FREEMAN UNITED COAL MINING CO. CROWN MINE II

February 15, 1978

Notes by John Nelson in mapping with John Popp, Bob Bauer, and Roger Nance.

7th Main East (Belt)

20.) Overcasts for 2nd Panels North and South shot into limestone. Limestone contains closely-spaced NE-trending vertical fractures, probably natural but accentuated by shooting. The bedding is thin and nodular, and the upper part of the limestone is sandy and mottled. The roof is slabby and hazardous. It probably would have been better to grade the overcasts through the underclay than to shoot them into the limestone.

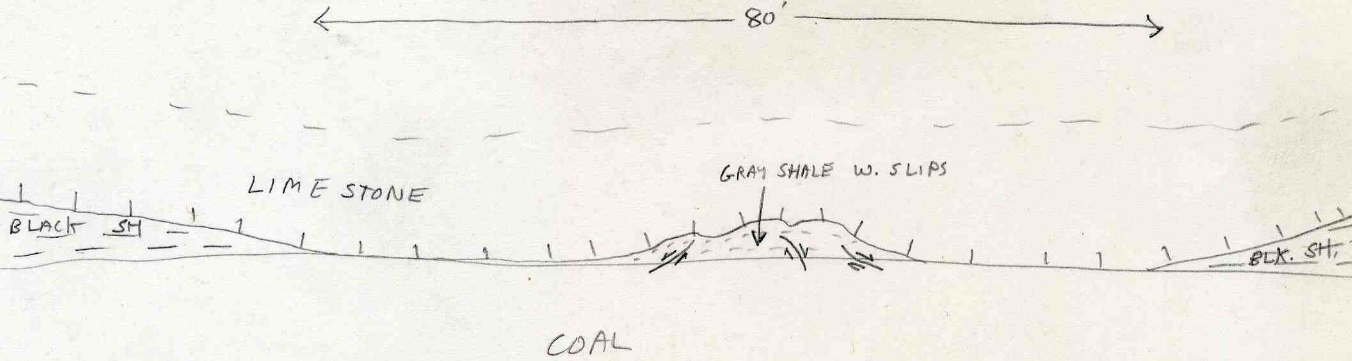
21.) Fracture in gray shale trending 135/45°SW, parallel with one set of joints. It appears as a slickensided slip about 2 feet above the coal and dies out in closely-spaced vertical fractures in shale and as "goat beards" in the coal. The fracture dies out to the southeast also. It seems to be related to jointing but has some features of compactional slips.

The other set of joints trends roughly 057°(quite variable). Both sets are very closely-spaced, often several to the inch. The gray shale has slabbed considerably.

22.) Pod of gray shale about 20 feet in diameter completely surrounded by area of limestone roof about 80 feet in diameter. Gray shale is directly overlain by limestone with nodules; the Anna Shale is absent. A similar pattern was also noted in the 5th-7th Main East near the 1st Panel (see compilation map).

23.) Face of 7th Main East shows a variety of fractures. A set of high-angle fractures trend about 120° and appear in places as slickensided slips and elsewhere as "en echelon" jointlike fractures or "goat beards". One cuts through the coal seam at least to the Blue Band. There is very slight displacement but the fracture plane is mineralized.

Stop 22
Schematic cross-section



The northeast-trending joints are locally intensified and form "en echelon" patterns. One joint is slightly open. These do not seam to affect the coal below the topmost foot or so. Only slight water dripping and slabbing of black shale.

February 16, 1978

Mapping 1st Panel North with Roger Nance. Mapping on a 1"-200' scale map (the only map available). Not possible to map in detail at this scale. Only lithologic changes and major structures plotted. Panel not mapped systematically.

1.) Dripping roof fall. Section as follows:

TOP   Sandstone, very light gray, very fine-grained, thinly laminated, slabby, argillaceous. Much water dripping. Indistinct contact:

1'   Limestone, gray, nodular, consists of lenses of impure limestone in matrix of greenish claystone or shale. Fairly sharp, even contact:

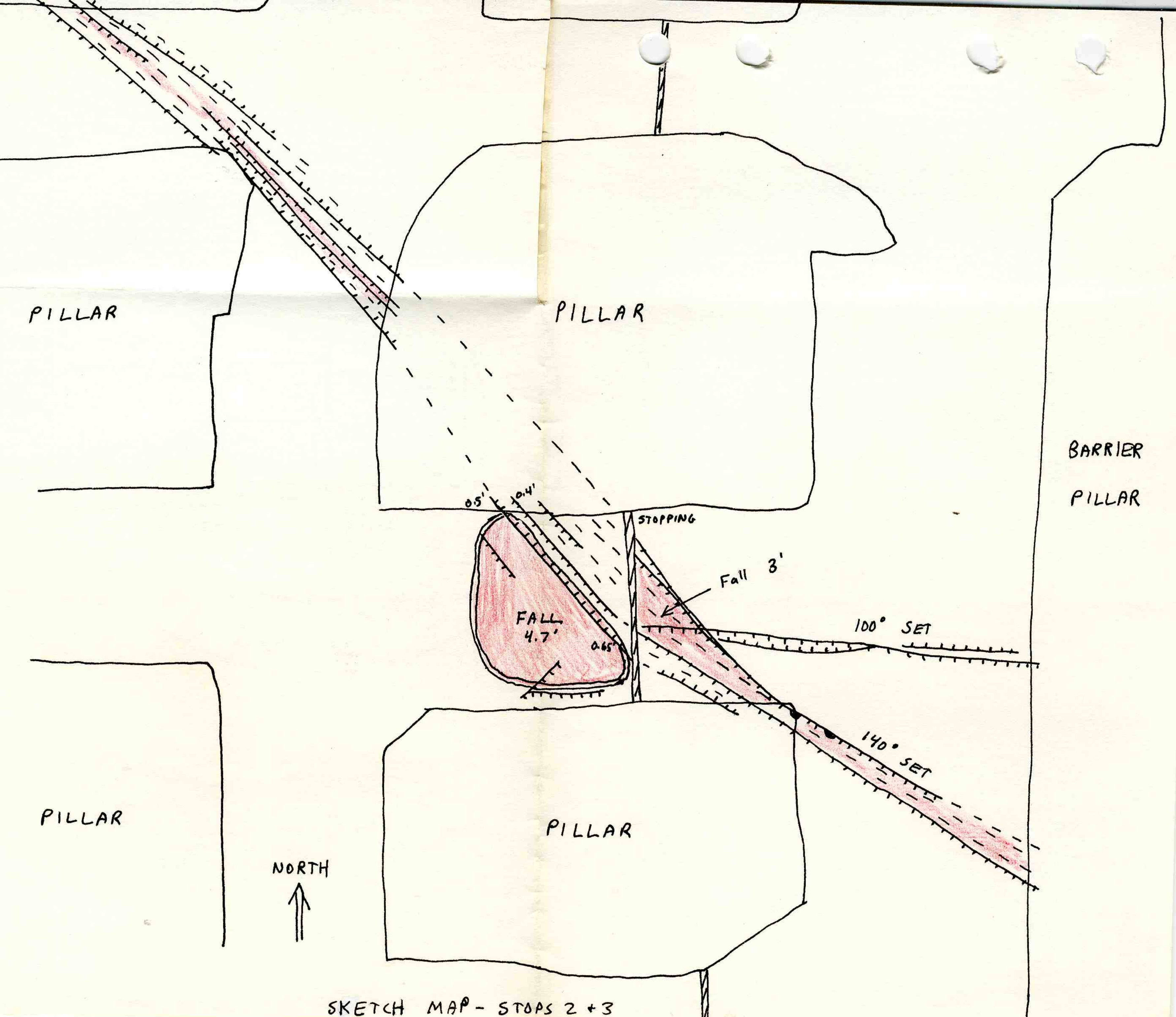
1'   Shale (Anna), black, mottled, phosphatic at top, several concretions noted. Appears to grade into:

2.8'   Shale (Energy), dark gray, poorly bedded, moderately jointed in a northwest direction.

2.) Fractured area. See sketch map (over; also includes Stop 3).

Two sets of fractures are present. The more prominent trends 140° and the other about 100°.

The 140° set consists of multiple closely-spaced high-angle fractures and small faults in a zone about 5 feet wide. Near the crosscut the zone appears to widen as the fractures diverge. Several faults have displacement on the order of several inches, mostly downthrown to the southwest. The fault planes tend to curve in dip direction and have prominent vertical slickensides. There are no indications of horizontal movement.



SKETCH MAP - STOPS 2 + 3

Accompanying are a great many high-angle fractures lacking slickensides or measureable displacement. They cause the black shale to break in long splintery wedges and appear similar to "goat beards" commonly obseved in coal. The fracture system penetrates the entire coal seam but the fractures converge to a single plane near the base of the coal.

One prominent fracture, marked with a clay dike symbol on the sketch map, displays "false drag", convergent bedding and steepens downward in typical clay dike fashion. However, no clay filling is present.

There is slight water and gas seepage from the fractured area along the east rib. A small roof fall has occured along the fracture set.

The 100° fractures consist of several parallel low to medium-angle slips in the roof, generally having the appearance of compactional slips. The two systems intersect near the stopping in the crosscut. The 100° fractures appear to be younger than the 140° fractures as they cross uninterrupted and in some cases appear to offset the 140° fractures.

3.) Continuation of fractures to northwest in next entry. A roof fall has occured near the stopping. It is the only large fall due to fractures in the 1st North.

As shown in the sketch map, the 140° fractures are very prominent but the 100° fractures are not seen, except for one slip along the south edge of the fall. The two largest fractures are faults forming a graben about a foot wide. They trend 137/60° NE and 137/45 SW and displace the top of the coal 0.4' to 0.7'. The slickensides are vertical. The SW fault cuts through and displaces the limestone with a thin zone of gouge. These faults, and several smaller ones, also cut and displace the coal down at least to the Blue Band.

Other slips in the fall affect the roof only and die out above the coal. They appear to be compactional features.

Water is dripping from a roof bolt in the limestone at the top of the fall. No water is seeping along the fractures.

Farther northwest it is possible to observe individual faults dying out along their length and others appearing beside them in "en echelon" fashion. The width and intensity of fracturing varies. The faults di die out near the base of the coal in "goat beards". The Blue Band is not displaced, and no fractures can be traced into the underclay. There is no observable drag, and in places the fractures are hard to see in the coal.

4.) In this area the Anna Shale does not show conspicuous jointing. The 135° fracturing is represented only by an occasional discontinuous fracture. The 065° set is more prominent but is not developed everywhere. All fractures are closed. The shale does not appear as fissile as elsewhere in the mine, perhaps because the jointing promotes slabbing. The joints are widely spaced and do not cross concretions. Small slips have formed around concretions and other irregularities in the roof. The shale has little tendancy to slab or "pot out" along joints or slip planes.

In general, the jointing here appears like that in the Hillsboro Mine. The direction (065°) also is more characteristic for other mines we have studied- possibly a significant change from the usual 045-055° at Crown II.

Southward the fracturing gradually resumes its normal character, with two well-developed joint sets at the south end of the panel.

5.) Exposures in two overcasts provide a good illustration of typical roof rock transitions at Crown II.

West of the belt entry overcast the coal is overlain by about 3 feet of Anna Shale with smooth, flat-bottomed limestone above. The shale is well-jointed (050° and 135°) and contains occasional concretions. The edge of an eastward-thickening wedge of gray shale appears just west of the overcast. The gray shale is finely laminated and the Anna Shale contact truncates the laminations, making an unconformable contact. Along the contact is a thin layer of very pyritic shelly debris, as commonly noted elsewhere in the mine.

At the east edge of the overcast the gray shale is about 3 feet thick with a slight decrease in Anna Shale thickness. The contact has become indistinct. Above the Anna Shale we still have flat-bottomed limestone.

In the overcast for the travelway the gray shale is 5 feet thick and the Anna Shale only about 1 foot thick. A couple of large concretions occur in the upper part of the gray shale. The Brereton Limestone is less than a foot thick and lenticular. Above it the roof has fallen, exposing about 3 feet of slabby sandstone. Considerable water is dripping, both from the sandstone and from bolts driven into the sandstone along the edge of the fall.

6.) Fractures trending 140-145° are a continuation of those described at Stops 2 and 3. The zone is narrower (1-2') here and the fracturing less intense than at earlier stops. Most of the features appear typical of clay dike-type faults, with curving slip planes, inconsistent direction of throw, local false drag, and slight convergent bedding. The only difference is the high-angle fracturing in the coal and roof, and the continuity in strike direction. The fracturing crosses other slips, but cannot tell which set is younger. No water seepage, and roof is intact.

7.) Further continuation of fracturing, as described above. General trend is 142°. The zone is 3-5 feet wide and includes both NE and SW-dipping faults, with quite intense fracturing of coal and rock.

Again the fault planes vary in dip and show only vertical slickensides. Generally no drag is displayed, but some coal blocks are tilted along fractures. In places clay partings have been dragged along by small faults. Again the system includes features of hard-rock and soft-sediment faulting.

2nd Panel North

Mapped in even less detail than 1st Panel North. Mainly interested in following continuation of faults.

8.) Continuation of fracture system. As shown in sketch (over) there is a complex zone of small steep normal faults. Some have displacements of several inches in the roof and upper part of the coal seam, but all die out before reaching the underclay. At the bottom of most faults is a set of "goat beards". The slickensides are vertical, and there is slight drag or tilting of blocks between faults. Most faults are high-angle; some steepen downward and others become shallower.

Some Brunton measurements on fault surfaces: 129/67° NE, 139/84° SW (near floor), 134/66SW°, 139/70° NE.

9.) Small roof fall along fractures exposing base of limestone. The largest single fault trends 133/48° NE and crosses the entry. The limestone is cut and displaced at least a foot, the top of the coal is offset several inches, and the fault dies out before reaching the underclay. No water seepage or indication of past water seepage.

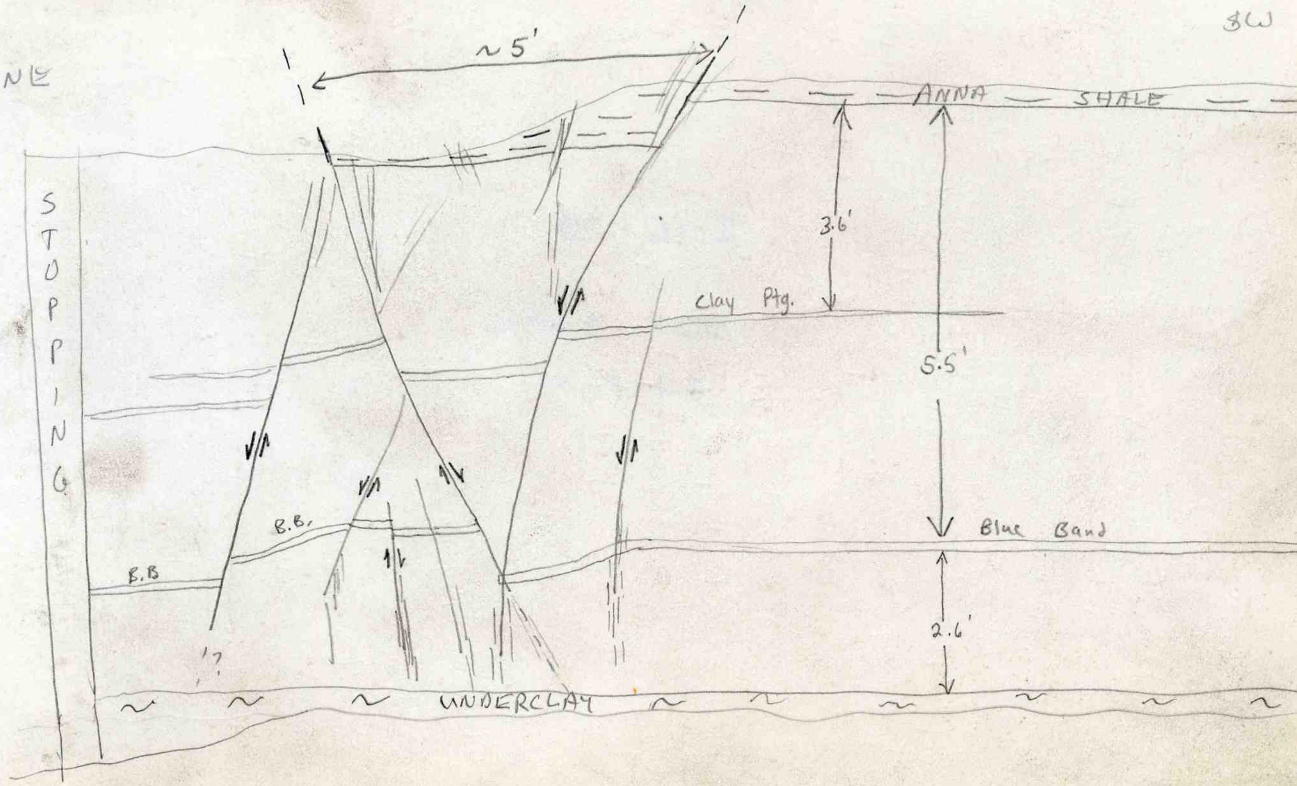
Other fractures parallel with the largest fault are seen to form a closely-spaced "en echelon" pattern.

REMARKS AND CONCLUSIONS ON FRACTURES

The fractures can be traced on a nearly continuous straight line for roughly 2500 feet. They continue through the East Mains southeast of the the 2nd Panel North and finally appear to die out as a series of jointlike fractures near the mouth of the 3rd Panel South.

We did not recognize the fractures in the Main North, but in the eastern four entries of the Main

Stop 8
View looking SE (along strike of faults)



North a very large clay dike appears on almost a direct line with the fracturing, and possibly represents a continuation.

A puzzling feature of the fractures is that they bear marks both of tectonic faults and of soft-sediment features. Perhaps this is best summarized in list form:

Tectonic Characteristics

Great continuity in strike direction despite small vertical displacement.
Near-constant strike direction.
Generally high-angle fractures.
Close-set parallel or "en echelon" pattern.
Lack of clay filling on fracture planes.
Parallel to one set of joints.
Displaces limestone.

Soft-Sediment Characteristics

Die out near base of coal as "goat beards"; generally do not displace coal.
Lack of consistency in direction of downthrow.
Frequent curving of fracture planes in dip direction.
Occasional "false drag" and convergent bedding along faults.

Possible explanations include tectonic activity before the sediments had lithified, or a series of clay dike-type faults exploited by later tectonic movement. Neither appears satisfactory to explain all the features, however.

Evidently the No. 6 Coal lies near the lower end of a larger fault or series of faults. We have no way of knowing how large they may be higher up in the section. There are strong similarities with the large SE-trending fault in the South Mains.

It might be the lower end of a large compactional growth fault, initiated at a higher level in the section.

FREEMAN UNITED COAL MINING CO. - CROWN II
Macoupin County
February 15, 1978
Notes by Popp, with B. Bauer, J. Nelson, and R. Nance

On this visit we are mapping the East Mains, and I am in the 8th Entry.

1. Overcast exposure. This is an unusual looking overcast that is probably a pre-bolted overcast, an innovation used in Crown II and described recently in Coal Age magazine by Chris Ledvina.

In the overcast the following lithologies appear above the No. 6 Coal:

1.2'	Shale, Anna, black, carbonaceous, fissile, phosphatic and mottled at the top. Joint directions at 30° and 115°. Grades into:
5.0-6.0'	Limestone, Brereton, medium light gray, fossiliferous, hard, somewhat flaggy, jointed at 30°. Grades into:
3.5-4.0'	Shale, Lawson, calcareous (?) and fossiliferous in lower portion and light gray in lower portion. Dark gray upwards, reworked (?). Grades into:
1-2'+	Limestone, Bankston Fork, light gray, cloddy at base, nodular upwards. Not well exposed and cannot be reached.

One of the unusual features here is the presence of synaeresis cracks and associated weathering coming down from the Lawson Shale into the upper portion of the Brereton Limestone. A sample was taken. The synaeresis cracks extend vertically, and the light gray weathering extends both vertically and horizontally away from the cracks approximately along bedding planes. This is the first time I have seen and identified synaeresis cracks and the associated weathering features underground.

There appears to be a slip in the Lawson Shale, and the Bankston Fork and Lawson both are jointed, incidentally of the overcast shooting.

2. Anna Exposure. About 1.0' of Anna is exposed, and a prominent joint trending NE goes through the Anna into the coal. The joint does not appear to go through the entire seam. Anna joints are common in the 8th Entry, and particularly prominent joints are indicated on the field map.

3. Fall Exposure. Fall evidently initiated by two "coffin-cover" type slips as well as a change in lithology. The slips run almost north-south and extend through the dark shale into the coal. On the south rib there is folding and deformation in the coal along the slip.

The fall has been cribbed with timber posts, rail ties, and wood. I don't have any good exposure of all the units but the following section is estimated:

~2.5' Shale, Energy, dark gray, pyritic, grading upwards into:
1.5' Shale, Anna, black
1.0' Limestone, Brereton, poddy, or knobby base.
4-5' Sandstone and siltstone, Anvil Rock.

4. Overcast Exposure. This is the first of a series of pre-bolted overcasts that was excavated but the overcast was not constructed. There are no signs of structural or lithologic roof failures. The overcast entry has been cleaned up, and the extra heavy duty roof bolts are in the roof.

