 Ls, md gry- dk gry, dense, arg, mdstn, few ech, brachs, some horz burrows, color varies from med - dk every .5', horz burrow prominent @ 915-16. Becomes almost barren of fossil material from 903.2-915 & very prominant horz burrows. Smooth lt gy cht nodule @ 917.2-.4, barren of foss. Lt gry - lt tan from 903-919.0.

920.6-923.0 Ls, lt gry, v ext arg, dns, wkstn, ech, brachs.

Muncie Creek Shale Member

923.0-923.9 Sh, blk, fissile, gry phos specks, no laminae, horz burrowed upper & lower parts, grades abruptly to md gry to lt gry arg ls, bivalve mold near top.

923.0-924.2 Sh, md gry, cal, foss w/hash of brachs & ech.

Paola Limestone Member

924.2-925.8 Ls, dns, md gry, arg, wkstn, ech, brach, osagia, grades to shale w/has above. Ls lense @ 25.7-.8 wkstone w/ech, brach, id. Bry also. Another lense from 924.5-25.0, ls, ext arg whole valve brachs & ech.

Chanute Shale Formation

925.8-936.0.Sh, lt grn gry @ base gading to med grn gry above, basal .3' incorporates tabular clasts of lms below both horz oriented & at high angle w/ash and ls fragment matrix, cal, nonlam, trace fish scale, ech frag, becomes foss in upper 2.5' w/ech, brach, id, scattered & concentrated in rare vert burrow, whole valve brachs also.

Dewey Limestone Formation

Cement City Limestone Member

936.0-936.9	Ls, lt grn gry, dns, mudstone, nonfos, arg, horz and vertical cracks very prominent w/some clay infiltration & spar fill, crack density greatest at top. Vert crack every .5 cm, horz crack every .5-1.0 cm @ top .3'.
936.9-939.8	Thinly interlayered ls and sh. Ls, lt gry, dns, mudstone non-fos, nodular in lower 1/2 w/sh and interlaminated in upper half. Lower half, nodular to lensatic ls, a/a, blends into sh. Sh, v cal, nonfos, texture perhaps due to burrowing?. Upper half, horz intlam (lam 1 mm to 5 cm) arg ls & sh, nonfos, sh is cal, apparent horz burrow traces.
939.8-943.1	Ls, w/.1' grn sh seams @ 40.5, 42.5, 42.6, 42.9. Ls, lt med gry, mudstone, arg, v sparse fos, ech, brach, a few whole valve brachs (large). Sh hash @ base .2 w/brach, ech?, & phos fish scale materials. Arg seams in this unit anastomose through lms and divide it into idens in places. 940.0-40.3 ls, lt gry, dns, grnstn, osagia, ech, peloids.
943.1-945.0	.Ls, lt gry, pkstn-grnstone @ base, dns, w/osagia, peloid, ech. Upper half is mudstone, lt gry, dns, few cal spar filled cracks, minor ech. Becomes flakey & arg in upper .1'.

Quivira Shale Member

945.0-947.7	Sh, dk grn gry at base grading to greenish gry above, cal, whole valve brachs, whole frond fens bry, w/minor nodular wkstone, ech?, sharp upper contact.
947.7-948.05	Sh, blk, non cal, grades to green shale above, green horz biot structures in upper part, non-lam.
948.05-948.15	Sh, blk, fissile, phosphatic, w/<1 mm phosphate laminae grading upward to phosphate flecks, fish scale.
948.15-948.7	Sh, blk, non-cal, w/grn sh flecks, carbonaceous fragmental debris.

Nellie Bly Shale Formation

948.7	Coal smut, blk, arg, coaly, 2-3 mm.
948.7-950.6	Sh, lt grn gry, sli mottled, slty, micaceous, non-cal to v sli cal, indeterminate brown-dk gry fossil flecks, non-lam, probable rooting, capped by thin coal smut at top.