It seems this company is not well organized in planning its ventilation system. Where overcasts are installed they often-times do not have ma n doors. Doors in stoppings are likewise very widely spaced.

5. Transition roof. In this area Anna Shale is thinning and limestone is just above. Then limestone (and clod?) is directly overlying the coal, then limestone is above thin gray shale which is directly above the coal then limestone is above very thin black shale which is overlying gray shale. The black shale is burrowed and reworked (?).

6. Roof exposure. Another probable pre-bolted overcast that was never put in. The roof gives a nice exposure of the following units:

1.5-2.0'	Shale, Energy, medium gray, pyrite octohedrons at the base. Grades into:
0.5-0.6'	Shale, Anna (?), transitional, dark gray with some pyrite and shell fragments. Grades into:
1.3-1.5'	Shale, Anna, black, carbonaceous, fissile, well jointed, mottled and somewhat burrowed toward the top. Grades into an irregular and uneven contact:
0.3-0.5'	Clod, grades into:
?	Limestone, Brereton.

Thursday, February 16,1978
East Mains, 12th Entry
1. Overcast exposure. Pre-bolted overcast excavation for an overcast that was not built. It exposes 3.0-3.5' of Anna Shale and 4-5' of Brereton Limestone above the shale. The Brereton is pretty well shattered and is dripping water at one bolt hole. There appears to be a slight joint preference to the northeast in the limestone.
2. Normal fault exposure. Small displacement fault trending 143°/68°NE with approximately 0.6' displacement. Fault extends through the blue band. The fault plane is not singular but rather appears as one or two planes with associated jointing and shearing. The coal and roof (Anna Shale) is gouged along the fault, but the roof remains intact.

When entries 9-11 were first mapped this feature was mapped as a slip or series of slips. There was good reason for that because the fault is not apparently evident where rock dust or top coal hide the displacement.

3. Fault Exposure. At this exposure the faults extend across the entry and appear in the roof as a "coffin-cover" set of slips extending upwards for at least 3'. The coal is well jointed, and minor faults on either sides of the main fault die out downwards as goat beards. See sketch on following page.

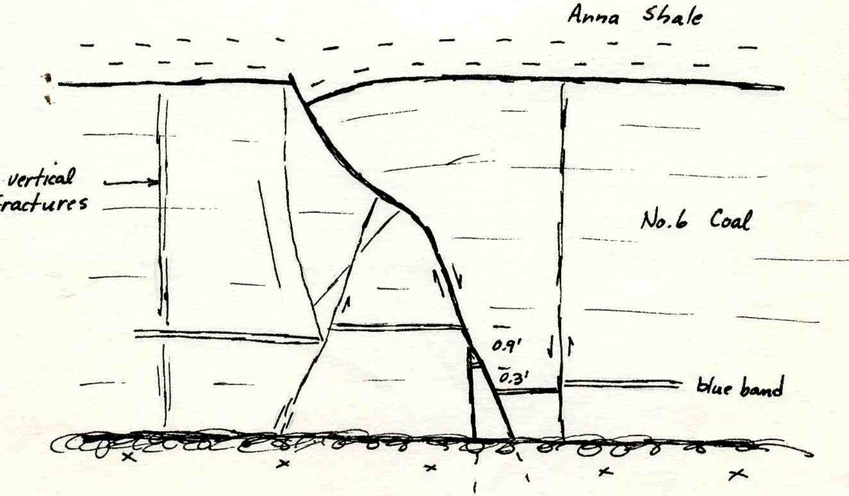
4. Fault Exposure. Same fault system maintaining a 142° heading. The fault is now a series of faults apparently fanning out slightly to the southeast. There are more faults each with less displacement.

5. Continuation of fault. Same fault as seen in the last several book notes. The displacement is 2-3" and the strike is 140°.

This fault may represent the eastern branch of the faults seen at booknotes 3 and 4. The fault trend can be traced to this location, and is represented by, more or less, one fault, rather than a zone of faults.

6. Continuation (?) of fault-slip-joints. This little slip may represent a western branch of the fault system in booknotes 3 and 4.

Booknote 3



Northwest facing view of the rib, looking at the corner of the ~~er~~ intersection.

This sketch sort of illustrates the multiple nature of the fault zone; rather than being one fault, this zone appears to have one slightly more prominent fault with one or more adjacent faults. The coal is fractured strongly in the vicinity.

CROWN II MINE - February 17, 1978
North Mains, Entries 9-12
Notes by Popp, Mapping with B. Bauer

This is a reconaissance visit to the North Mains. Entries 9-12 are in terrible shape to the south - the ribs are rashing badly and every intersection is cribbed.

It appears that all four entries are return air courses for the entire North Mains. Perhaps this is also why the 9th Entry is timbered most of the way - to serve as an escapeway.

The roof is not in bad shape overall in the 9th and 10th Entries. Top coal is falling to expose black shale, and joints are apparent in both the northeast and northwest directions.

There are a couple well-developed and well-displayed clay veins as marked on the map. Also seen was an intra-seam deformational feature affecting especially the dirt band zone about midway in the seam. A feature similar to this deformational feature was described in the 3rd Panel South.

1. Clay dike exposure. Excellent exposure of a clay dike that extends across all the entries. We looked at the dike because of the synaeresis-type weathering phenomena in the limestone, and because the clay dike appears to be comprised largely of floor clay-like material.

The immediate roof is black shale and limestone. The clay dike is pretty much in line with the small displacement normal fault mapped in the East Mains.

This clay dike is a text book example and would make a good picture.

2. Sandstone Roof. In this area we found sandstone forming the immediate roof first as a thin, planar unit, and then as a channel-like, or u-shaped, unit extending downward into the coal. Our first impression was to describe this channel-like sandstone as the erosional facies of the Anvil Rock Sandstone. To me it appears

that some coal bedding planes are in fact truncated by the sandstone, but there are a number of slips associated with the channel shape. The channel shape trends across to cross cuts between the 11th and 12th Entries, and appears to have a "tributary" in the 12th Entry. However, in the 26th crosscut, where there is an excellent exposure of the feature, the channel shape appears only on the South rib while the coal and roof on the north rib is unaffected. This sudden termination, as well as the slips along the margin, indicate that the feature may in part have resulted from loading.The entire area needs studying; a petrographic study of the sandstones as well as a study of the bedforms would be beneficial.

In the 25th crosscut between the 11th and 12th Entires, another distinct sandstone is present. It is truncated by the Anna Shale which in turn is truncated by the Anvil Rock Sandstone.

2/17/78 Reconnaisance mapping Main North Entries with Roger Nance, using 1"-200' scale map. We walk the west four entries and face area. John Popp and Bob Bauer do the east set of four entries.

1.) Typical transitional area with large roof falls and water dripping. As this is intake air and the weather has been cold, large stalactites and stalagmite of ice have formed. One stalagmite is 8 feet high. The water is dripping along NE-trending fractures in the sandstone at the top of the fall.

Features of the area include: clay dikes and clay dike-type faults, "white top", irregular lenses of gray shale, reworked Anna Shale with injected clay, highly nodular lenticular limestone with silty clay partings, gradings into very argillaceous sandstone with limestone nodules. The gray shale thickens and the limestone correspondingly pinches out to the northeast.

Driplet

2.) Driblet of water from a roof bolt hole in black shale has produced a solid column of ice over a foot in diameter, lending, I suppose, an extra measure of roof support.

One would think that if the entire mine could be kept below freezing, not only could the miners run their equipment over solid ice instead of mud, but ice columns would form at the worst spots, creating free cribbing right where it is most needed!

3.) Water is dripping from three holes in limestone roof, one of which is also producing gas. The gas-producing hole is 4.5 feet deep and the other holes are shorter. The holes were made with a 1" diameter drill.

Some roof bolt holes are also seeping slight amounts of water. (Length of roof bolts unknown). It suggests the limestone may be rather thin here.

4.) Seeming reversal of stratigraphy; gray shale overlying black shale!

It is not a local freak condition but occurs over a fairly wide area. The immediate roof appears in all respects to be typical Anna Shale; hard, black, fissile, and well-jointed, with occasional phosphatic lenses. The black shale ranges from 0.1' to 1.0' thick.

Overlying this with a razor-sharp contact is shale whose appearance varies but in most places is indistinguishable from Energy Shale as seen throughout this mine. That is to say; a medium-dark gray shale, weathering yellowish-brown, poorly bedded, silty, with finely divided carbonaceous debris, lacking definite jointing. In places it is dark gray and coarsely silty with mica and much plant debris; occasional woody fragments. In one place (against the west rib of the west entry) there is an irregular layer of sandstone in the shale. The sandstone is medium-light gray, medimm grained, well cemented; a lenticular bed containing shale partings.

Unfortunately only a foot or so at the most of the roof is exposed, so we cannot tell what overlies the gray shale. This in itself is unusual, as large roof falls normally occur in gray shale areas.

In places the contact of gray shale to black appears unconformable, with evidence of scouring. The Anna Shale below the contact is occasionally stained brownish, perhaps by water seepage from above. The area now is dry with stable top.

The only explanation I can suggest is that the gray shale is the Lawson/Anvil Rock and that the Brereton Limestone has been removed by erosion.

5.) Very unusual roof sequence:

TOP

0.5' Coal, generally dull, with thin vitrain laminae, cleat trends about 050 and 135; contains lenses of hard, dark brown, finely laminated bone coal (?) of very low density. Contact indistinct, variable.

0.4' Coal, N.B.B., blocky, with much orange-red material on cleats.

0.25' Shale, medium gray, weathering light yellow, poorly bedded, soft, silty, contains occasional coal inclusions. Varies in thickness. To the south it overrides thin Anna Shale with apparent erosional contact.

7.70' Coal (Herrin No. 6) Normal appearing. Contains several thin shale bands or partings, some of which are pyritic. A continuous dark gray pyritic shale band lies 3.25' from the top and another continuous band (the Blue Band) is 2.45' above the base. The other bands are discontinuous.

The roof is very sound, with no water seepage. Generally we can only see what the miner has cut.

Split Herrin (No. 6) Coal normally is associated with the Walshville Channel. I have no idea of the significance of this split coal or how it relates, if it relates at all, to the area of gray shale over black shale.

6.) Coal appears to be split as at Stop 5. The top of the crosscut is the lower surface of the coal above the shale parting. The shale is over half a foot thick in places. On the south rib the upper 1-2 feet of the coal below the split contains unusuallly abundant thin shale lenses. It also contains lenses of hard, granular, sandy (?) pyrite, and of coal-ball material.

The excellent top hints that the main roof may be limestone or possibly a hard, well-cemented sandstone.

7.) Roof exposure in small fall shows sandstone directly overlying black shale. The sandstone is light gray, fine to medium-grained, well-cememted, with very uneven thin bedding and partings of yellow-weathering gray shale. At the base there are interclasts of black shale and very small stringers of sandstone are squeezed into the top of the underlying black shale. The contact is sharp and very uneven.

The black shale is roughly a foot thick. The lower part is locally hard and fissile, but the bedding is much disturbed in the upper part. The upper shale is somewhat mottled and contains abundant phosphatic material.

Except for the one small fall the roof appears stable, and there are no indications that water ever seeped here. The fall occured along a set of small compactional slips.

I would interpret this as Anvil Rock Sandstone in erosional contact to Anna Shale.

8.) Return to "normal" rock sequence; a westward-thickening wedge of gray shale overlain by about a foot of burrowed, concretionary Anna Shale, with flat-bottomed limestone above.

In the crosscut to the west, a roof fall has occ-ured along a clay dike-type fault. In the fall very irregular, "bossy" limestone overlies 1-2' of highly disturbed Anna Shale.

It should be noted that every intersection in the Main North has been cribbed without regard to the nature of the roof rock. Apparently the company over-reacted to trouble encountered in transitional roof areas near the start of the panel. It is a great waste of timber to build cribs under limestone or other solid roof. We can think of many places in the Main South and South Panels where the cribs could be put to much better use.

9.) Fall in black shale exposing base of limestone. Black shale contains two layers of phosphatic lenses, exactly as seen in the Hillsboro Mine. The upper layer is just below the top of the black shale and is about 0.4' thick. The lower layer is about a foot below the top of the shale and is o.3' thick or less. The phos-phatic lenses in the lower layer are very thin and elongate while those in the upper layer are thicker and shorter. The shale between the two layers is black and poorly bedded. Below the phosphatic zone the shale is black and well-bedded, becoming fissile in the lower foot or so. Total shale thickness is 2.7'.

Jointing is present only in the lower, fissile portion, and even there is inconspicuous and uneven. The main trend is 055-60. A few SE-trending fractures are preaent but they are very inconsistent. The shale does not break in rectangular slabs the way it does where it is well-jointed.

10.) Jointing in base of Anna Shale is quite indistinct. The main set trends roughly 055 but individual fractures may curve slightly. The spacing is wide; about one joint every 2 feet. Only occasional discontinuous SE-trending fractures.

Nearby, gray shale roof lacks jointing. In falls the black shale overlying gray shale is not visibly jointed either.

11.) At the north edge of a large roof fall is a beautiful example of sandstone interfingering with the Anna Shale (see sketch, over).

A large clay dike-type fault, with thin clay filling and prominent "false drag", penetrates the coal seam. There is "white top" and the Anna Shale is heavily reworked above the hanging wall. The coal and black shale are not reworked above the footwall.

Several large fingers of sandstone intrude northward into the black shale, as shown in the sketch. The sandstone shows intense internal folding. A great many smaller lenses or fingers of sandstone, also internally folded, are interlayered with the shale below.

Near the top of the fault (north) an intrusion of fine gray siltstone cuts through the laminated sandstone to enter the black shale. Clearly this material has its source above the laminated sandstone- the source is not visible in this exposure.

I believe the interfingering of shale and sandstone is secondary and was contemporaneous with faulting. The sandstone appears to have been not at all lithified, but the shale must have been laminated and partially indurated. As the hanging wall slid down the fault plane, the sand was squeezed between layers of shale. The picture was later altered by final compaction.

Stop 11 Looking East

12.) Fall with water dripping has occured at place originally shot for overcast. Section as follows:

TOP

3' Shale and sandstone, interlaminated; greenish-gray faintly mottled, finely laminated, micaceous, rather weak. Thin beds of fine sandstone. Water dripping from top. Appears to grade into:

5' Limestone (Brereton), medium-light gray-brown, fine grained, coarse very nodular bedding throughout, closely fractured appearance. Shaly partings between nodules. Irregular lower surface; thin transition zone (clod).

2' Shale (Anna), black, smooth, well-bedded, with thin phosphatic laminae and lenses throughout. Lower portion is more fissile than upper part. Only the fissile part is jointed.

Coal (not described)

It was a mistake to shoot this overcast into the limestone. The limestone is already weaker than normal because of its nodular bedding. The blasting probably fractured it thoroughly and allowed it to fall through to the sandstone. Instead of shooting overcasts into limestone, Freeman should cut them into the underclay.

13.) Same situation as at Stop 12; overcast shot into limestone has fallen through to sandstone. The shooting has imparted severe northeast-trending fractures to the rock. Water is dripping, and this fall needs to be rebolted or cribbed.

14.) Shale cut down to base of limestone for overcast. No roof failure or water seepage. The shale is 1.8 to 2.0' thick and the base of the limestone is flat-bottomed. One large "boss" is present at the north center of the exposure. A gray shale wedge begins 20 feet north of the "boss".

At this point we quit mapping and joined Popp and

Bauer in the east set of four entries. There we briefly examined some features they had mapped and described (see Popp and Bauer's notes for this day). There is an area where gray shale overlies black shale, as we saw at Stops 4-7. Locally there is split coal, and in some places sandstone lies directly on the coal. Most interesting are several large rolls or small channels in the coal, filled with sandstone and gray shale. The area of these features is directly east of where we observed the gray shale overlying black shale.

The observations tend to confirm our early theory that the gray shale is the Lawson Shale and that we have an area where the normal roof rock sequence has been eroded and replaced by Lawson Shale and Anvil Rock Sandstone. We still do not know how the split coal fits into the picture. The area should be mapped in detail, preferably after the middle set of four entries have been mined through the sandstone roof region.

The other significant observation in the Main North is the change in the jointing pattern. It confirms observations made in the 1st Panel North the day before. The jointing diminishes in intensity northward, the southeast-trending set dies out, and jointing is confined to the fissile lower part of the Anna Shale. Jointing near the face of the Main North appears very similar to that observed in most other mines statewide.

I currently believe that the two very strong sets of joints observed in the south part of Crown II are tectonic fractures related to the east-west trending strike-slip fault system. The jointing increases in intensity toward the fault, with open fractures and movement along joints close to the fault. Some open fractures and faults with movement extend some distance away from the east-west fault, but the effect dies out northward. In the face of the Main North we are beyond the tectonic influence and see only ordinary Anna Shale jointing.

It should also be pointed out that theoretically we should expect to see two sets of subsidiary fractures associated with an east-west trending left-lateral shear. There should be northeast-southwest trending normal faults, or open joints; and northwest-southeast trending reverse faults, or closed joints.

Notes on meeting at Freeman United Coal Mining Co. office in Mt. Vernon, February 20, 1978. Notes by John Nelson.

People Attending

Freeman	I.S.G.S.	U. Mo. Rolla
"Doc" Harrell	H.-F. Krausse	Nolan Auchenbaugh
Charles Sanford	John Nelson	Don Warner
Frank Padavic	Steve Hunt	
Bill Mullins	Cathy Hunt	
Harold Combs	Ross Brower	
Dick Rouse		
George Sessen	Paul Weir Co.	
Roger Nance	D.J. Kachik	
	Jerry Siekierski	

Topic of meeting is water problems at Crown Mine II; what has been learned so far, future research, and possible ways to deal with the water.

Roger Nance summarized the geologic data, as outlined in the Survey's preliminary report. He also noted that drill hole data indicates the Anvil Rock Sandstone thins northwestward and eastward, generally. The sandstone cut-out in Crown I appears to run northward from that mine (it was encountered in two drill holes).

South and west from Crown I, in the proposed Crown III area, the sandstone thins and the Bankston Fork Limestone lies close to the Brereton Limestone and Anna Shale.

Charles Sanford reported that Freeman attempted to sink an air shaft at the Main North of Crown I, very near the location where Survey geologists noted faults In the drilling quicksand-like material was encountered in the bedrock about halfway from the surface to the mine (possible fault gouge ?)

Also reported that no water problems were encountered in Crown I except along the sandstone cut-out. The Main North had bad mining conditions throughout. The company drove a set of entries northeast with no better results.

Also noted that the 2nd and 3rd Panels South at Crown II were both very wet when first mined, with much water and gas issuing from fractures in the roof.

Auchenbaugh said that on their one-day visit to Crown II they saw WNW-trending fractures or "reverse shears" in the 2nd and 3rd Panel South, in the roof. The fractures were tight, with no water seepage, and it appeared as if the rocks had been jammed together along them.

Cathy Hunt told of the early hydrologic testing. The water sampled on the December reconnaisance visit is high in sodium and its source evidently is the Pennsylvanain bedrock. A full analysis will be complete in about 10 days.

She said that generally water in Pennsylvanian bedrock is mineralized below 200-300 feet from the surface. The deeper you go, the saltier the water.

Doc Harrell pointed out that the main problem at Crown II is not the volume of water seepage, which is slight, but the widespread distribution of water, making it difficult to gather the water in one place for pumping.

Ross Brower outlined plans for future hydrologic testing. Piezometers will be placed in roof bolt holes to obtain water samples and record the pressure of water in various strata. A total of about 20 piezometers will be installed at active working faces. Plans call for comparison of wet vs. dry areas and jointed vs. non-jointed roof rocks. The tests should provide figures on rock permeability and source of

In addition, he would like to take cores of rock to perform laboratory tests of permeability.

Nolan Auchenbaugh said his people may try to core the roof using a core barrel that can be fitted to a roof bolting machine. The system provides NX core up to about 10 feet into the roof. A disadvantage is that it ties up a roof bolter for some time.

Steve Hunt suggested using a Chicago Pneumatic drill for roof test coring. The main difficulty is finding a compressor that will supply enough air to the drill. Recommended checking for occurence of bedrock valleys in the mine area and questioned whether some of the water could be from glacial drift.

Kachik and Siekierski of Paul Weir Co. next presented their data. They used drill hole information only to make isopach and structure maps of several units. They presented a bedrock surface map showing a trough trending NW-SE at Crown II, and suggested the trough may relate to the large SE-trending fault encountered in the mine. The trough could serve as a gathering place for water. The glacial drift generally thickens southward; up to 125 feet in places.

A Brereton Limestone isopach shows no limestone in a zone trending roughly east-west along Crown II. It is theorized that this may show a channel system in this area.

A structure map of the base of the Anvil Rock Sandstone shows an anticlinal nose trending ENE along roughly the same line. Proposed that this supports the existence of a channel system.

The coal-to-Anvil Rock interval map shows a thin area along the same trend.

The Anvil Rock Sandstone thickness map does not fit the pattern; the sandstone is no thicker along the supposed channel than elsewhere.

Paul Weir found a few notes of visits to abandoned mines in the area, but these contained little useful information.

I note that the Paul Weir maps are based on drill holes averaging about a mile apart. Noting the extreme variability observed during in-mine mapping, I strongly question whether any "channels" can be located from such widely spaced data. Probably it is pure coincidenc that four or five drill holes showing no limestone happened to line up.

Doc Harrell presents possible ways to de-water the mine:

(1) Long horizontal holes, 1000 feet or more long, drilled into the coal face or roof within the mine.

(2) Drilling holes from the surface into the Anvil Rock Sandstone and trying to pump the water out.

(3) Pumping from selected roof bolt holes at the face.

Bill Mullins favors Idea 3 as least expensive and best if, as seems likely, the sandstone is discontinuous.

Steve Hunt concurs that long holes or surface holes won't do much good in aquifers of low permeability. Suggests drilling holes angled forward from the working face.

Don Warner favors vertical holes from the surface, providing they can de-water a large enough radius. By the time de-watering holes are drilled in the mine, the face is already in trouble.

Surface holes would have to be cased through the Anvil Rock Sandstone, and Freeman would have to obtain easements from farmers on whose land the holes are drilled.

The hydrologic testing will be very important to determine how large a radius can be drained from a single hole. Most people present feel short holes will be preferable unless it is shown that the sandstone is more continuous and permeable than we think at present.

The question of whether water sinks to topographic lows in the sandstone is asked.

Doc Harrell raises the matter of changing the mining layout to improve the water situation. It is generally agreed that no such changes are likely to help.

Auchenbaugh proposes that top coal should be left to protect the gray shale from slaking. He suggests using trusses or hydraulic props for roof support.

Mullins recommends staggering pillars in trouble areas to avoid 4-way intersections, where most roof falls seem to occur. The entries in the mains are 14 feet wide and cannot be made any narrower.

Rouse will have a team study roof bolting procedures. A combination resin-mechanical bolt will be tried. Straight resin bolts do not seem to be helpful.

Prognosis for Crown III and beyond: Crown III should not be troubled with water as much as Crown II, because the sandstone appears to thin toward Crown III, and the limestone becomes more continuous. Gray shale pods will be encountered and may present roof stability problems. In some areas the Anvil Rock interval is occupied by green shale (Lawson) which may overlie gray shale with no limestone between.

The possible hazards of "clod" roof are discussed. There seems to be some disagreement on what is meant by "clod". It seems that "clod" was more of a hazard in the days before roof bolting, because large slabs could break off between timbers.

Experiments and Research To Be Conducted:

Hydrologic data
Piezometer tests
Sandstone samples-testing
Try pumping a roof bolt hole in wet area.
Drill a hole through limestone in unfractured area to see if water is present.

Drill several cores from surface for geologic data.
Try pumping water from one or more of these holes.
Experiment with new roof control methods.
Perhaps try a long horizontal hole at a working face.

FREEMAN UNITED COAL MINING CO. CROWN MINE II

February 21-23, 1978

Mapping and Notes by John Nelson with H.-F. Krausse.

Feb. 21 and 22 spent completing the mapping of several areas in the Main South and Main West that were missed in earlier mapping.

1.) Limestone roll or very large "boss" giving the appearance of a slump structure. The limestone intrudes about 3 feet into the coal on the north rib; slightly less on the south rib. It is very nodular with silty shale partings and is fractured; roof looks dangerous.

Bordering the limestone protrusion are clay dike-type faults forming sort of a graben. The top layers of coal are torn up and mixed with clay (white top). Light greenish-gray clay also interfingers with the Anna Shale. The source of the clay is not obvious.

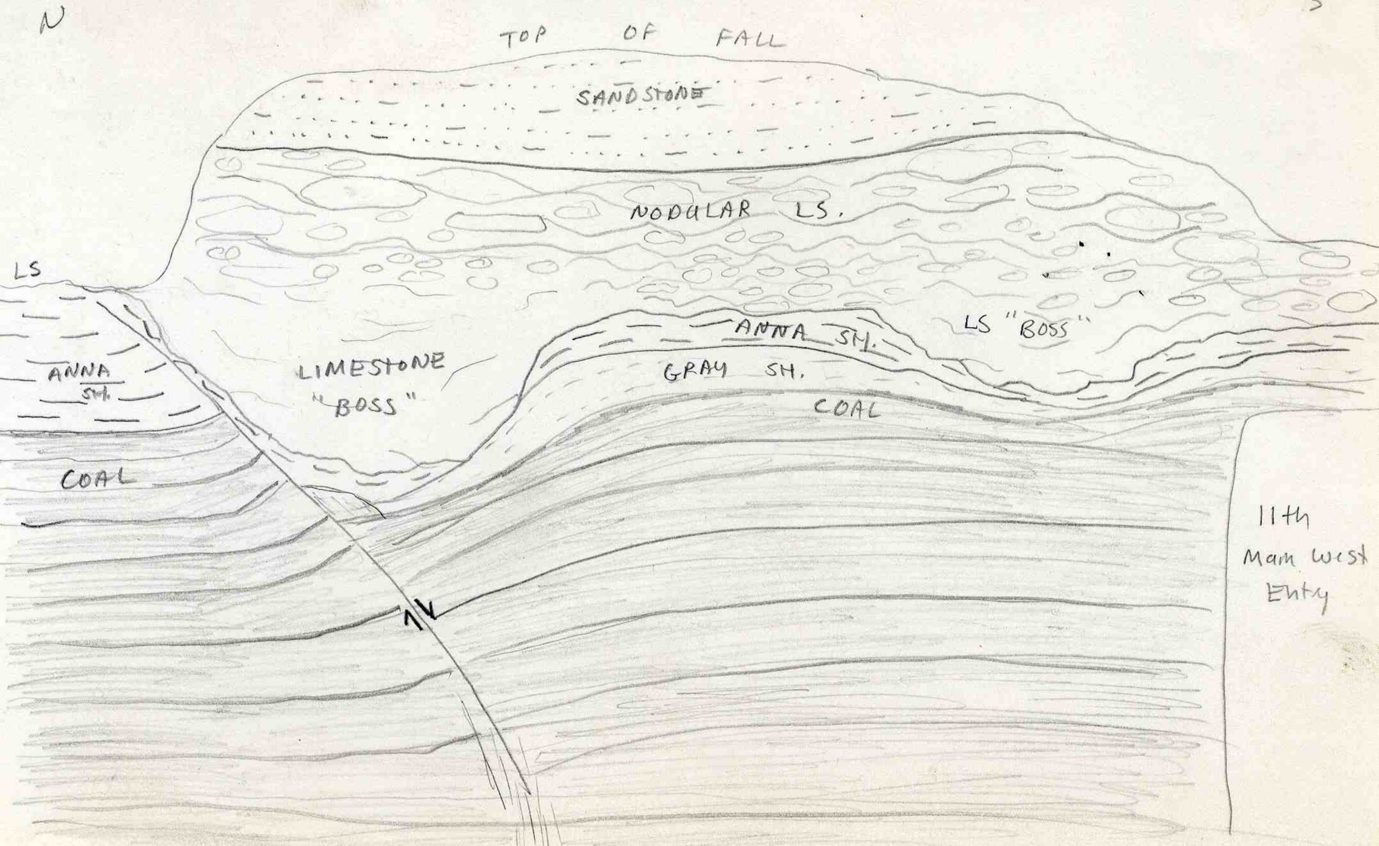
2.) Jointlike fractures in Anna Shale with pronounced "en echelon" pattern. One set in particular is very prominent. The individual fractures trend 045/80° NW and are only a few inches long. The spacing is $\frac{1}{2}$-$\frac{1}{4}$" and each successive fracture appears southeast of the one behind it. The average trend of the set is about 060°. Some of the fractures penetrate concretions in the Anna Shale and they extend into the top coal.

Just to the south a small amount of water and gas is escaping from 045° joints in the Anna Shale. The joints are closed and are not "en echelon".

3.) Small amount of water and gas seepage at face, despite lack of apparent structural or lithologic weakness. Nearly all faces in this mine have made a little water. This appears to be nothing more than the normal slight seepage seen in nearly all mines.

4.) Roof fall provides a cross-section through limestone "bosses".

Stop 4- East Rib.
width of View 25'



On the east rib (see sketch, over) two "bosses" are present. The larger one, to the north, is about 10 feet in diameter and protrudes about 2 feet into the coal. It may have connected with a similar "boss" exposed on the west rib.

The top of the fall exposes about 2 feet of sandstone; light greenish-gray, fine grained, very argillaceous, thinly laminated, and slabby. Water is dripping in several places. The contact of the sandstone to the limestone is a distinct, gently undulating surface. It is nearly level above the large "boss" on the east rib and above the "boss" on the west rib, but it bulges upward slightly above a smaller limestone "boss" on the south edge of the east rib. Thus we can see that "bosses" represent an actual thickening of the limestone and are not folds or downwarps of the limestone.

The limestone itself is nodular throughout, with wavy partings of dark, sandy, calcareous shale. The nodules are generally elongate and flattened and vary greatly in size and shape. The limestone is about 2 feet thick between the "bosses" and up to twice that at the "bosses". The limestone in the lower part of the "bosses" is harder, less shaly, and more massive than that above.

Below the limestone is shale ranging from a couple of inches to about 1.5' thick. Only Anna Shale is present along the west rib, but thin Energy Shale occurs in places on the east rib. The shale is thin and deformed beneath the limestone bulges.

Beneath the "bosses" the coal has bent downward and large clay dike-type slips have formed. It is easy to visualize how the "false drag" developed along the slips. Probably the weight of overburden gradually pressed the coal layers downward beneath the bosses, and eventually they ruptured and a slip was formed. The "boss" continued to weigh down on the hanging wall, bending the coal layers farther down. The pressure on the coal of the footwall was released by the slippage, and the coal layers rebounded upward.

It is difficult to state whether limestone "bosses are depositional features, or load/slump structures. The appearance in cross-section suggests that they represent an actual thickening of the limestone, perhaps due to deposition of limy material in a small hole in the swamp floor. The form of the "boss" and of the underlying shale and coal was changed during compaction of the sediments.

The fall here illustrates that limestone in this mine is not always a safe roof stratum. It seems to be generally true that "bossy" limestone varies in thickness and is nodular. The shale partings in nodular limestone weaken it and create the possibility of roof falls similar to this one.

5.) Area of "reworked" Anna Shale. Greenish silty clay interfingers with the black shale. In places the two rock types are finely interlaminated. Elsewhere the greenish clay intrudes into the black shale as thin wedges crossing bedding planes at a low angle. The upper few inches of the coal seam are also intermixed with clay, forming "white top".

The source of the greenish clay is not seen, but it must be from above. It cannot be an alteration product of Anna Shale because it differs in texture as well as in color. In a few places a thin layer of greenish clay overlies the Anna Shale, but it seems unlikely this was the source. Possibly the clay is from the Lawson Shale/Anvil Rock interval.

Here the main roof is limestone, very nodular, with wavy shale partings and thin sandy laminae. The thickness is unknown. The roof looks very unstable, and is dripping water in several places.

6.) (Omit this note)

7.) In the 12th Main South jointing is very prominent in the black shale; especially the 055° set. Spacing varies from less than an inch to about a foot. Many joints consist of closely-spaced parallel fractures, and some are slightly open. Most extend into the coal.

There is a trace of water and gas seepage, but it should be noted this is against the solid barrier pillar. The 055 joints continue in the limestone as closed fractures; not very distinct.

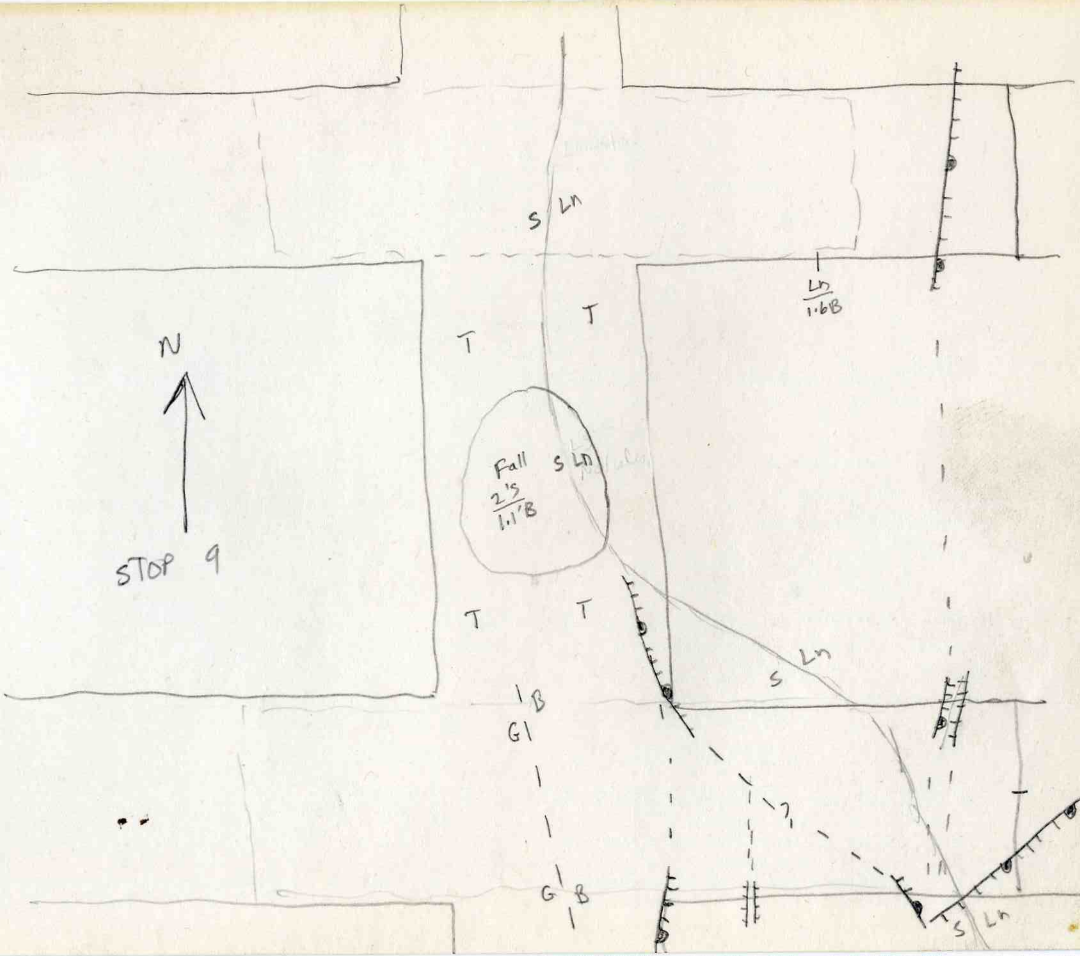
8.) Large roof fall exposes base of Brereton Limestone about 3 feet above top of coal. The lower surface of the limestone is smooth to slightly knobby and bulges downward into the center of the entry. The bulge is very pronounced but is too gradual to be called a "boss". The bulge appears to be elongated north-south, parallel with the sides of the fall and with several large clay dike-type faults, as mapped.

The faults can be traced several pillars northward and about one pillar southeast of the fall. Most have thin clay fillings and cut through the entire coal to the underclay. They follow strongly curving trends and undergo frequent reversals of dip direction.

No gray shale is present in the area. I would speculate that the broad bulge in the limestone is a linear feature and that the faults developed along the margins during compaction. In our mapping we have nearly always found that clay dike-type faults follow some kind of irregularity in the roof sequence. As there is no irregularity visible in the shale, some anomoly in the limestone must be suspected.

Notes 9 and 10 are from an area previously mapped near the south end of the Main South. It is an extremely complex area, both structurally and lithologically, and very difficult to portray on a 1"-100' scale map. Fred and I have decided that the area should be remapped on a scale of 1"-50'.

9.) See sketch map (over). Very complicated area; cut down for overcast. Numerous large slips and clay dikes are present. It is very difficult to link them from one side of the entry to the other because the roof has been cut down and it is well known how rapidly the


N
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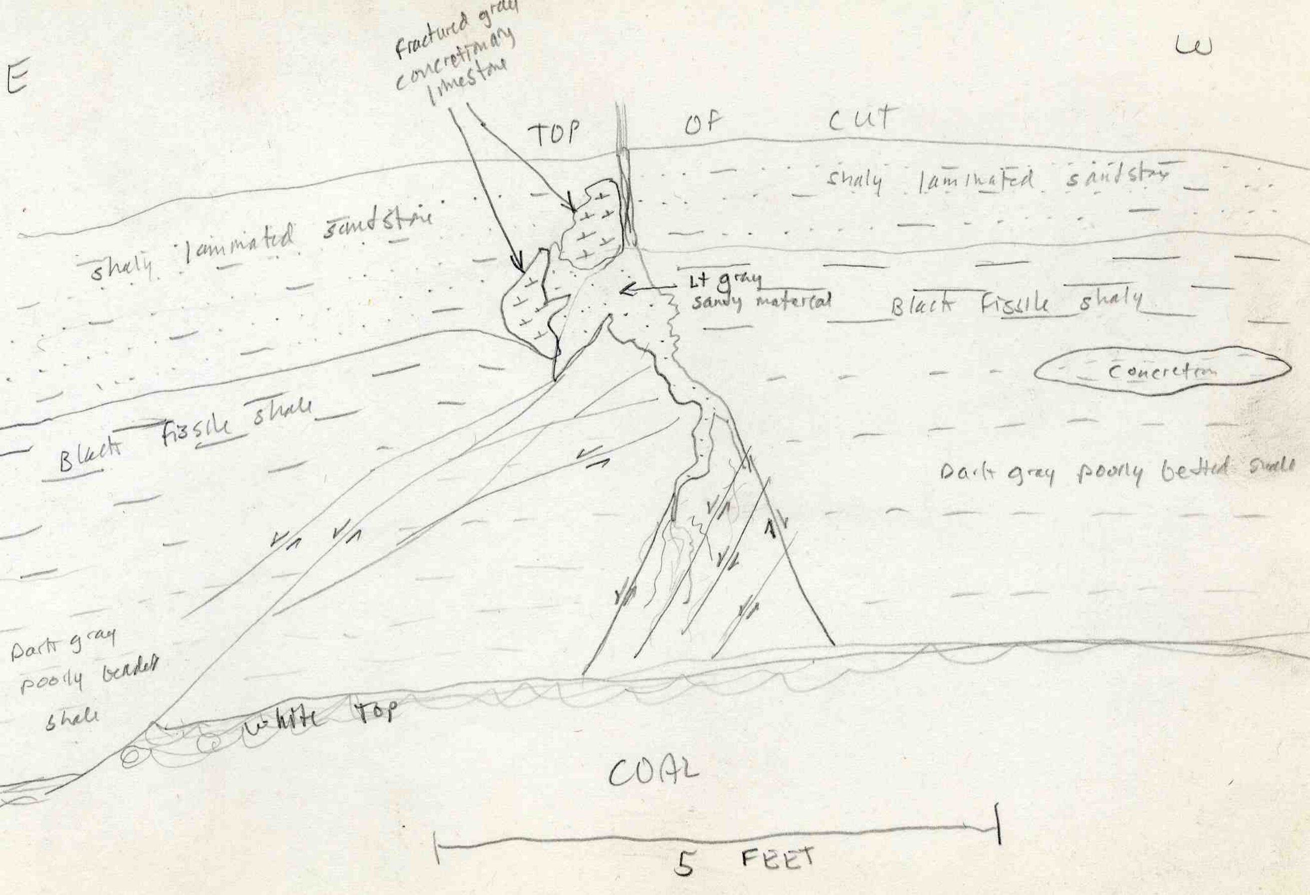


E
W
Fractured gray concretionary limestone
TOP OF CUT
shaly laminated sandstone
shaly laminated sandstone
Lt gray sandy material
Black fissile shaly
Concretion
Black fissile shale
Dark gray poorly bedded shale
Dark gray poorly bedded shale
White top
COAL
5 FEET

strike and dip of these structures can change.

At the east edge of the cut, near the mandoor, the immedaite roof is a mixture of "white top" and Anna Shale with clay intrusions, overlain by thin nodular limestone. The limestone pinches out to the west and sandstone directly overlies the black shale. The sandstone is shaly and thinly laminated, and does not bear water. Occasional limestone nodules or concretions occur along the lower contact.

West of the limestone pinch-out dark gray shale wedges in beneath the black shale. The upper contact of the gray shale is gradational. So the limestone has pinched out ~~before the Energy Shale was done~~ in a belt where no Energy Shale is present.

On the south rib is an unusual structure (see sketch, over). It appears as a north-south trending slip in the sandstone at the top of the cut. It divides northward and dies out before reaching the north rib. On the south rib, as sketched, it forms a clastic dike with a filling of light gray sandy clay or silt. It branches downward into a series of slips that die out in the top coal. Clay or sand is intruded along some of the slips.

We rarely see the top of a clay dike in the coal. Perhaps this is the upper part of a clay dike. It shows that at least some clastic dikes form in the Anvil Rock Sandstone.

10.) Huge roof fall, cleaned and re-bolted. Fall caps out in base of sandstone, but there is no sign there ever was water dripping here. The sandstone is light gray with a greenish cast, fine-grained, argillaceous, slabby, thinly laminated.