Cherryvale Formation

Westerville Limestone Member

950.6-954.6	Ls, wh, dense mudstone-pkstone, pelletal, w/calcite spar in lower 2.0'. Uper 2.4' becomes white, soft, flackey & chalky w/common cal spar filled voids to several mm and cracks (birdseye), concave flakes & chips spall off core, lith is mudstone. Gry-grn clay from overlying unit fills birdseye & frctures as low as 952.4', usually mixture of grn clay & cal spar. Concentration of clay fillings increase upward to overlying shale.
954.6-955.4	Ls, conglomerate, lt gry-grn, angular to rounded mudstone clasts, many clasts blackened (pos asphaltic) on outside or with alteration rind, finer angular mudstone clasts in basal .2' grn sh. Grades in middle to filled fabric then back again to .15' of cong and topped by 15' grn sh w/few ls frags.
955.4-956.6	Ls, lt gry, osagia grnstn @ base grading upward to mudstone w/calcite filled fractures. Abrupt upper contact.
956.6-958.2	Sh, gry grn, v cal, wsand to cm size ls nodules horz oriented within. Ls, lt gry, mdstn.
958.2-965.0	Ls, lt gry w/cal gry-grn sh irg lam to nod lms in part. 961.8-965.0 ls, lt gry w/sh a/a, fin grianed wkstn w/scattered ech, fus, brach, algae?, arg to v arg shaly seams, some

whole brach. 960.8-61.8 ls, lt gry, grnstn-pkstn, w/algae dasyclad, some osagia some forams. 958.2-960.8 ls, bedded to nodular, lt gry w/gry-grn (10GY 5/2) irreg shale seams, wkstn-grnstn w/abun fus, minor brach, grades to 1.0' fus pkstn to grn w/ech at top.

Wea Shale Member

965.0-969.0 Sh, med gry grading to med-lt grn gy in upper half. Lower 1.4' sh, med gry, cal mostly ech & brach frags w/fewer to no fus, non-lam. Grades sharply at 67.6 to horz mottled med lt grn & med gry shale w/fewer fos, horz burrows abundant (mottling), sli slty, ib, brach, ech, bry frags & whole frend fenst. bry, bivalve impress, become green shale at top. Sharply overlain by ls lense then back to grn sh. Ls, lense, lt grn gy, arg, biot, mudstone, grades back to cal grn sh. Sh, v. cal, w/whole large brach valves, few fus, ech, horz burr; grades over .5' to ls above.

969.0-971.0 Basically a continuation o 71.0-72.3. Sh, m gry, v cal w/ls (wkstn) nodules, abundant fusulinids, ech, ls nod, lt gry mdstn w/rare ech, bivalve, brach, fus, surrounded by fos med gry sh w/fus, ech, some brach, bry.

971.0-972.3 Ls, lt gry w/cal & fos v arg to sh interlayers, v. arg w/med to lt gry sh. V arg brach & ech wackestone to base grading to interlayered fusulinid pkstone lt gry to v arg to shale fusulinid wkstone-packstn.

Block Limestone Member

975.0-976.5 Ls, m gry, grnstn, coated grains (osagie) principally, coatings are m-dk gry, tr gastropod, upper .2' shaley m gry, cal, biot.

976.5-978.0 Ls, m gry, skel pkstn-wkstn w/peloids, maybe some coated grains, abraded bryz fragments, algal, blades, grades up to large lms nodule of skel mudstone w/sty @ 77.0-77.3. Thin .15' dk gry cal sh w/shel mat @ top and penetrating .1 down into mdstn.

Fontana Shale Member

978.0-984.6 Sh, 84.6-82.7 sh m-lt grn, non-cal to sli cal, nodules of lms (6 cm) in lower .5', non-foss, uneven contorted contact w/overlying fos gry sh. 82.7-78.0 sh, lt-m grn gry, laminated to micro-ripple lam w/thin lighter tan silty laminae, very large complete (whole) fenestelid bryz & brachs in basal .3', brach hash @ 81.9, scat sparse mostly unidentifiable skel debris throughout, fish scale @ 79.6, brach @ 79.0, upper 1.0' grades to lighter green sh w/scatt whole brach valves, becomes more calcareous. Upper .5' very cal to arg ls, biot, brachs, ech.