Below the sandstone is shale ranging from 6 feet at the south to about 9 feet at the north edge of the fall. The top foot or so is black shale (Anna), poorly bedded, with concretions at the base. It grades downward to dark gray shale; moderately hard, finely silty, poorly bedded, with fine parallel laminations in some zones, quite pyritic, containing Pecten.

Numerous low-angle slips trending 145-180° cross the intersection. They do not seem to affect the sandstone but cut through the shale and the upper layers of coal. A few show slight "false drag" and there is no clay filling. Evidently they are compactional slips.

I speculate that the absence of water in this fall may be due to the height of the sandstone above the coal. The water may have drained to the low places where the sandstone lies close to the top of the coal.

February 23, 1978   Mapping in 3rd Panel South.

1.) A structural disturbance bearing evidence of strike-slip movement. Slight water dripping.

In the limestone roof the structure appears as a fractured or brecciated zone trending about 077. On close inspection numerous "en echelon" fractures each trending 055° are seen. The limestone contains open cavities and angular blocks, coated with fine crystals, appear to have dropped down. The limestone appears to be downthrown about 0.3' to the north along sort of a monoclinal flexure.

Near the middle of the entry, in the limestone, there is a thin zone of gouge along a fracture which bears slickensides trending 060/90° and plunging 15° west. The slickensides indicate the primary direction of movement was left-lateral with a small vertical component down to the north.

On the west rib the structure appears as a monocline in the black shale and a fault in the coal. The monoclinal axis dips about 60° east in the shale and turns to nearly vertical in the coal. The shale is sharply folded but there is little offset or displacement. The axis appears to trend 120° and plunge about 10 degrees southeast, but this is unclear. Some bedding planes are slickensided in the flexure. The shale is highly fractured and pulverized along the axis of folding. Away from the fold the shale contains two very prominent sets of fractures; one trending about 050/85° SE and the other 138/85° NE. These appear as joints in the roof.

A bedding plane in the base of the "clod" has slickensides trending 045/15°NE plunge. A similar bedding plane near the east rib shows striations trending 045/8° NE plunge.

On the west rib the coal is offset along a fairly definite fault plane trending about 092/80°S with slickensides plunging 20°W. The coal is downthrown 0.6' to the north but the main component of movement is left-lateral. By geometry there has been about 1.65' of lateral movement and total displacement in direction of movement indicated by the slickensides is 1.75'. There is a thin zone of gouge and not much drag in the coal.

On the east rib the structural axis dips 45°S from the limestone to the coal. There is no single fault, but a zone of fracturing and flexure less than a foot wide. The shale is sharply folded down to the north and shows compression in tight little folds. The coal also is folded down about 0.6' to the north and is fractured with a thin gouge zone, but no single plane of movement. The axis of folding steepens downward. The lower half of the coal was not mined so we cannot tell what happens there.

Reconnassance visit to Main North

We walked up the east four entries of the Main North to examine the "sandstone channel" phenomena noted by Popp and Bauer on the previous visit.

1.) Large clay dike in area of thin Anna Shale overlain by limestone. The clay dike extends through the entire coal seam to the underclay and is several feet wide in places. It extends upward through the limestone as a series of clay-filled slips. Where it passes through the Anna Shale the shale is brecciated and intruded by clay. Tiny angular pieces of Anna Shale and coal occur within the clay filling of the dike. This shows that the Anna and Brereton had both been deposited before the clay dike formed.

This is the clay dike that lies nearly on direct line with the fracture zone mapped last week in the 1st and 2nd Panels North.

2.) Area of Lawson Shale roof, as known from contact relationships with other units. There appear to be several subtle distinguishing features of Lawson Shale. It appears to be considerably sandier and siltier than typical Energy Shale, and is harder, breaking off in large slabs. Lawson Shale is not jointed. It is very rich in plant material, with large well-preserved leaves and stems of ferns and other plants. In some places the top of the coal and the Anna Shale appear to have been scoured by currents before deposition of the Lawson Shale. The Lawson Shale in places contains sandy interbeds, and locally it interfingers with sandstone.

In some Lawson/Anvil Rock roof areas the upper layers of coal are very bony, often with a sandy texture, and split by layers of gray shale. It raises the question of whether the Lawson was in part contemporaneous with the coal.

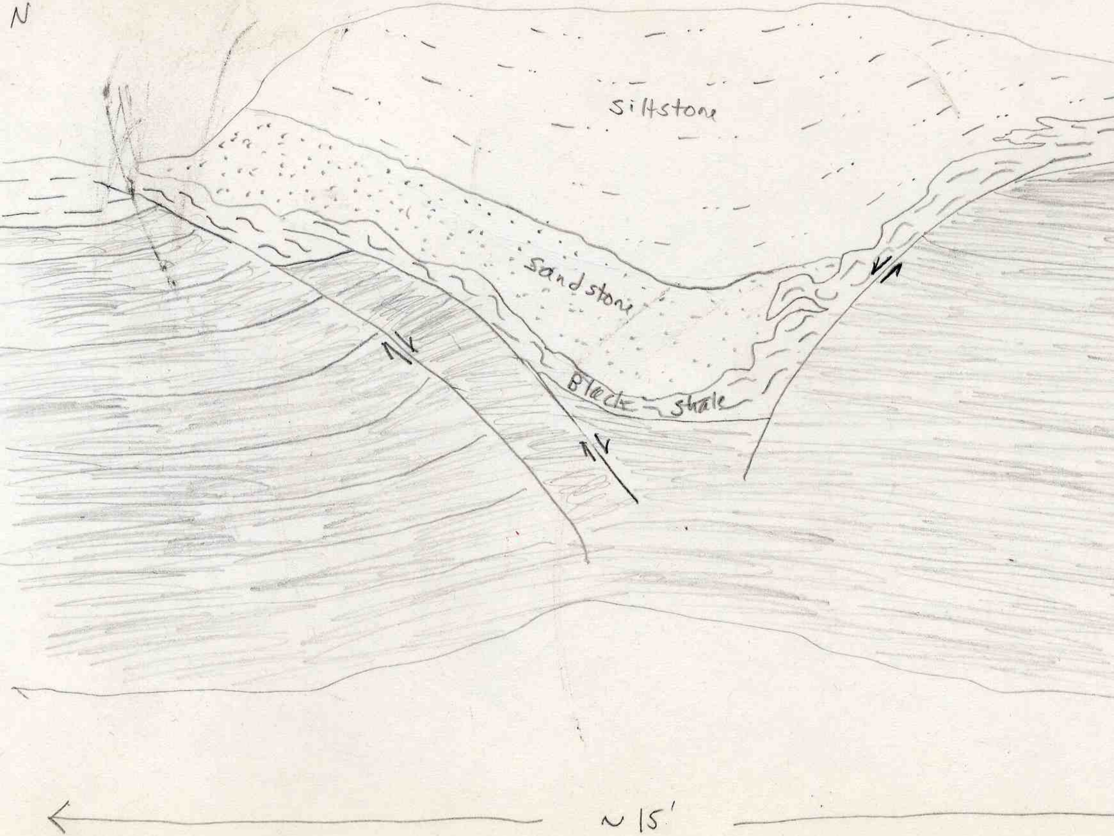
The roof is dry and stable, in contrast to Energy Shale roof areas. The main roof may be a hard, massive, tight sandstone. The only water seepage and roof failure (slight) is near some of the rolls or channels.

3.) Protrusion of sandstone and siltstone in the coal has much more the appearance of a slump/load feature than an erosional channel. See sketch (over).

The feature is about 18 feet wide and 4 feet deep on the west rib, and slightly narrower and less deep on the east rib. It crosses the entry on a rough east-west heading, but is not present in the next entry west. A true channel should be more continuous.

The coal is not eroded at all; rather, it is dropped down along slips forming a graben (see sketch). The overlying Anna Shale is greatly thinned beneath the sandstone, but is not cut out. Some of it must have been eroded, but much of the deformation is due

Stop 3 - East Rib



to movement or compaction and not to erosion. Small lenses and veinlets of sandstone are found within the Anna Shale.

A body of sandstone a little more than a foot thick dips into the trough from the north but does not cross the east limb. The sandstone is gray-brown, fine-grained, very hard, massive, and well cemented.

Above is a fine-grained siltstone or silty shale, medium gray, moderately hard, poorly bedded, and faintly laminated. The layering is bowed downward into the trough, as indicated in the sketch. The siltstone is badly fractured, with many slips, and is unstable roof.

A small roof fall has occured in the siltstone. No water is dripping within the roll, but there is some seepage just north of it. Undisturbed Anna Shale overlies the coal both north and south of the roll.

Other sandstone intrusions into the coal were briefly examined. In general they appear similar to the one described above. Though there certainly has been erosion of Anna Shale and locally of top layers of coal, no true channels are present. The sandstone protrusions probably are load casts or slump features. The exhibit no lateral continuity, and the main movement has been along slips rather than erosion of coal and replacement but sediment.

FREEMAN UNITED COAL MINING CO. CROWN MINE II
March 14-16, 1978
Notes and Sketches by John Nelson working with H.-F. Krausse.

We are re-mapping a portion of the Main South fault zone on a scale of 1"-50'. Special emphasis is placed on the strike-slip fault and associated features. We intend to re-map the entire fault zone through the Panels South off the Main East.

Numbers refer to locations on field map.

1.) Large normal fault in 2nd Main South (2nd entry from west). Fault trends 140/50 NE and shows some peculiar features. See sketch (over).

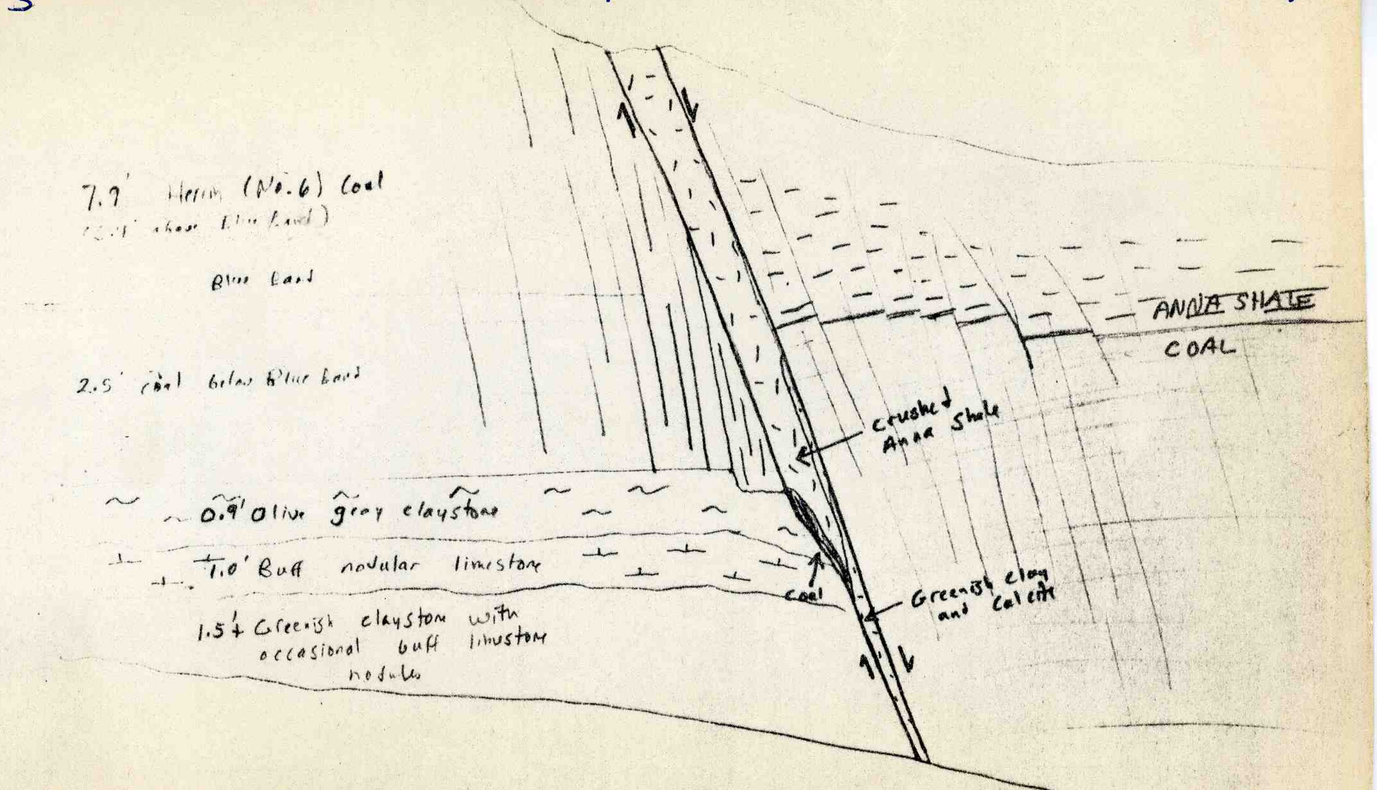
On the east rib the fault is essentially a single plane. The coal and rock layers lie horizontal right up to the fault; almost no drag, though fracturing is somewhat more intense close to the fault. There is a small amount of normal drag in the Anna Shale on the hanging wall, and there is a thin gouge zone along the fault plane. The slickensides plunge in dip direction. Displacement is 5.7 feet down to the northeast.

On the west rib the fault zone is about 0.5' wide, becoming slightly narrower downward. The displacement is about the same (5.6') as on the east rib. As shown in the sketch, Anna Shale exists in the gouge zone 3 feet below the base of the Anna on the hanging wall. In the lower part of the fault zone the gouge consists of greenish claystone or shale similar to that below the Higginsville Limestone. Some greenish claystone is squeezed or dragged along the hanging wall to a point several feet above the Higginsville Limestone. I am not sure of the source of the clay, but there is no doubt about the Anna Shale in the gouge zone.

I can conceive of three ways this could have happened, but only one appears likely here:

(A) Strike-slip movement. But slickensides are vertical and the dip and direction of faulting are constant

Stop 1



GIRARD FAULT, ENTRY 2, MAIN SOUTH

(B) Reversed movement along the fault. Difficult to explain mechanically. Also there are no good indications such as compressional folds for reverse faulting.

(C) The fault formed by extension and an open void was produced, and Anna Shale dropped along the fault plane by the force of gravity. This seems the most likely explanation.

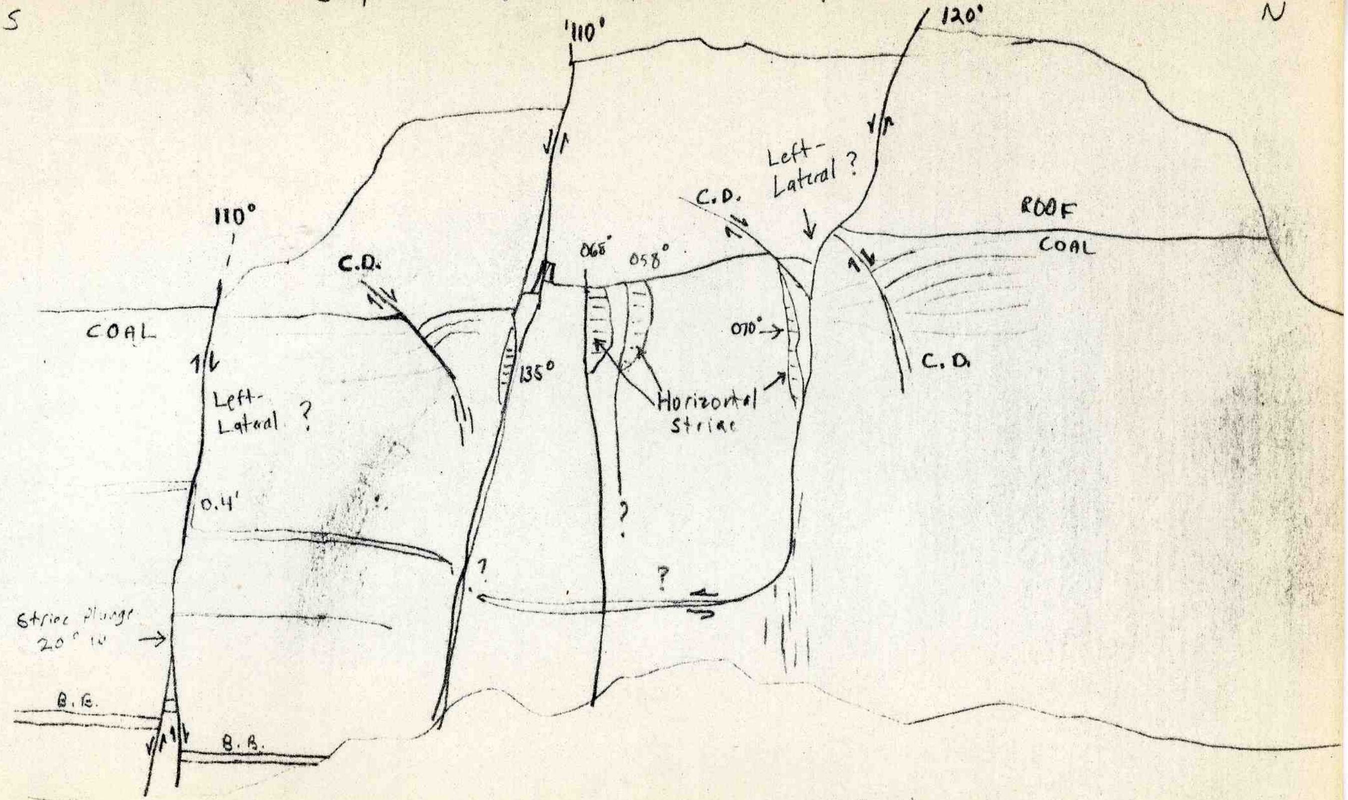
Evidence for extension, with open fractures, is found in the form of numerous closely-spaced high-angle fractures on both sides of the main fault. The fractures strike parallel with the main fault and dip steeply northwest. The coal is displaced up to several inches on some of the fractures, but most fractures lack slickensides. The coal on the hanging wall is folded slightly downward toward the main fault, and offset in a series of small steps down to the northeast. The small fractures are the type we have mapped as open joints.

The pattern indicates that the coal and rocks were brittle at the time of faulting, but probably not under great overburden pressure. I suspect the extension fracturing is related to the strike-slip movement along the east-west zone just south of here.

2.) Strike-slip fault zone in same entry. Compare with Note 7 for Jan. 10, 1978.

Sketch of west rib (over) shows at least seven individual faults with horizontal slickensides. Their azimuths range from 058 to 135 and vertical displacements up to 0.5'. The southernmost fault bears slickensides plunging about 20 west, which, combined with downthrow to the north, indicates left-lateral movement The northernmost fault appears to offset a small compactional slip about one foot in left-lateral direction and the same fault seems to turn into a bedding-plane shear along a clay parting in the coal. These two faults and also a third fault with 0.5' vertical displacement can be traced across the entry to the east rib.

Stop 2 View of West Rib.



C.D. = Clay Dike - Type Fault
Directional Trend of Strike Slip Faults indicated

The east rib has heavy rock dust and is very high; therefore I did not attempt to sketch it. Three main fault planes are present. As noted on Jan. 10, a clay dike-type fault appears to have been displaced about 5 feet in a left-lateral direction across the entire fault zone.

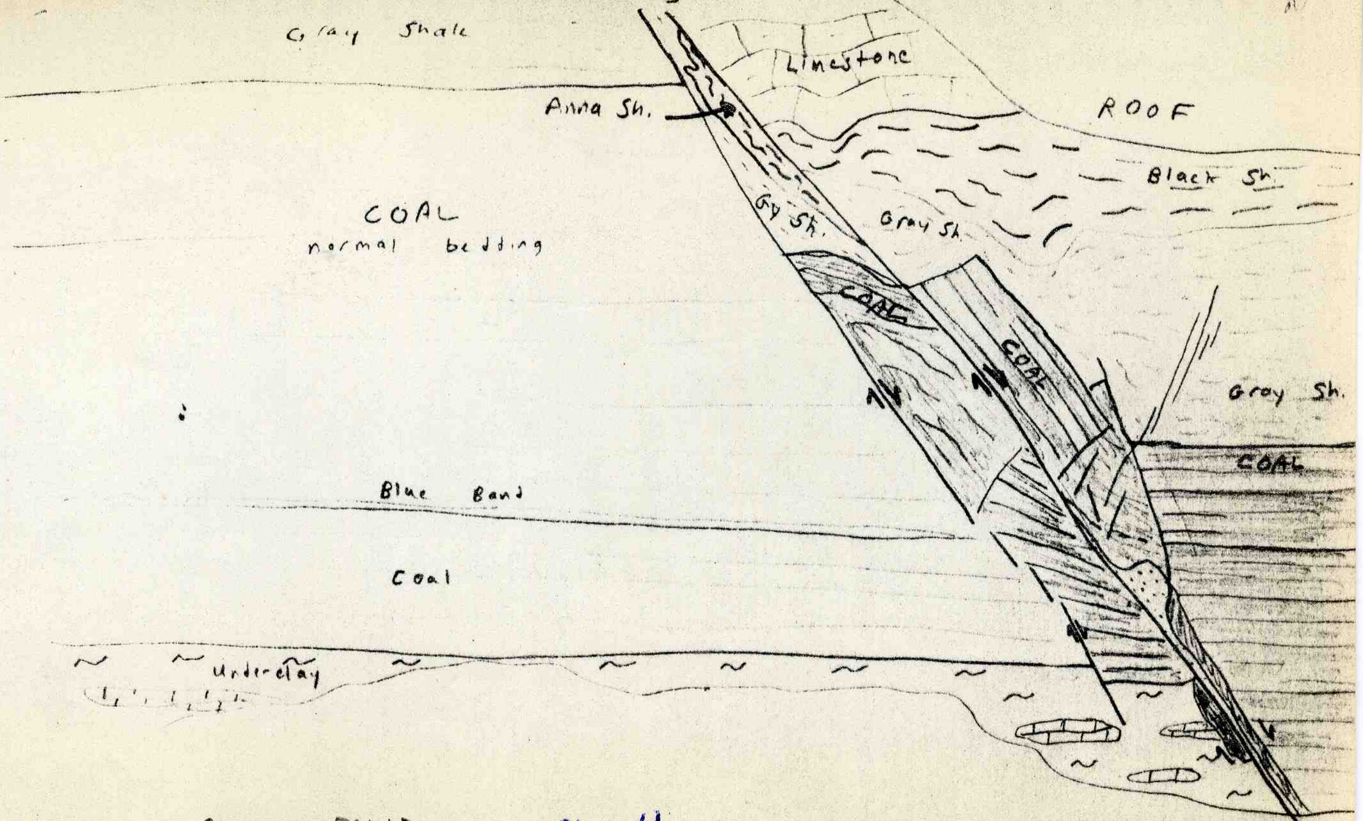
A roof fall has occured in the fault zone; the base of the limestone is exposed. The limestone is slabby and appears to be shaly. It is jointed but contains no open fractures. The Anna Shale is about 3 feet thick and is reworked, with injected clay and "white top" disturbance at the base. Numerous small clay dike-type faults are present.