BRONSON GROUP

Dennis Limestone Formation

Winterset Limestone Member

984.6-996.7 Ls, lt gry, dns, no frac, fus pkstn-grnstn 96.7-95.9, skel wkstn-pkstn w/ech, brachs, forams, 95.9-95.4; 95.4-91.0 fus pkstn-grnstn, arg, w/ech, brachs, 91.0-89.0 wktstn-pkstn, forams w/occ ech, arg in upper 1.0' burrowed. 89.0-85.5 grnstn, coated grains, peloids, occ brach & ech, 85.5-84.6 skel wackstn, poss algal, thin sh laminae @ top. Sharp contact w/overlying shale.

996.7-1000.0 Ls, lt gry to lt grn interbd, grad w/sh below and lms above. Two interbeds of arg to less arg ls. Wkstn to pkstn below w/abun, brach, ech, bryz, and some fusilinid forams, to ext abund fus wkstn to pkstn ext arg to sh in upper half w/occ ech, some pyrite.

Stark Shale Member

1000.0-1001.6 Sh, dk grn gry in basal few inches grading upward to olive green. Few bivalves, horz burrow in basal .6', rest is cal, w/brach & ech debris scattered.

1001.6-1003.4 Sh, blk, fiss, phos lam, fish debris, grades to dk gry grn shale above.

1003.4-1009.0 Sh, grn, mudstn, w/occasional blk ls clasts, sl cal, slty towards middle, pyritic, fewer lms clasts upward wxcept at 05.3-04.8. A little lam fabric from 05.2-07.0. Becomes better lam @ 4.8 and small high spirls snails, int brach, pectins appear calcareous. Becomes more fissile upwards and generally darker gren until it grades into black shale abruptly @ 1003.4. horz burrows @ 1003.7, brach hash @ 1003.6, some brachs pyritized.

Galesburg Shale Formation

1009.0-1011.7 Sh, grn, sli cal w/lms clasts (dns mdstn), minor rootings @ 11.0, brecciated fabric, rubbly.

Swope Limestone Formation

Bethany Falls Limestone Member

1011.7-1027.0 Ls, v lt gry, dns, sparse skel wkstn to mudstn 27.0-19.0 w/brach, bryz, coated grain or foram, ech, gast very arg @ basal .3' w/brachs, horz burrows. Sh, grn laminae and stylo laminae @ 20.5, 20.9, 21.1, 21.3, 21.9, whole brachs @ 20.4. 1019-11.7 ls, m, grn gry, v dns mdstn, color mottled, prob biot, gry sh sty every cm or less. Becomes progressively more agr w/green sh upward. Uppermost 2' (13.7-11.7), v to ex arg, v dns, lith, mudstn to nodular lime mdstone, non-fossiliferous.

1027.0-1027.9 Sh, m-dk gry in basal 1/2 grading to m-lt grn in upper 1/2, cal, noinfissile, large bryz, ech, brachs, bivalves.

1027.9-1034.2 Ls, v lt gry, sparse skel wkstn, brach, bryz, ech, abun stylites, upper half w/v arg interbds .1-.3 thick, grn grading to dk gry to blk in upper 1.0'. Upper most 3' ls, skel wkstn, ech, biot, nodular black chert, forams, pyritic.

1034.2-1034.3 Sh, dk gry to blk, w/small brachs, cal.

1034.3-1036.1 Ls, lt-m grn, arg -v arg, skel wkstn, ech, brachs, upper .2 grades to blk sh above.

Hushpuckney Shale Member

1036.1-1036.6 Sh, grn, cal, horz bur, pectin.

1036.6-1039.5 Sh, blk, fissile, lam, phos lam, conodont, fish scales, pectin and horz biot in upper .3, grades abruptly to grn sh above.

1039.5-1039.7 Sh, m gry grn, cal, biot, brachs art and inart, grade to unit above.

Middle Creek Limestone Member

1039.7-1040.0 Ls, m brn-gry skel wkstn, ech, brachs, forams, bryz, arg.

1040.0-1040.6 Ls, v lt gry, skel wackst to packst, burrowed (hor to subhor), irreg, shaly part top 0.2'; scatt brach debris, crin, much indet dark skel grains, grad below.

Ladore Shale Formation

1040.6-1041.6 Sh, lt gr, calc to v calc (up), burrow mottled (hor & subhor), scat brachs, crin debris, ostracodes, becomes more skeletal upward except common brachs lower 0.1' including Derbyia; sharp basal contact.