The roof jointing appears to be very intense between here and Stop 1 (normal fault) and it diminishes away from the fault zone in both directions.

3.) Series of fractures bearing 140, as noted in Stop 8 on Jan. 10. I can trace the system from the 1st M.S. to the 4th M.S. where they appear to die out. The fractures appear identical with those in the Ist and 2nd Panels North, and many other SE-trending fractures we have mapped. The overall system is quite linear but individual fractures do not extend very far. Some fractures have slickensides and normal displacement, but others are vertical closely-spaced jointlike breaks in coal and roof. Some die out upwards, some die out downwards, and one is entirely within the coal. Another appears as a high-angle slickensided slip in the coal and traces upwards to a series of vertical calcite-filled fractures in the roof, with small but appreciable displacement. The underclay is not exposed, but there does not seem to be any tendancy for the overall system to die out downward, as does the system in the 1st and 2nd Panels North.

4.) Sketch of normal fault on the west rib of the 3rd Main South. See Krausse for notes and sketch of east rib.

The fault zone is narrow at the top of the entry



S GIRARD FAULT, ENTRY 3, MAIN S. Stop 4 N and widens downward, with crushed and disturbed coal and rock. On the hanging wall the top one foot or so of the coal seam has broken away and tilted upward so that the bedding is parallel with the fault plane. Farther up the Anna/Energy Shale contact is displaced along what is geometrically a reverse fault. I do not believe it is really a compressional fault, but the effect of extension. As the walls of the fault were pulled away from each other some of the gouge material moved downward farther than did the main hanging wall of the fault. Compare with Stop 1.

March 15, 1978   Visit with R.L.Langeneheim.

Prof. Langeneheim, of the Geology Dept. of the University of Illinois, visited the mine for a general tour. I took him around the mine while Fred continued to map in the Main South. We toured the Main South and 1st and 2nd Panels South observing features of general interest. I noted that the face of the 2nd Panel South had been advanced through the fault and fractured zone. As the U.M.W.A. strike is still on this was obviously mined by company personnel.

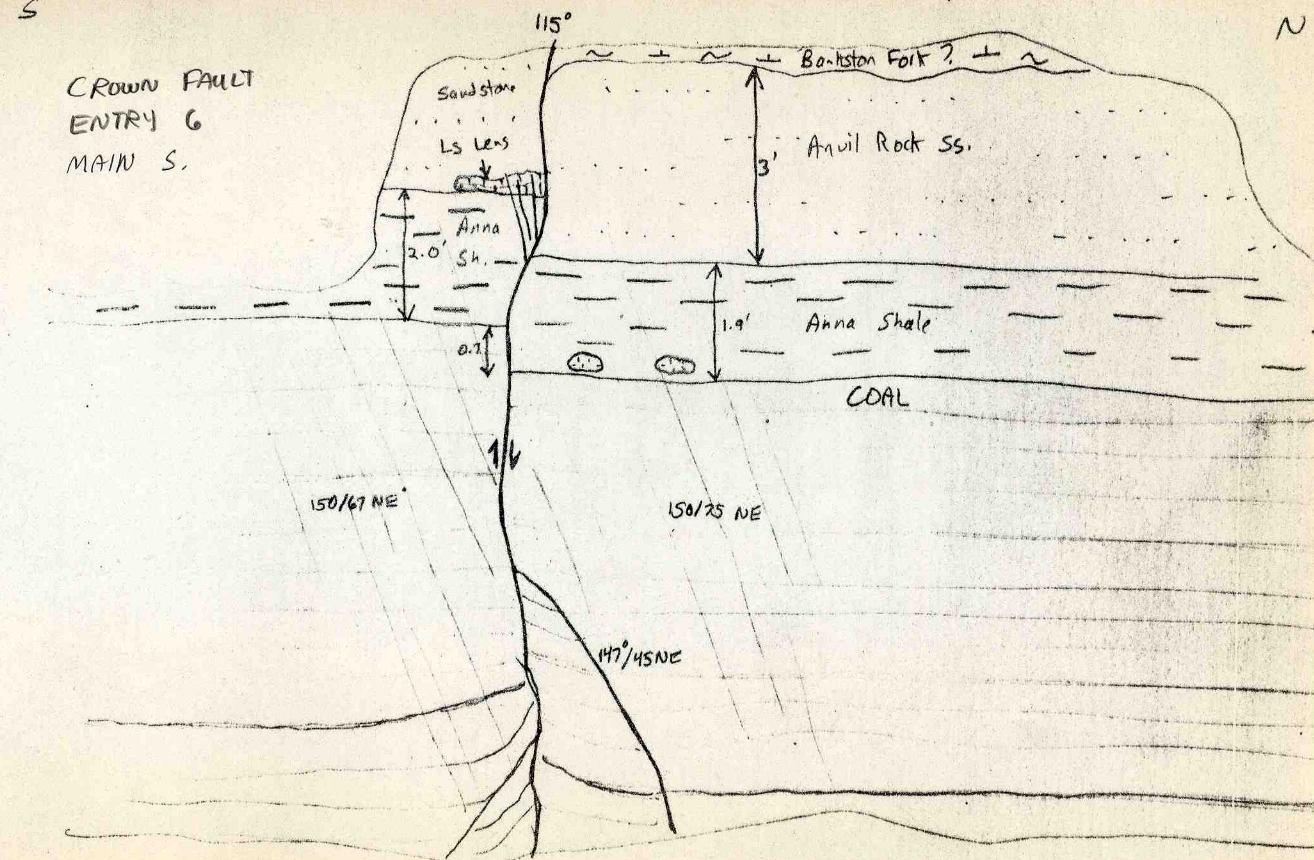
One note and sketch made near end of same day:

5.) Strike-slip fault in 6th Main South (compare John Popp's Note 2, Jan. 12 and Nelson's Note 20, same day). On the west rib, as shown in sketch, the fault plane is sinuous and nearly vertical with the coal downthrown to the north. Slickensides are not very prominent, and both horizontal and oblique-plunging sets are seen. Near the main fault the coal contains many fractures trending 150 and dipping steeply to the northeast. None of these have slickensides or measureable displacement.

The main fault trends about 115° across the roof and appears as a single line (more or less). Many pinnate fractures branch off in a southeasterly direction, in the sandstone roof.

On the east rib the fault forms a small graben-like

View of West Rib. STOP 5



structure (sketched by John Popp on earlier visit). The coal is slightly lower on the north side of the graben, but the black shale/sandstone contact is approximately even across the fault zone. Thus, the black shale is thinner south of the fault than north of the fault. It is not possible to show how much if any lateral displacement has occured.

The east rib also shows fractures trending 150/75 NE branching off the main fault. A couple of these have indefinite horizontal slickensides.

March 16, 1978   Continue mapping with H.-F. Krausse.

6.) Strike-slip fault in 4th Entry South, with huge roof fall (see Nelson note 25 from Jan. 12, 1978) We approach the fall from the south. The entry is blocked, but Fred is more courageous/foolish than I am and sticks his head in far enough to see the fault zone.

The fault displaces all strata from the sandstone at the top of the fall to the coal seam. The sandstone is downthrown 2-3 feet to the south so it is a normal fault geometrically. Sandstone has dropped or been dragged downward along the fault zone into the Brereton Limestone. The gouge zone is about a foot wide and appears to have been an open crevasse with dropped-in material. The footwall shows normal drag near the fault. The fault angle becomes shallower downward into the coal. Coal is crushed in the fault zone, but not much can be seen due to fallen material against the ribs.

Estimated section in roof fall:

TOP

6-8'	Shale, greenish-gray.
1-2'	Limestone or calcareous shale
3.3'	Sandstone, thin-bedded as usual; irregular contact.
4.5'	Limestone (Brereton) massive for the most part; nodular at base, with about 0.2' dark shaly

layer at top.

2.0' Shale (Anna) Bedding dips 10-12 north-northeast near fault.

South of the fault there are feathering open fractures in roof and coal. The most prominent one trends 123 in the limestone and dies out near the east rib. The coal and shale contain numerous fractures trending 135, and there are closed but intense 045 fractures in the shale.

On the east rib is a small clay dike-type fault with "white top" disturbance. The Anna Shale is highly reworked, with up to 50 % light brownish clay interbedded. Small high-angle fractures offset the laminations. Fred took several photos. (evidently lost)

7.) Somewhat linear protrusion of limestone into the Anna Shale. The feature is too broad and gentle to be called a "boss", but is in many ways similar. Large clay dike-type faults forming a curving graben follow the boundary of the protrusion. The Anna Shale is much reworked with "white top". The feature appears to continue southward.

In our earlier mapping we have found several areas where large clay dikes or slips follow curving paths through uniform-appearing Anna Shale roof. Perhaps such slips are related to bulges of limestone like this one. The limestone will not be visible until the shale slabs away, but the clay dikes warn of possible unstable roof and lithologic changes above.

At the southeast edge of the structure is a northeast-trending set of open joints. The base of the limestone is fractured and may be displaced slightly down to the southeast. The coal and shale are shatterd along the trend of the fractures; the entire height of the coal seam is affected.

8.) Another shallow roof fall, exposing a gentle bulge of knobby limestone. In this case the limestone body does not seem to be linear, and no large clay dikes are present; only one slip on the west rib.

More open joints or fractures trending 050 are seen here. They are vertical to steeply dipping, and are quite obvious in the limestone, where they have healed. There appears to have been slight movement on the fractures in some cases. The coal is affected down to the underclay but is not visibly displaced.

We are finding that this type of fracture is much more common than we realized before. Many such features were missed in the first stage of mapping. Our early conclusions about their distribution may be wrong.

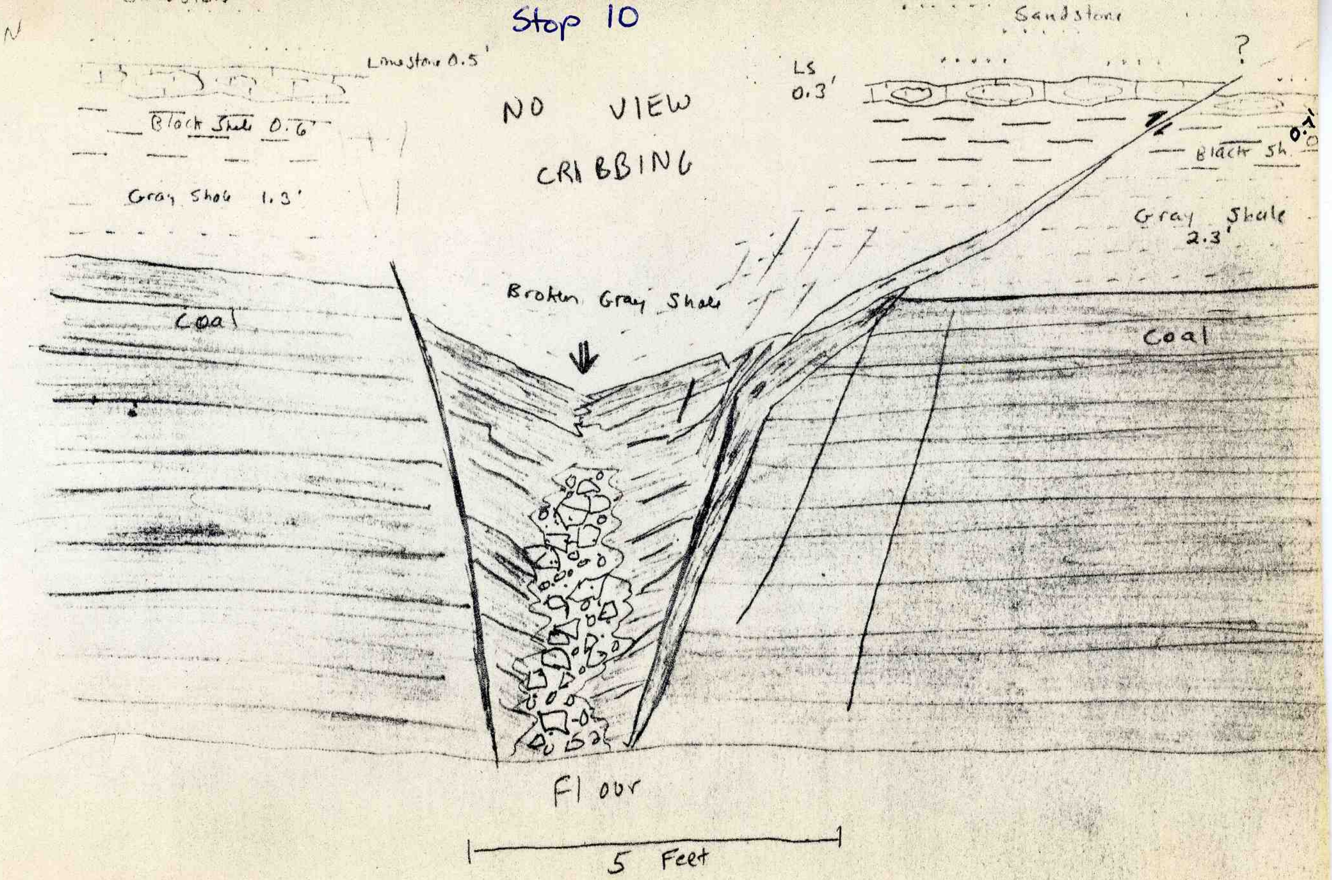
9.) Large normal fault in 8th Main South and adjacent crosscut. The fault trends 132/45 NE. The coal and rock are intensely fractured along the fault, with one set of fractures parallel and the other at right angles to the main fault. Also there are inclined antithetic and synthetic fractures. The small fractures do not show measureable displacement. The main fault has vertical slickensides.

On the downthrown (northeast side) of the fault is a large irregular bulge of knobby limestone. Possibly the bulge was formed during faulting, if the limestone was not completely lithified. There is a westward-thickening wedge of gray shale in the crosscut.

In the general area of the fault are intense 050-060 fractures, some of them open. The limestone is affected, as is the full height of the coal seam. It seems to be a continuation of the line of fractures noted at Stops 7 and 8.

10.) Strike-slip fault in 8th Main South. Large roof fall and cribbing blocks view of west rib, where the fault appears to be narrow with little vertical offset. The east rib is partially exposed (see sketch, over).

The general form is of a graben that narrows downward. The width is 5 feet at the top of the coal and about half that at the base. The bounding faults contain pulverized coal but very little vertical displace-


Stop 10
N
Limestone 0.5'
Black Shale 0.6'
Gray Shale 1.3'
NO VIEW
CRIBBING
Sandstone
?
LS
0.3'
0.1'
Black Sh
Gray Shale
2.3'
Coal
Broken Gray Shale
Coal
Floor
5 Feet

ment has occured. Rather, the coal and shale have broken and sagged downward like a bridge that had too much weight placed on it. In the central part of the graben is a jumble of angular coal fragments with a loose matrix of finer coal. It seems to be another case of the walls of the fault moving apart to form an open fissure into which material dropped.

The south bounding fault is steep through the coal but abruptly shallows in the roof and appears to die out upward. The north bounding fault is very steep in the coal and is hidden by cribbing above.

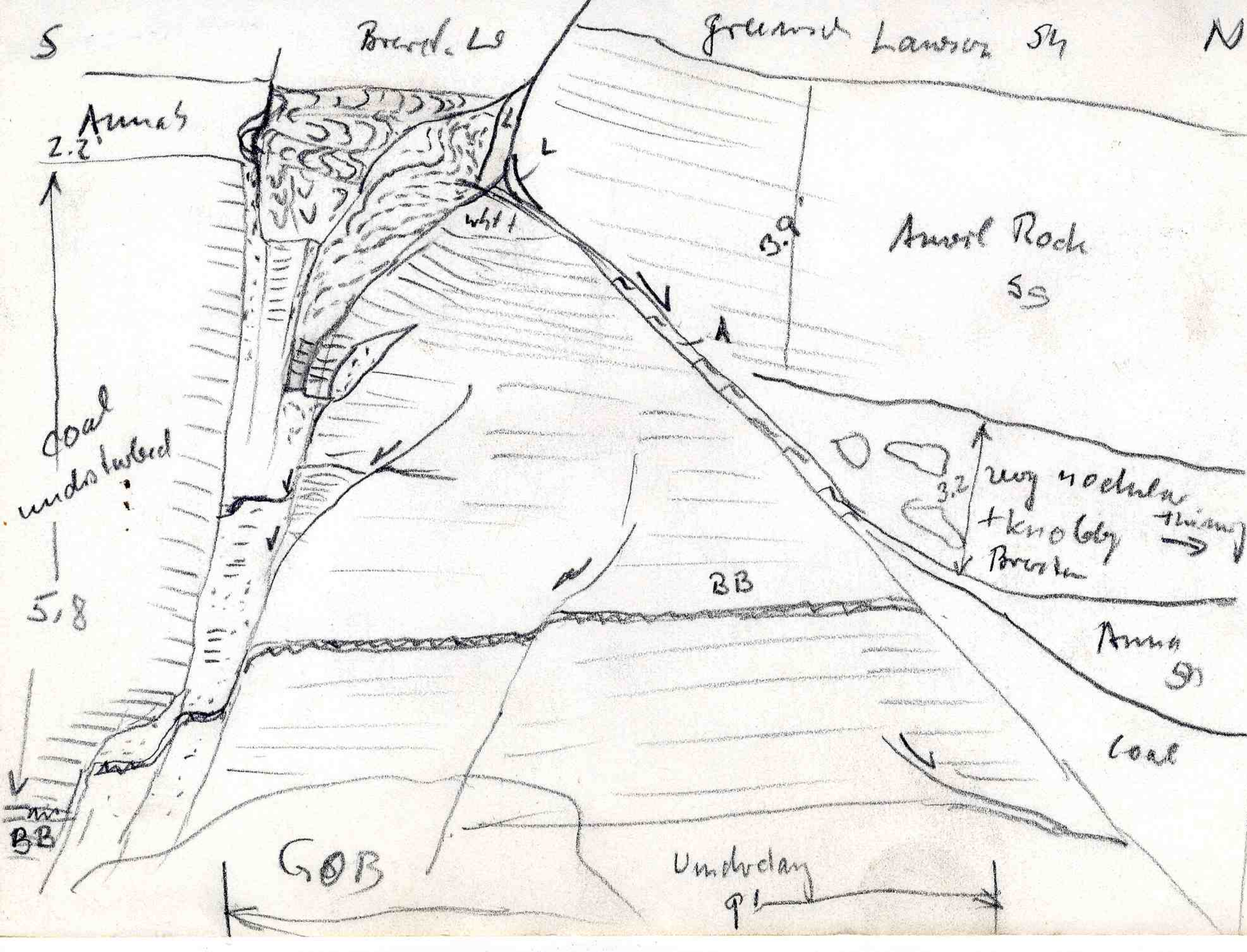
South of the fault the coal contains very closely spaced fractures trending 140-150/75 NE. They are clearly not ordinary cleat and probably are related to faulting.

11.) Abrupt wedging of roof rock units, with possible erosional contact of sandstone to shale below.