1041.6-1045.7 Sh, lt-lt m gr, calc, blocky to chunky, predom clayst but some silt-micac; in part fractured, soil fabric thru, scatt to common slickensides, soil fabrics best developed 42.-45.

1045.7-1046.7	Sh, lt gr, hard, v calc top half, part with fractures and soil fabrics; wavy to nudular limestomes in sh in lower half, calcilutite with birdseye? brach?

Hertha Limestone Formation

Sniabar Limestone Member

1046.7-1047.8	Ls, v lt gr, dense, top half with sm calcite-filled burrows? and calcite spots (birdseye?); lower half become calcarenitic with crin, echinoid spines?, brachs, indet skel debris.
1047.8-1048.3	Ls, shaly, v lt grn gr, with calcarenitic lenses containing sm brachs, crin debris bryoz.
1048.3-1049.4	Ls, v lt grn gre, with wavy arg parts (esp lower half), wackst with brachs noted; packst lens at 49.1.
1049.4-1050.25	Sh, lt grn gr, v calc, top half with abnt sm ls nodules (possibly osagia); sh dominated below; 49.9 productid.
1054.25-1058.55	Ls, lt gr, dense, abnt stylos and arg stylo-streaks thru, predom skel wackst scat crin-brachs; 53.4 mollusc or algal molds filled with calcite; 54 nice brach and lg crin; 55.3 mollusc?; 58-58.3 algal blades?
1058.55-1059.05	Sh, lt grn gr-m grn gr (down), v calc, crin debris common upward; stylo top; sharp base.
1059.05-1061.2	Ls, v lt grn gr, dense, arg parts at 59.3, 60.7, skel wackst; top half with mollusc, crin, sm brachs; lower half is crinoidal; becomes skel packst near base.

Mound City Shale Member

1061.2-1062.35	Sh, lt gr, v calc, grad down to sh, lt m gr, calc, scatt fossils thru esp near top where it approaches as ls; sm cup coral, crin debris, brachs at top; sm brachs, crin, bivalve below.
1062.35-1063.8	Sh, blk, phosphatic lam thru most to 63.6; 62.6 sm gastro and larger bivalve; 63.3 conodont; 63.6-63.8 m gr to blk, with scatt brachs.

Unnamed Limestone Member

1063-1064.25	Ls, lt gr, v arg, calcilutite, part calcarenitic, brachs.

Pleasanton Formation

upper Unnamed Shale Member

1064.25-1066.4	Sh, lt gr, carbonaceous at top, calc; scatt dark sand grains, scatt plant debris top half, soft-crumbly, resembles underclay.

Exline Limestone Member

1066.4-1068.2	Ls, v lt gr, highly weathered with broken to brecciated texture calcite-filled vertical fractures; sl arg with some irreg arg parting; no fossils no.
1068.2-1069.3	Sh, v. lt brn gr, calc; irreg nodular ls near top, becoming thin lensatic ls below; indet fossils near top; 69.2 brach.
1069.3-1070	Sh, v lt grn gr, calc, slickensides.
1070-1071.8	Ls, v lt gr-v lt grn gr, skel calcilutite, sl arg with irreg arg partings at 70.8; highly fractured and weathered top 0.6'; 70.9 crin debris; 71.7 brach.
1071.8-1072.9	Interbedded ls and sh; sh, v lt grn, calc; ls in nodule and lenses with ls bed at 72.5-72.7, no fossils noted except calcarenitic at base (indet skel grains).

1072.9-1074.9	Interbedded ls and hs; sh, v lt grn, calc; ls in nodules and lenses with ls bed at 72.5-72.7, no fossils noted except calcarenitic at base (indet skel grains).
1074.6-1075.65	Ls, v lt brn gr, dense, wavy arg streak 75.1 and top 0.3'; skel wackst, mollusc-crin grains.
1075.65-1075.9	Sh, lt gr, v calc, v crinoidal.
1075.9-1078.1	Ls, v lt brn gr, dense, skel wackst; wispy arg streak 76.4; smooth cerht nodules at 75.9-76.1 (m brn) and 77.1-77.3 (lt gr); crinoidal top 0.8'; bott 0.7'; crinoidal with sm brach ; brachs at 76.6, 77; 76.7 mollusc or algal blade; grad below.
1078.1-1078.6	Ls, v lt brn gr, with lt gr shaly streaks and parting thru; brachs thru; crinoidal top half at base.