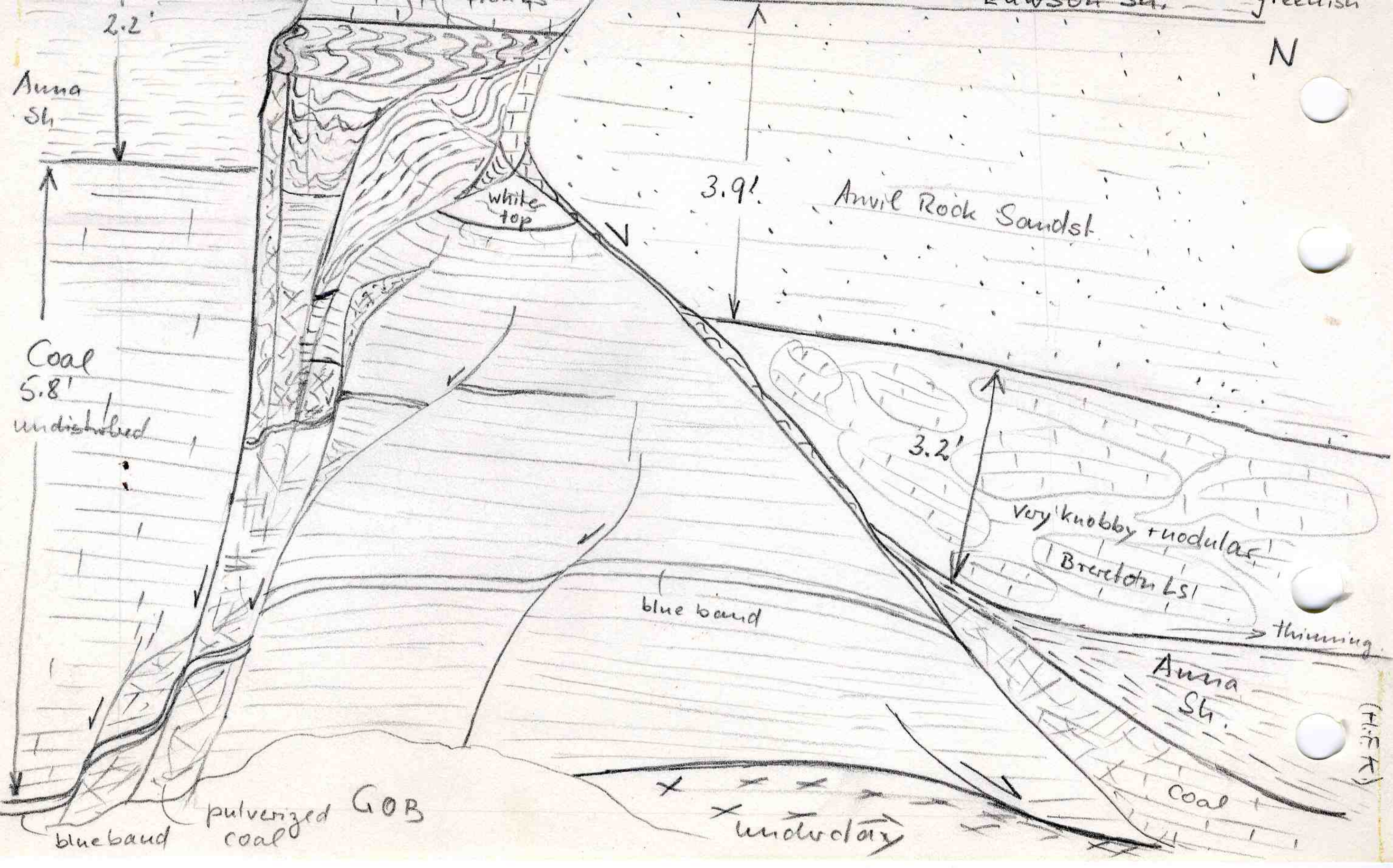
The Energy Shale thickens rapidly to the west and pinches out along the east rib. Above it the Anna Shale lies in unconformable contact; its bedding dips about 25 eastward, parallel with the Anna/Energy contact. The black shale is phosphatic but contains no significant clay or sand interfingering.

The sandstone sharply overlies the Anna Shale and its bedding is roughly parallel with the contact. Some erosion appears to have taken place but it is not certain. The condition of the roof does not encourage close detailed study. Locally lenses or concretions of limestone lie along the sandstone/Anna contact.

Many large clay dike type faults cross the roof fall. Most trend N-S and so roughly parallel the local lithologic trends.



Main Normal Fault 5th Main South Ely West R.6
+ Strike Slip Fault
03/16/78
(H.F.K.)



Lawson Sh.
greenish
N
2.2'
Anna Sh.
Coal 5.8' undisturbed
white top
3.9'
Anvil Rock Sandst
3.2'
Very knobby + nodular
Brereton Ls
blue band
thinning
Anna Sh.
Coal
pulverized coal
GOB
blueband
underclay
(H.F.K.)

FREEMAN UNITED COAL MINING CO. CROWN MINE II
March 28, 1978
Visit by John Nelson with Phil DeMaris

Phil began setting up a sampling and study program in the Main East for an investigation of shale partings in the coal. Meanwhile, I collected coal samples requested by Dick Harvey and Russ Peppers.

All samples were collected in the 1st through 3rd Main South near the fault zone. They are located on my 1"-50' scale field map for that area.

Dick Harvey Samples- Oxidation Study

These samples were collected for a study which will compare oxidation of coal in the fault zone with oxidation of coal away from the fault zone. Samples were placed in small plastic bags inside cloth bags and weigh about 2 pounds each. All samples were taken near the base of the coal seam in an attempt to try to reduce variables.

Sample 1H Coal from the gouge zone of the normal fault in the 1st Main South.

Sample taken on west rib of entry in fault "slice" opposite coal/underclay contact on footwall. Coal is fractured and locally is crushed, but bedding is still visible; i.e. the coal is not pulverized.

Sample 2H Coal from gouge zone of normal fault in 2nd Main South.

Sample taken from west rib; fractured coal from base of seam on footwall adjacent to fault plane. Coal is highly fractured but bedding is apparent. Calcite-filled vertical fractures are present. (The actual gouge zone here is very thin and contains clay or crushed shale).

Sample 3H Coal from gouge zone of normal fault on 3rd Main South.

Sample from east rib ; crushed and mineralized coal in fault "slice" opposite base of coal on footwall Bedding nearly destroyed.

Sample 4H Coal from gouge zone of strike-slip fault on 1st Main South.

Sample from west rib near base of seam just south of fault plane. Coal is practically pulverized and bedding is warped upward toward fault. Possibly some clay in sample.

Sample 5H Coal from gouge zone of strike-slip fault in 2nd Main South.

Sample taken from east rib near base of seam near south edge of the fault zone (multiple faults in this area). Coal is badly fractured to pulverized, and some clay may be present.

Sample 6H Coal from strike-slip fault in 3rd Main South.

Sample from west rib near base of coal seam, in center of narrow fault zone. Coal is badly fractured to crushed, but bedding is still visible. Coal appears to be slightly mineralized.

Sample 7H Coal from midway between the two faults on the 2nd Main South.

Sample from lower 1 foot of seam along west rib. Normal-appearing coal with prominent cleat trending 060 and 138. Some mineralization of cleat surfaces.

Sample 8H North of normal fault on 2nd Main South. Sampled lower 1 foot of seam on southeast corner of intersection (see map) two crosscuts north of fault. Coal has well-developed cleat trending 054 and 136, and some brownish to white calcite cleat filling.

Sample 9H South of strike-slip fault on 2nd Main South at southeast corner of second intersection south of fault. Basal 1 foot of seam sampled. Coal has strong cleat trending 045 and 135. Note that at 7H, 8H, and 9H, cleat roughly parallels jointing in roof.

Sample 10H Shale from gouge zone of strike-slip fault. Location same as Sample 5H. Black carbonaceous shale (Anna Shale) immediately above coal.

Sample 11H Sample of shale from gouge zone of normal fault. Location same as Sample 2H. Black carbonaceous shale (Anna Shale) dragged or dropped down between walls of fault. See notes and sketch for Stop 1, March 14, 1978.

Samples for Russ Peppers

These samples will be analyzed to compare pollen and spores from coal under gray shale roof vs. coal under black shale roof.

Sample Set 1P Collected under gray shale roof. Location is south rib of crosscut between 2nd and 3rd Main South, 4 crosscuts north of the normal fault.

1P-A Top 2" of coal seam
1P-B 2" to 4" from top of seam
1P-C 4" to 6" from top of seam
1P-D Composite of entire coal seam.

Measured section in small roof fall at sample site:

Top- Base of Brereton Limestone. Gray-brown, mottled, shaly, slightly irregular lower surface. Thin transitional "clod" zone.

1.3' Shale (Anna), black, mottled, weak, poorly bedded phosphatic, contains numerous small slickensided fractures but is not jointed. Contact indistinct:

2.5' Shale (Energy), medium-dark gray, moderately hard, smooth, poorly bedded, finely carbonaceous, contains fine faint parallel laminations near base. Numerous small slips; indefinite jointing. Pyrite crystals at base.

8.10' Coal (Herrin No. 6) subdivided as follows:

0.98' Coal, N.B.B., blocky, with white to brownish calcite on cleats.

0.01' Shale, dark gray-brown, pyritic, a discontinuous lamina.

0.42' Coal, as above.

0.03' Shale, dark gray, carbonaceous, pyritic, a lenticular, discontinuous band.

1.22' Coal, as above, with a few very discontinuous fusain partings.

0.03-0.13 Shale, medium to dark gray, mottled, smooth, very carbonaceous, contains thin coaly streaks, occasional pyrite; varies considerably in thickness but is continuous. Offset by several small slips that die out above and below within the coal seam.

0.49' Coal, N.B.B.

0.02' Fusain, locally pyritic, lenticular, discontinuous.

0.37 Coal, N.B.B.

0.02' Shale, dark gray to black, carbonaceous, pyritic

1.16' Coal, N.B.B.

0.02-0.07' Shale, dark gray, carbonaceous, pyritic, varies in thickness but is continuous.

0.62' Coal, N.B.B.

0.05' Shale (BLUE BAND), medium-dark gray, carbonaceous, contains thin coaly streaks, fairly consisttent thickness.

2.50' Coal, N.B.B., no significant partings, but contains closely-spaced calcite-filled cleats and "goat beard" fractures.

Claystone, olive-gray, only top exposed.

Sample Set 2P Under black shale roof on east rib of 2nd Main South, 1½ crosscuts north of normal fault.

2P-A Upper 2" of coal seam

2P-B 2" to 4" from top of seam

2P-C 4" to 6" from top of seam
2P-D Composite of entire coal seam.

Measured section at sample site.

0.5' exposed Shale (Anna), black, hard, smooth, fissille, contains two very prominent sets of vertical fractures trending 052 and 133; cleat in coal is parallel with fractures in roof. Some cleats in top coal connect directly with fractures in roof. Base of shale contains coarse carbonaceous debris which is slightly pyritized. Sharp contact:

7.80' Coal (Herrin No. 6) Subdivided as follows:

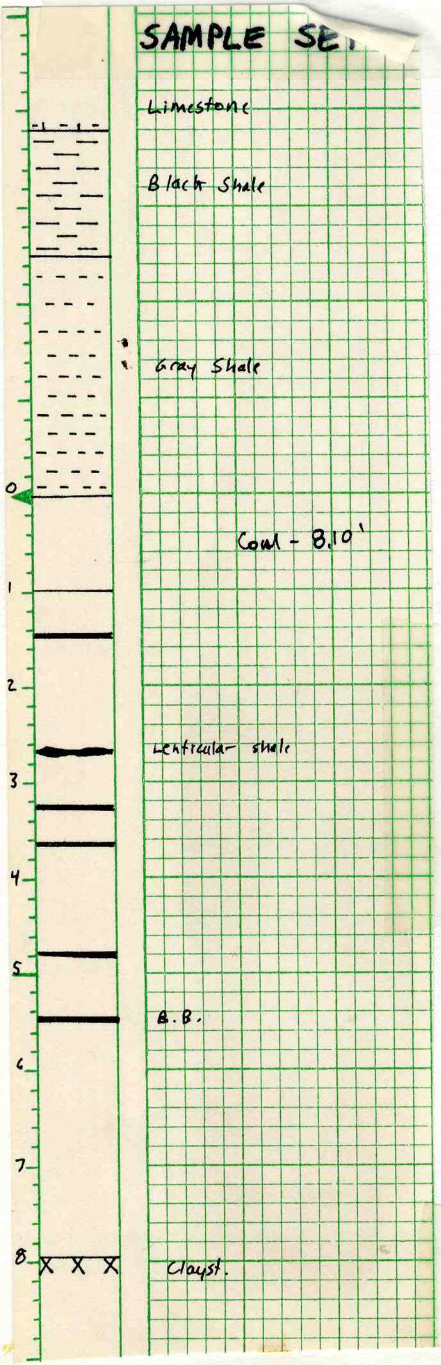
1.00' Coal, N.B.B., with very prominent cleat parallel to roof shale jointing, as noted above.
0.01' Shale, dark gray to black, pyritic, a discontinuous lamina.
0.23' Coal, as above.
0.01-0.02' Shale, dark gray, hard, pyritic, fairly continuous parting.
1.41' Coal, N.B.B., cleat slightly less prominent than in top coal, contains a few thin discontinuous lenses of shale and fusain.
0.02-0.12' Shale, medium gray-brown, mottled, rather soft, carbonaceous, contains pyrite crystals. Forms a lenticular but continuous band. (.04 used)
0.25' Coal, as above.
0-0.07' Shale, dark gray, a very thin parting with knot-like lenses of pyritic shale. (.04 used)
0.50' Coal, as above.
0.05' Pyrite, very fine-grained, hard, lenticular, with streaks of dark gray carbonaceous shale. A discontinuous lenticular band.
1.27' Coal, N.B.B., with strongly developed cleat.
0.03' Shale, dark gray-brown, fairly hard, pyritic, fairly consistent in thickness.
0.55' Coal, as above.
0.05' (average) Shale (Blue Band), medium-dark gray-brown, fairly hard, carbonaceous, fairly continuous but pinches out locally.

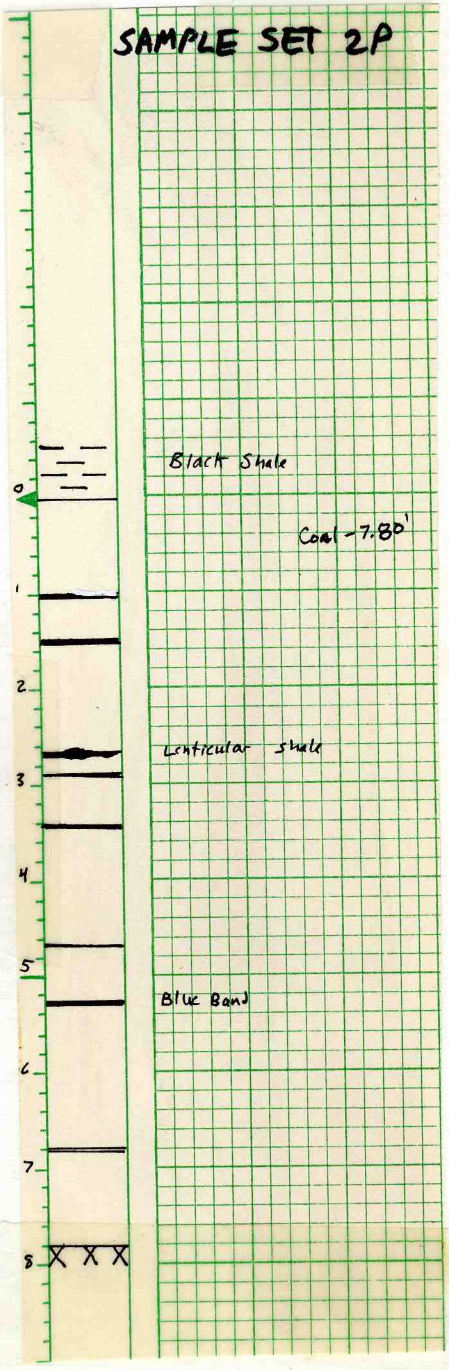
..53' Coal, N.B.B., with closely-spaced not quite vertical cleat. Coal is duller with more disseminated shale and fusain than above.

).04' Fusain and vitrain, finely interlaminated.

).78' Coal, similar to 1.53' unit above.

Claystone, olive gray, moderately hard. Only top exposed.


SAMPLE SET
Limestone
Black Shale
Gray Shale
0
Coal - 8.10'
1
2
Lenticular shale
3
4
5
B.B.
6
7
8
Clayst.


SAMPLE SET 2P
Black Shale
0
Coal - 7.80'
1
2
Lenticular shale
3
4
5
Blue Band
6
7
8

Afternoon March 28, 1978 Begin mapping Main North with Phil DeMaris.

Mapping the region of large clay dikes and sandstone roof on 1"-100' scale base maps. We have learned the Main North is to be sealed shortly. Apparently the company drove the Main North to get early coal production, and now that panels have been established off the Main East, they have decided to concentrate in that direction and drop the Main North. All intersections are being cribbed in an attempt to hold the roof until the area is re-opened, which may be several years from now.

1.) Roof is Anna Shale overlain by Brereton Limestone. The lower surface of the limestone is very irregular or nodular. The basal "clod" layer is quite thick in places and grades into the underlying black shale. The shale displays the usual two directions of jointing. The joints are quite prominent, but no open fractures or fracturing of coal noted. Average joint spacing is about one foot. Occasional northeast-trending healed fractures are seen on the base of the limestone.

In the Main South the limestone generally was nodular only where it was thin, near a pinch-out. In the Main North the limestone commonly is nodular even where it forms the immediate roof.

2.) Two very large clay dikes trending 155-160. Both dikes affect the limestone roof and the full height of the coal seam. The primary slips dip northeast but the dikes are very irregular, will sills protruding on both sides.

The filling consists of mottled, light greenish to brownish silty clay, carbonaceous and very crumbly. Numerous angular coal fragments with rotated cleat and bedding lie within the clay. The dike filling is much lighter in color than the limestone roof, which is cut by slickensided fractures. The dikes tend to become narrower downward, but do not die out.

Typical features of convergent bedding in coal, "false drag", etc. are developed, but there is no significant vertical displacement of the coal across the dike.

The source of the clay is not obvious, but there is a good chance it came from the Anvil Rock/Lawson Shale interval.

Several smaller clay dikes trend oblique to the two largest dikes.

The basal "clod" of the limestone roof interfingers with the coal. The lower surface of the limestone is nodular; the nodules are small. Note some water seepage around bolts in several places. Probably the limestone is thin, or water is seeping along slips in the limestone.

March 29, 1978 Continue mapping Main North with Phil DeMaris, also Roger Nance and Steve Phifer, company.

3.) Numerous clay dikes, mainly trending NNE. Dikes are not quite as large as those at Stop 2 but are large compared to those elsewhere in the mine. Direction of dip is not consistent. Some appear to cut to the underclay but others do not. They can be traced in the limestone roof as "healed" slips. Exposures generally not very good due to rock dust and hard ribs.

Most of the dikes appear to be confined to limestone roof areas and do not cross lithologic boundaries but exceptions are seen. Generally they are similar to the clay dikes mapped in the Hillsboro Mine.

4.) Area of Anna Shale roof with several fractures trending slightly north of west. Fractures are steeply inclined, locally almost vertical, and their slickensides are vertical. They affect only the top layers of coal at most, and die out downward. In some places a thin clay filling is present, and there is a small amount of "false drag" shown on a few.

Farther north are similar-appearing fractures that trace into closely-spaced "en echelon" fractures in the roof shale. I believe they are probably clay dike-type faults in the roof and that we are seeing only the bottom end, where they turn into "goat beards".

The Anna Shale in this area is quite damp and also is mottled, appears to have been altered by moisture. The regular joints are still prominent, but no open fractures or joints of unusual intensity.

5.) Area of sandstone "rolls" or small channels, as noted on previous visits. See sketch map and drawing (over).