lower Unnamed Shale

1078.6-1080	Sh, lt-m gr (top), lt gr (below), sl calc to noncalc, calc at top; scatt carbonaceous plant debris top 0.4'; bott 1.0' chunky, hard to nudular, slickensides, underclay-like.
1080-1081.9	Sh, lt gr, similar to above but more calc; top 1.3' chunky, slickenside with small (1-10 mm) ls clasts or nodules, soil-like fractured fabric in lower part; bott 0.6' becomes more homogeneous with less soil fractures, more silty-micac.
1081.9-1083.9	Mudst, v lt grn gr, silty-micac, with scatt irreg ls nodules or concretions (1-40 mm), nodules are unfossiliferous calcilutite.

DES MOINES SUPERGROUP

MARMATON GROUP

Lost Branch Formation

Copper Creek Limestone Member

1083.9-1087.3	Ls; v lt brn gr, mostly skel wackst but packst swirled in irreg mottles top 0.8', lens at 86.3, packst in burrow at 86.3; crin debris, scatt brachs thru; arg stylos at 84, 85, 96.3.
1087.3-1088.1	Ls, v lt brn gr, skel wackst, crin & scatt brachs; abnt m gr shaly to arg stylo swarms thru.
1088.1-1092.8	Ls, v lt brn gr, skel wackst; top 1.9' with crin and scatt sm brqchs; 90-92 sm brachs, scatt sm crin; 92.2 packst lens, scatt sm brachs below; stylos at 88.3, 89.8, 90.1, 91.3, 91.5, 91.7, 92.1, 92.6.

Nuyaka Creek Shale Member

1092.8-1093.2	Sh, lt grn gr at top grad to dk gr below, calc; top half with scatt brachs; lower half darker with hor bur (burr lt gr in dk gr matrix).
1093.2-1093.8	Sh, dk gr-blk, sl calc, irreg lt gr hor mottles thru part; finely lam in lower part.
1093.8-1094.4	Sh, lt m-dk gr, calc, part lam, some hor burrows; scatt fish debris.
1094.4-1095.55	Sh, m-dk gr, calc, scatt sm brachs.

"Memorial" Shale Formation

1094.5-1102	Sh, lt-m gr, sl calc to calc, part sl micac-silty, slickensides, chunky, underclay-like; sm carbonate clasts or nodules (1/2 - 2 mm) scatt thru most; carbonaceous at top, a few scatt sm carbonaceous plant frags top 0.5'.

Lenapah Formation

1102-1104.3	Sh, v lt grn gr, calc, interswirled with irreg nodular ls (skel wackst), nodules 1-50 mm; interval is 50/50 sh/ls; 02.8 brach-bryoz debris; 03 brach; 04 scatt crin; brach at base.

Nowata Shale Formation

1104.3-1105.3	Sh, m, maroon with lt grn gr mottles, sl silty-micac, fine carbonceous specks near base, grad below.
1195.3-1109.9	Sh, v lt grn gr, sl to v silty-micac, sl calc to calc; 106-base with irreg ls nodules (1-60 mm), unfossili, nodules esp well developed 06.7-07.5.
1109.9-1110.85	Sh, v lt grn gr, calc, sl silty-micac; 10.3 intraclastic or brecciated.
1110.85-1112	Sh, m red brn to lt grn gr, sl calc to calc, sl silty, hard, structureless; 11.6 nice Neuropteris frond; becomes v lt grn gr at base with carbonaceous plant debris.
1112.-1113	Mudst, lt gr-lt grn gr, shale at top, hor lam with abnt silt-micac, scatt plant debris alternate with shaly lam; ripple x-lam near base; calc with calcareous nodules in middle.
1113-1115.5	Silty mudst to arg siltst, v lt gr-v lt grn gr, calc, micac, hor lam to low-angle x-bedded; part hard calcite-cemented.
1115.5-1116	(T.D.) Sh, lt m gr, calc, numerous slickensides.