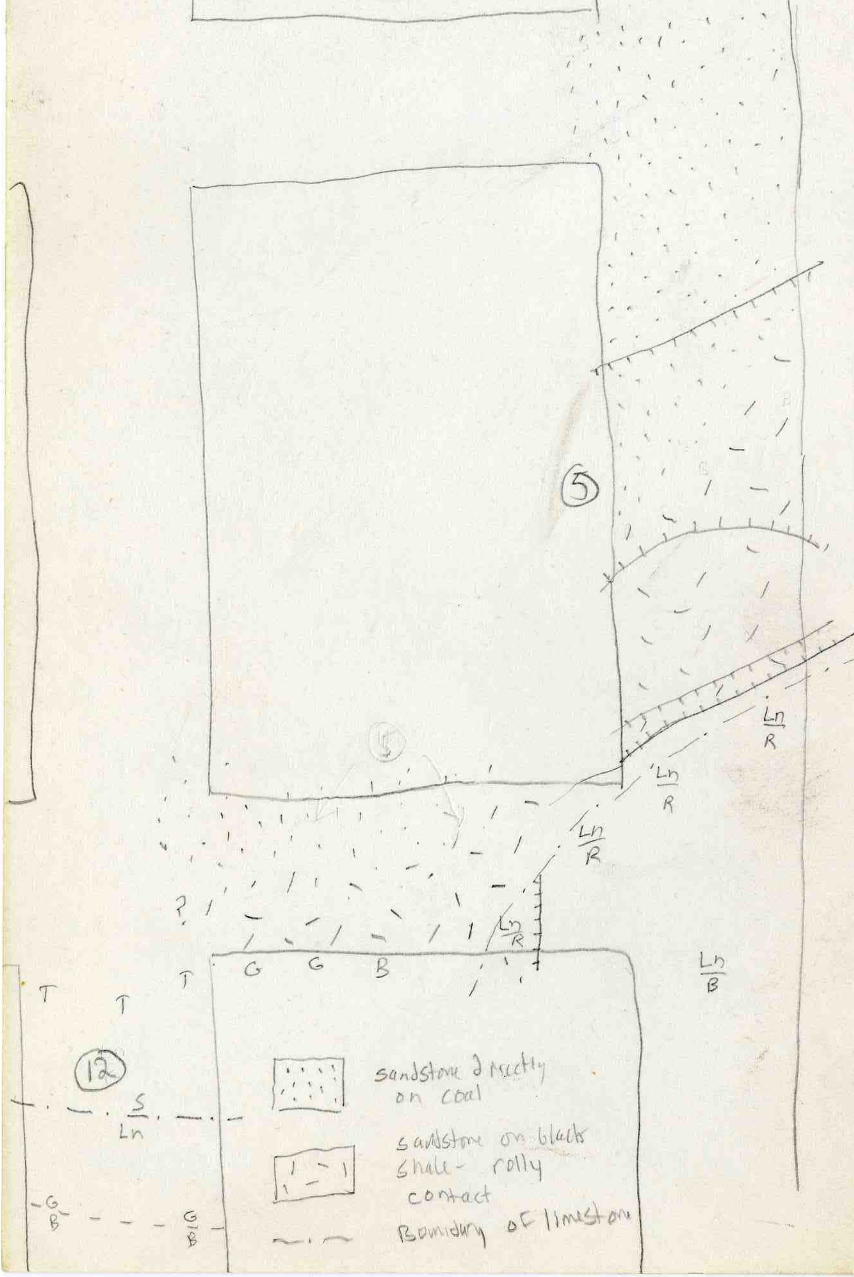
To the south the coal is overlain by Anna Shale less than a foot thick with very shaly, nodular limestone above. The limestone ends along a line trending NE-SW and is replaced by sandstone. The contact relationship of sandstone to limestone cannot be directly observed, but I infer that it is an erosional contact.

For about 10 feet southeast of the sandstone/limestone boundary (under limestone roof) the black shale is reworked with numerous stringers and lenses of both clay and sandstone. As noted on earlier visits, some of the sandstone lenses are quite large. The top layers of coal are also mixed with clay, forming "white top".

There is a northeast-trending belt 20-30 feet wide where sandstone overlies Anna Shale with no limestone present. The contact is extremely irregular and in places the shale bedding is truncated, so there is little doubt that it is an erosional contact. The shale contains thin sandstone lenses and partings, and there are torn-up stringers and fragments of black shale near the base of the sandstone.

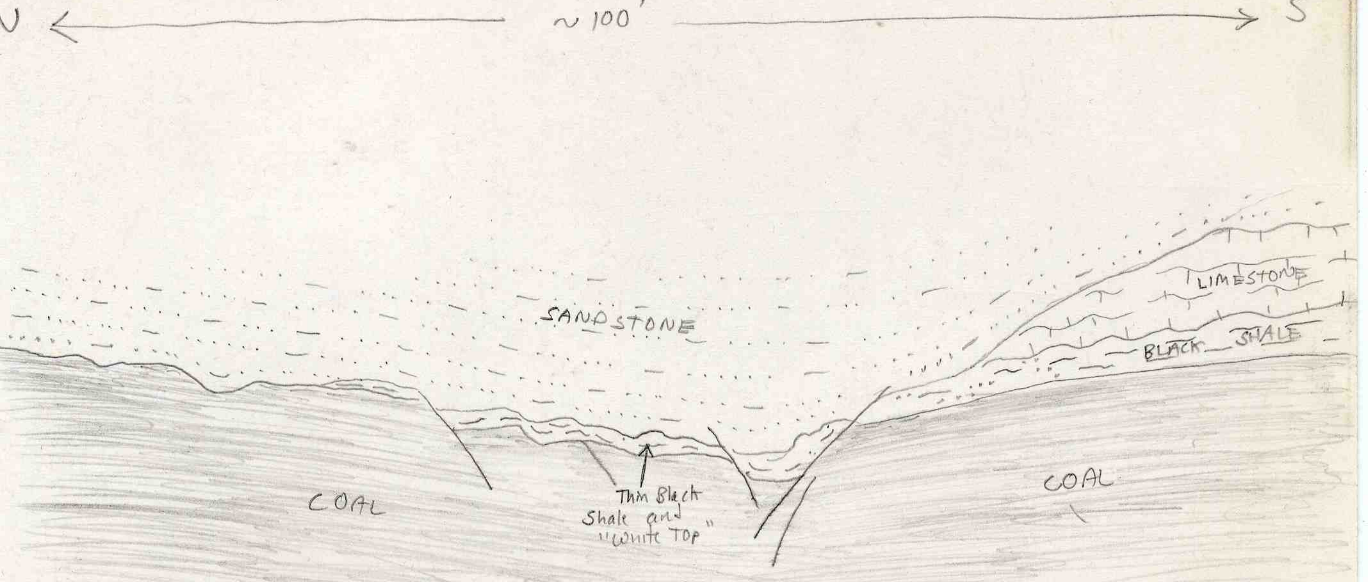
Farther northwest the black shale is absent and sandstone lies directly on the coal. The coal/sandstone contact is quite irregular and there appears to be a small amount of scouring along the contact, but not much erosion has occured.

The sandstone changes in character to the northwest On the southeast it is light gray, medium grained, thick-bedded to massive, slabby, micaceous, and very well-cemented in most places. To the northwest it becomes much shalier and thin-bedded, more like that seen elsewhere in the mine. The sandstone makes competent roof. Slight water and gas seepage is occuring



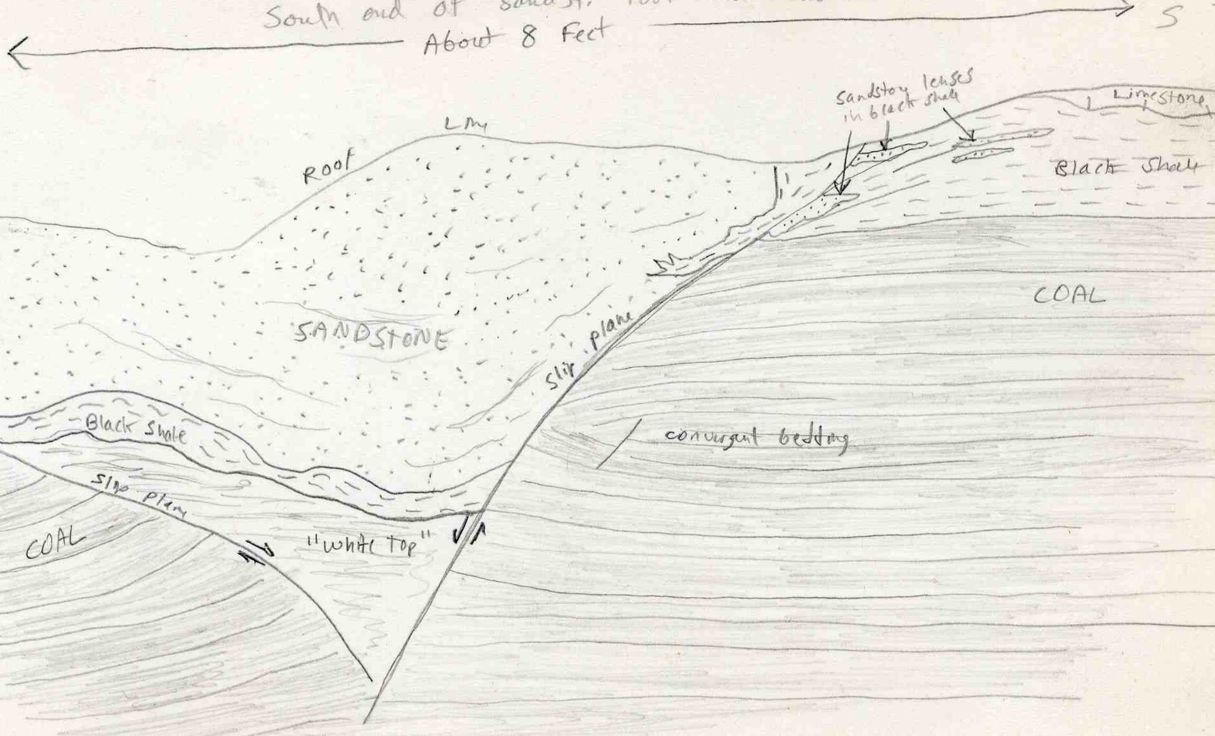
5
Ln/R
Ln/R
Ln/R
Ln/R
Ln/B
?
T
T
T
G G B
12
S/Ln
G/B
G/B
sandstone directly on coal
sandstone on black shale - rolly contact
Boundary of limestone

Stop 5 -
Generalized interpretive view of east rib.



Stop 5

South end of sandst. roof area - east rib



along the east rib, but not enough to hinder mining much.

Along the south rib of the crosscut a wedge of Energy Shale occurs. The top of the wedge is truncated with sandstone above; Anna Shale has been eroded. The contact is much scalloped in appearance.

6.) Large intrusion of sandstone into coal (see sketch, over). The shape and orientation of the feature are poorly shown, but it does not extend for any great distance. A set of slips trend ENE from the sandstone body and die out about 50 feet away. The sandstone does not extend across the 11th Main North.

In the plane of the rib the intrusion is 12 feet wide at the top, and a maximum of 3 feet deep. The sandstone/coal contacts lie along slip planes except on the west side, where the coal "fishtails". A rider of coal extends up over the sandstone on this side. The miner did not cut high enough on the east side to show whether the coal rider extends across the east side as well.

The sandstone is dark gray, with abundant stringers of coal and dark shale and much finely divided carbonaceous debris. The bedding is very wavy and distorted, and bowed downward in the middle of the lens.

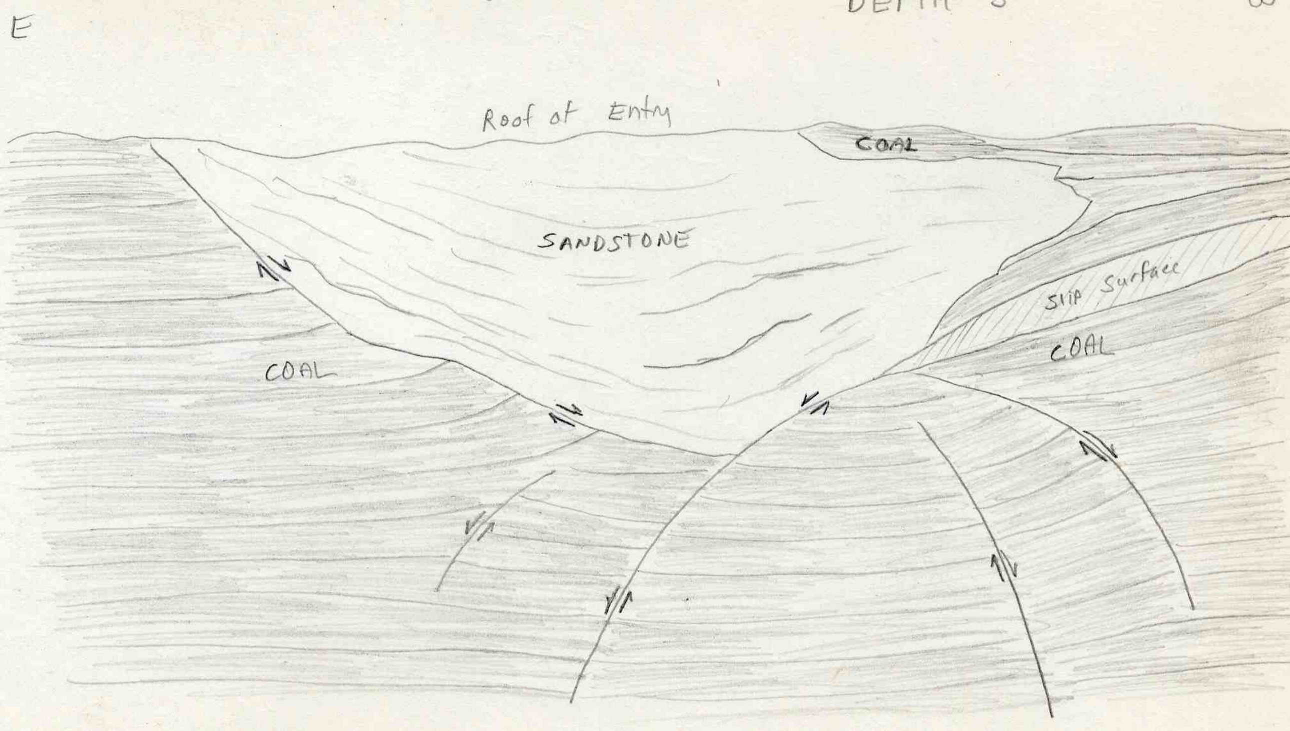
It is difficult to speculate on how the lens formed when we cannot see the upper contact. Probably a combination of erosion and slumping is involved. Sandstone emplacement certainly took place while the peat was still soft, as evidenced by the curving slip planes and "false drag" in the coal bedding.

7.) Lawson Shale roof area; with local remnants of Anna Shale. The latter is a couple inches thick at the most and the top surface is scoured. In one place a concretion is preserved. The Lawson Shale is very silty and contains abundant coarse plant debris, and locally stringers of coal or bone coal. The No. 6 coal has not been eroded to any appreciable extent.

8.) Coal split with parting of Lawson Shale. The upper layer of coal is very bony and rises gently

Stop 6
View of South Rib

WIDTH 12'
DEPTH 3'



to the north. The maximum thickness of parting observed is about 2.5', seen about 50 feet north of the point at which the split begins. Beyond this the split is lost in the roof.

Description of materials:

Coal (only base observed); thickness unknown; varies from fairly bright-banded to a dull, highly carbonaceous shale or bone coal. Laminated bone coal is most typical. Sharp contact:

0-2.5' Shale (Lawson ?), medium-dark gray, poorly bedded, moderately hard, generally silty, micaceous, and very carbonaceous, with abundant plant material. Lacks jointing. Contact to coal very sharp but even, with no evidence of erosion.

0-0.2' Coal, black, canneloid, brittle, fissile, grades to bone or shale near top. Contains abundant fine pyrite, plant impressions, and *Lingula*. Upper part resembles Anna Shale but base grades into normal coal. Very locally developed; best on northwest.

Coal (Herrin No. 6) N.B.B., not described in detail.

This is the best exposure we have seen of the peculiar split coal.

Sketch (over) of a fossil plant that is quite common in the Lawson Shale. We have not observed this plant in Energy Shale.

This appeas to be a stigmarian root cast with rootlets. Nelson 1/27/94.

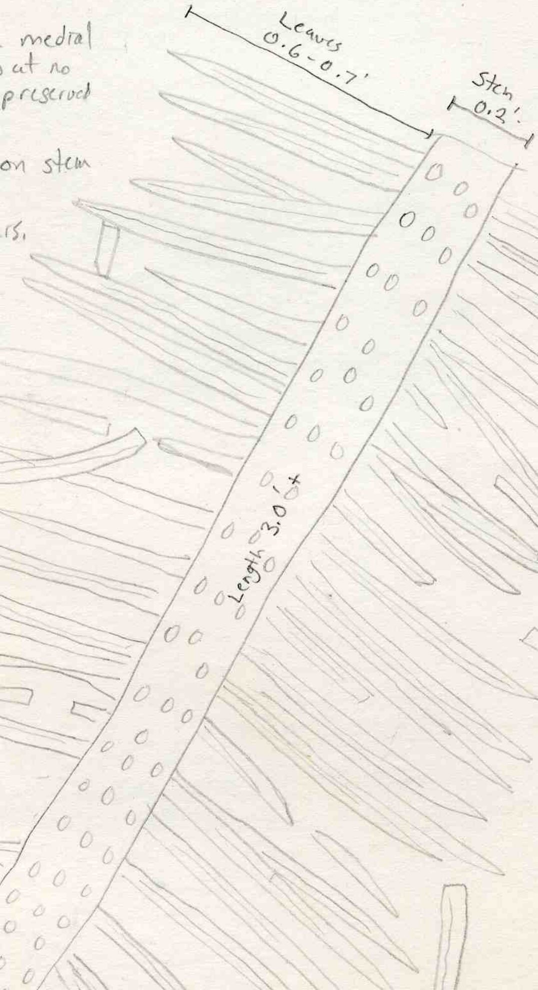
9.) Roof consists of interlaminated bony coal, vitrain and carbonaceous shale. In most places it shows fine parallel laminations, but locally the bedding is wavy or folded. In a small patch the rock above the split coal is observed; gray micaceous slitstone or fine-grained sandstone. The bony laminated coal is the material that forms the upper split at Stop 8.

10.) Approaching from the north, we see Anna Shale as immediate roof. Just north of the intersection Lawson Shale can be seen above the Anna with erosional contact top 8. Fossil Plant in Lau

medial
at no
preserved

on stem

rs.



But only 10 feet south the immediate roof is gray shale overlain by black shale. We interpret the second gray shale as a pod of Energy Shale (it is smooth, not silty, and contains abundant Pecten). The contact relationships are not very well exposed. The pod of Energy Shale is quite small. On close inspection the textural difference between Lawson and Energy Shale is apparent.

11.) Seem to have another split coal situation with Lawson Shale dividing an upper layer of bony coal from the main Herrin (No. 6) Coal. In this case the split thickens to the south. Can also observe apparent interfingering of sandstone and Lawson Shale. At the southwest corner of the intersection a thin layer of sandstone lies directly on the coal, and shale overlies the sandstone. The sandstone is dark, shaly, and carbonaceous, like that at Stop 6. A big, nearly vertical coal stringer is present.

See Note (9)

In Phil's mapping area we observed the following sequence:

Bony laminated coal ~~(upper split)~~ Upper part boney, lower Bright Banded.
Gray silty shale forming parting
Anna Shale with concretions, top surface scoured
Herrin (No. 6) Coal.

This leads us to conclude the the bony, [then it is not a "split". P.J.D.] laminated coal is not part of the No. 6 Coal at all, but was deposited during Lawson Shale sedimentation. It is younger than the Anna Shale and probably younger than the Brereton Limestone as well.

March 30, 1978 With Phil DeMaris only.

12.) See sketch map for Note 5. South end of sandstone roof area in 11th Main North.

The contact of sandstone to nodular limestone here trends nearly east-west, as shown on map. The exact contact cannot be picked and the contact relationship is not seen.

A small wedge or pod of Energy Shale underlies the limestone along the entry. To the north where the limestone is gone the sandstone lies directly on the Energy Shale. The Anna Shale pinches out; probably eroded. The sandstone/shale contact is very uneven, with a large boss-like protrusion of sandstone into the gray shale.

Along the contact line the coal dips gently to the north. Do not know whether this is related to the change in roof conditions.

13.) South edge of sandstone roof area in 10th Main North. See sketch (over).

The sandstone contact trends roughly east-west. Immediately north of the contact on the west rib is a small sandstone roll. As shown in the sketch, Anna Shale separates the coal from the sandstone. The shale and coal are bent downward and displaced along slips.

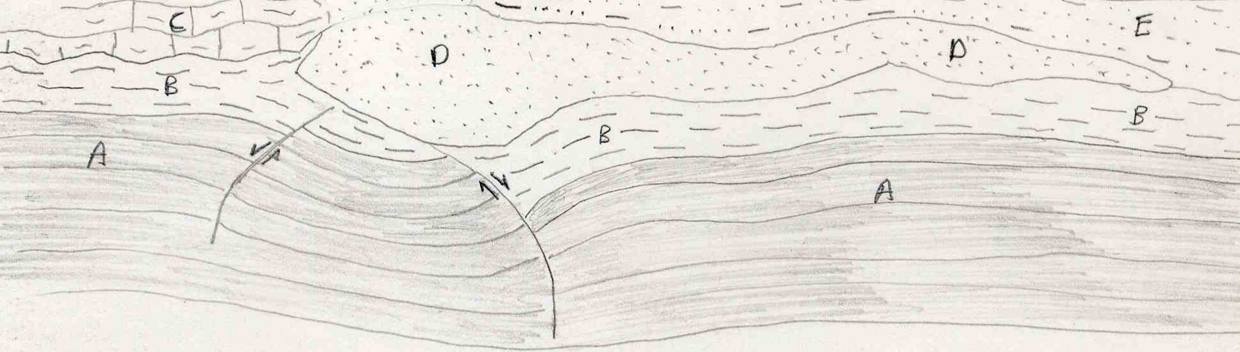
The sandstone roll is actually an elongate lens of sandstone, pinching out to the north and overlain by sandy shale and siltstone. On the south the lens intrudes a short distance between the limestone and the black shale.

The sandstone in the lens is light gray, fine to medium grained, very hard, and massive, except for thin dark wavy streaks. Near the base it contains small angular fragments of dark shale and limestone (?).

The material above and north of the sandstone lens is quite heterogenous, including light to medium gray silty shale, siltstone and fine-grained sandstone, thin bedded and somewhat lenticular. All is very micaceous, with abundant carbonaceous plant debris.

The situation is similar on the east rib except that the sandstone lens is thinner and does not push the coal down.

The sandstone roof area is dry, but water is dripping just south of it, through limestone. About 50 feet north of the sketch area, sandstone lies directly on the coal.



A - Herrin (No. 6) Coal

B - Anna Shale

C - Brereton Limestone, shaly and nodular bedded

D - Massive lenticular body of sandstone

E - Gray siltstone, silty shale and lenses of sandstone

14.) Large clay dike from Stop 2 splits northward in the 10th Main North. Excellent exposure of east dike at corner of pillar (see sketch, over).

The clay filling is quite wide in the coal, and there is the usual "false drag", convergent bedding, clay sills, and angular coal fragments in the clay. The clay is light brownish, soft, and crumbly, with much pyrite.

The dike splits into a series of slips upward and the clay filling quickly pinches out in the Anna Shale. The slips have calcite filling. Only one slip reaches the bottom of the limestone. One slip appears to be an open fracture filled with loose clay and angular shale fragments. Other fractures seem to be slightly open.

The exposure provides very good evidence that clay dikes form by lateral extension of the coal seam. However, in this case the source of the clay filling is a mystery. Only one slip reaches the limestone and it does not look large enough to have provided a passageway for all that clay. The clay is so different from Anna Shale or limestone that I cannot believe they are the source. A source from below (underclay) also does not fit the picture, and would be very hard to explain mechanically.

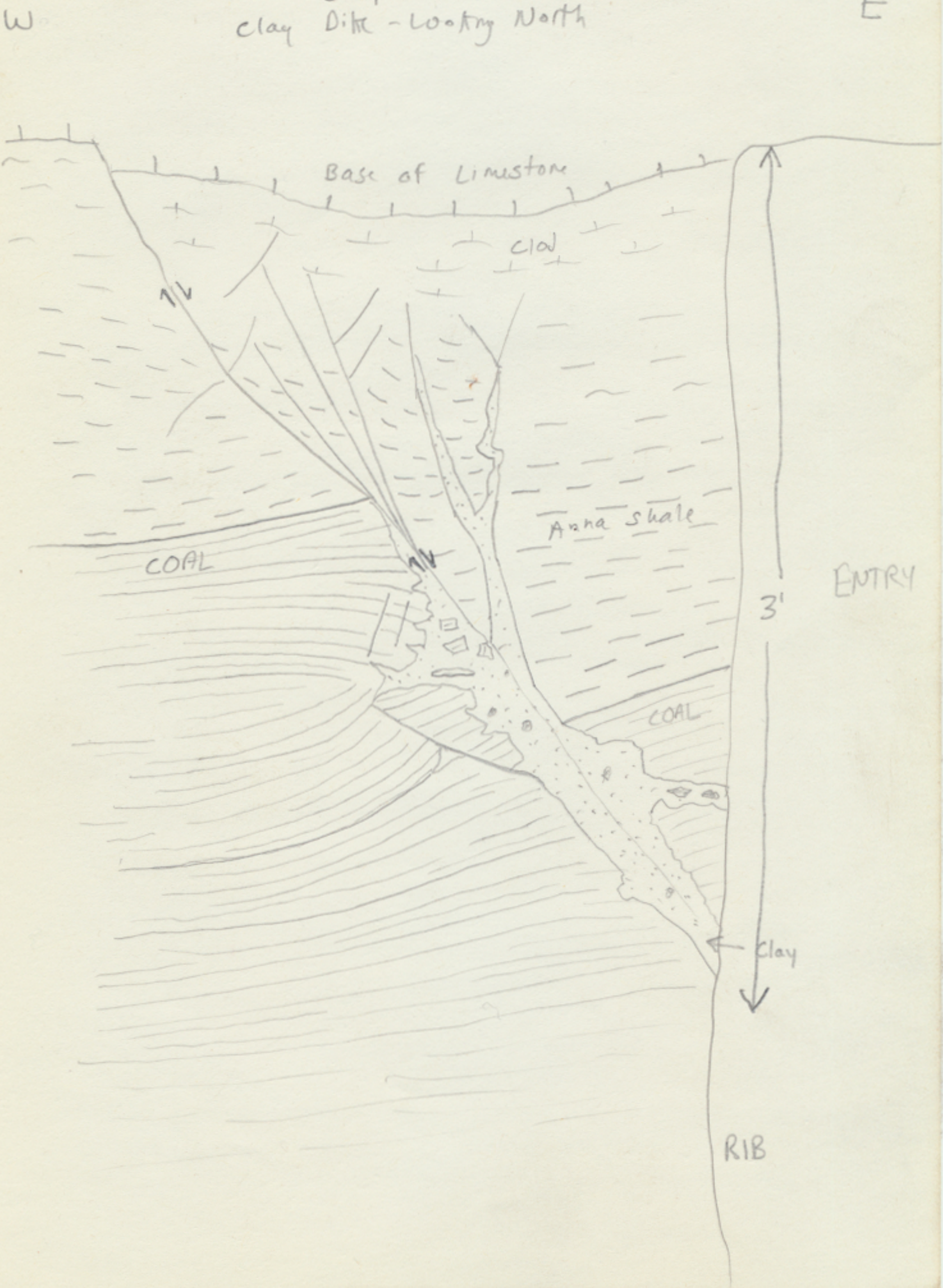
15.) West branch of same clay dike, about 15' west of Stop 14.

The dike dips northeast at a shallow angle and the filling is rather narrow. The clay is light greenish-yellow; not the brown color observed at stop 14. The clay appears to pinch out above the underclay.

Much clay is intruded along fine fractures and partings in the Anna Shale giving a "white top" appearance. This is only seen on the downthrown side of the slip.

As at Stop 14 the clay dike divides upward into a series of slips, and clay does not continue very far upward. A couple slips cut the base of the limestone, but no clay is seen.

Stop 14
Clay Dike - Looking North



The limestone forms an elongate bulge whose axis parallels the clay dike and lies along the trough formed by the slip. It is a real downward fold or bulge, not a graben; there is almost no displacement of the limestone along slips.

See also sketch map for Stops 13 and 15.

16.) Now mapping 3rd and 4th Main North. Large roof fall with east-west trending clay dike, as mapped. The slip dips to the south and there is yellowish clay filling. The clay dike branches into a series of slips upward. None of the slips reach higher than the base of the Anna Shale. They do not reach the sandstone. The sandstone cannot be the source of the clay material In this case the clay could have come from the Energy Shale, but whether this is actually the source is not known.

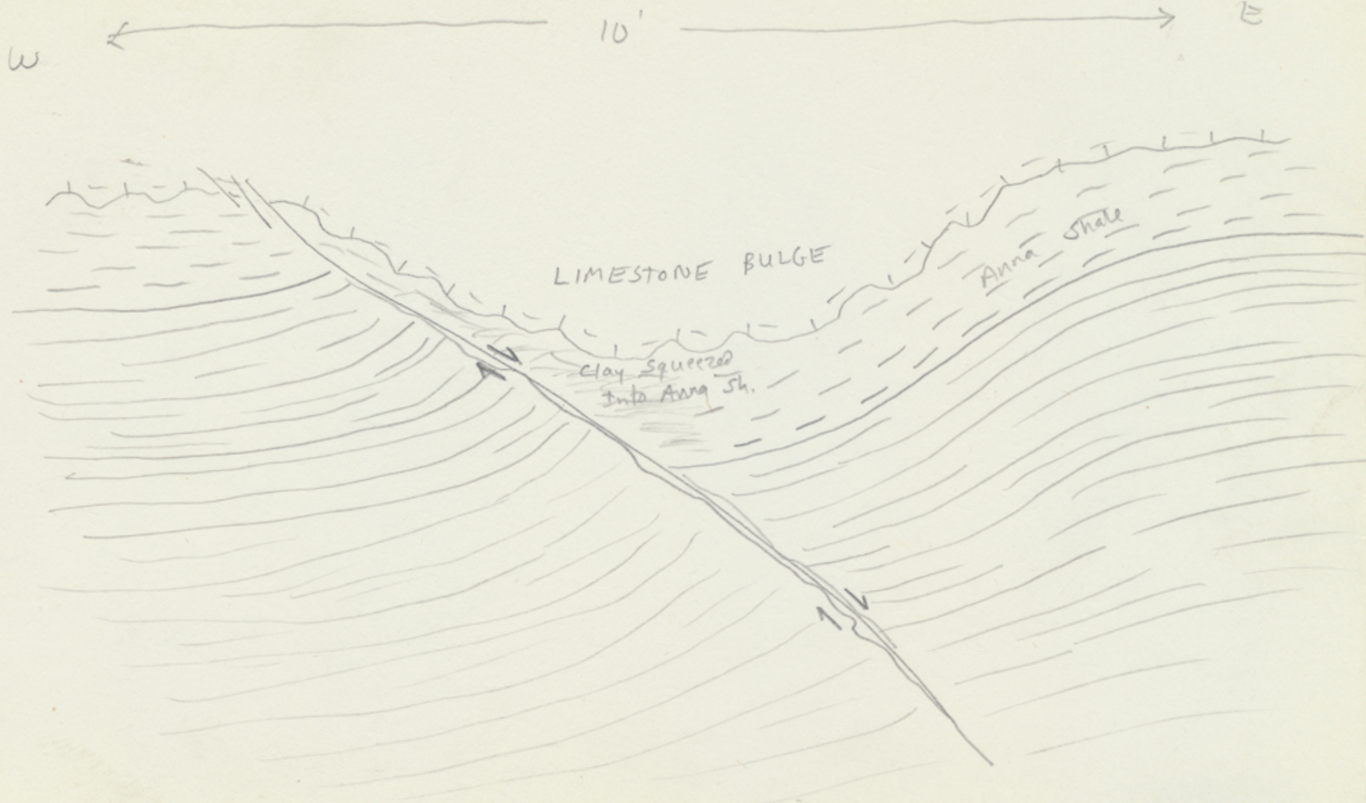
No evidence of channel activity in roof fall.

17.) South edge of sandstone roof area in 4th Main North. Limestone/sandstone contact hidden by top coal. Note a water drip from limestone just south of contact. Water seems to be seeping through "clod". Sandstone roof is dry.

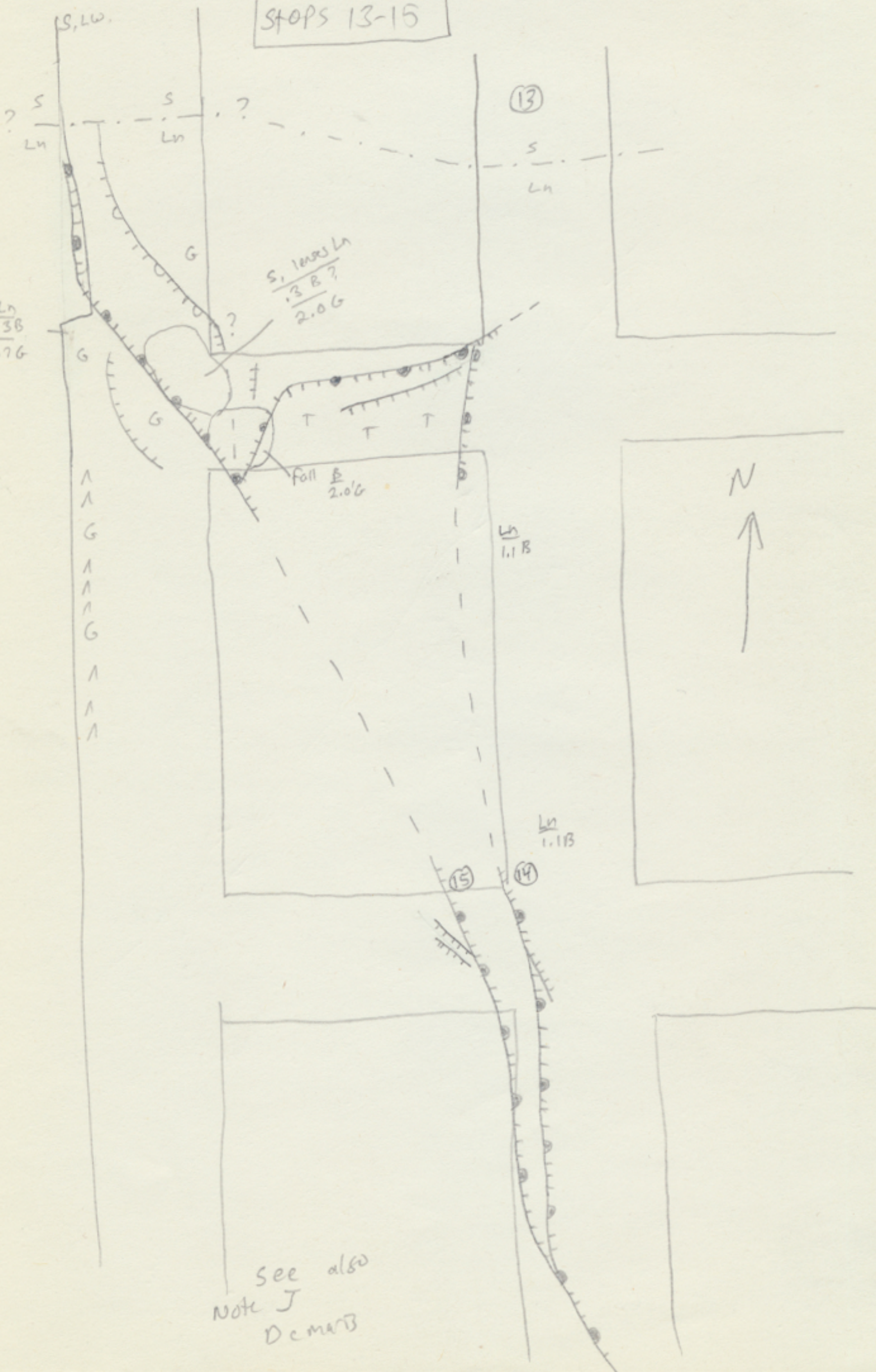
Under sandstone roof the coal surface is slightly irregular, but there are no intrusions or channels. The sandstone is quite shaly and thin to medium-bedded. Bedding is lenticular.

18.) Good exposure of Lawson Shale/Anvil Rock Sandstone as immediate roof. To the south, roof is mostly shale; medium-dark gray, weathering brownish to yellow, hard, poorly and irregularly bedded, very silty to sandy (grades to siltstone), carbonaceous with abundant fine to coarse plant detritus and occasional lenses of very hard sandstone. Northward the shale interfinger with sandstone; light gray, fine to medium grained, ver very hard, tightly cemented, micaceous, highly carbonaceous, with abundant coal fragments and numerous partings of dark carbonaceous shale. The bedding is thin and irregular, with lenses of shale and siltstone.

Rough Sketch Stop 15



Stops 13-15



See also
Note J
DcMarB

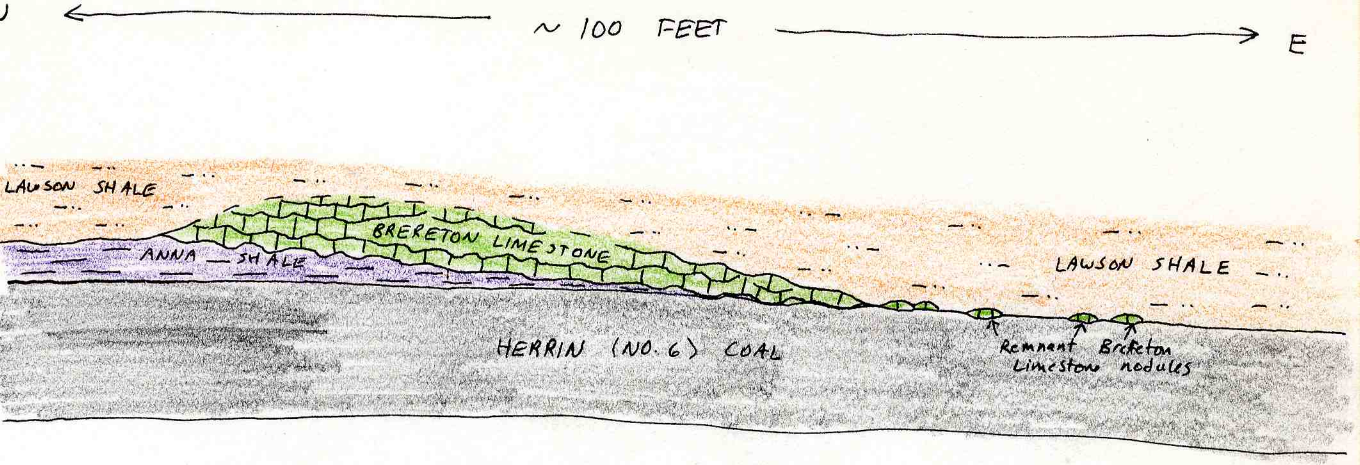
As usual the roof is dry and stable, with only minor slabbing. The coal/roof contact is even to slightly irregular and is conformable. No slump or erosion.

19.) Contact of Lawson Shale to Anna Shale and limestone well exposed. The best such exposure we have seen in our mapping.

To the east Lawson Shale lies directly on the coal Westward small nodules of limestone start to appear at the coal/roof contact. The limestones are not concretions but have typical Brereton lithology; dark gray, fine grained limestone. At the base of the limestone the coal interfingers with "clod" exactly as it does under Brereton roof. The limestone nodules must be erosional remanants of the Brereton Limestone.

A short distance farther west, the Brereton appear as a continuous layer and the upper contact to Lawson is exposed. The limestone is extremely nodular; a knobby appearance with shale matrix. The upper surface of the limestone is likewise knobby. The nodules stand as bumps in the base of the Lawson. There tends to be a light gray sandy lag deposit at the base of the Lawson, especially in low places on the eroded surface of the limestone.

Limestone roof is intact through the intersection and the Lawson cannot be seen there. But on the southwest corner of the intersection the limestone is missing, and Lawson Shale directly overlies about half a foot of Anna Shale. The contact is knife-edge and scalloped.



STOP 19

GENERALIZED VIEW

SUMMARY AND INTERPRETATION

by John Nelson

The Anvil Rock Sandstone/Lawson Shale observed in this part of the Main North represents different facies from that found in the rest of the mine to date. A more active erosional phase before Anvil Rock/Lawson deposition is indicated in this study area.

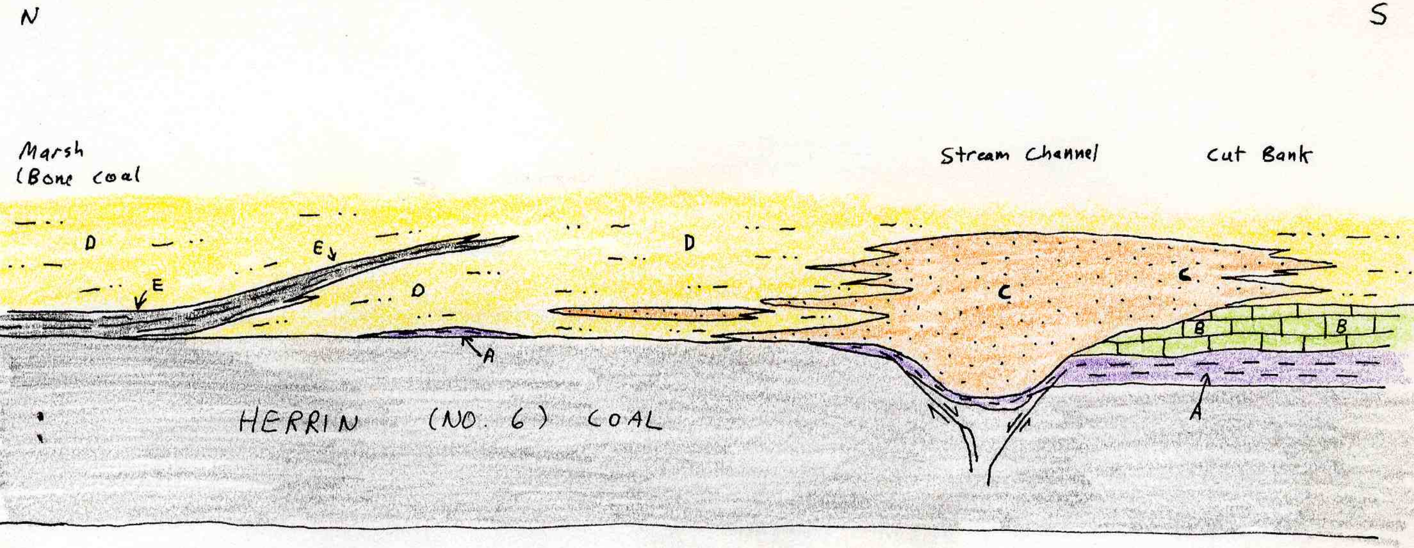
Anvil Rock/Lawson Shale lies directly on or close to the top of the coal in an east-west trending belt 400-500 feet wide. The units below the sandstone have been eroded down to the top of the coal, but very little erosion of the coal itself has occured. The truncation of black shale and limestone appears to be abrupt to the south, and very gradual to the north. Relatively coarse, massive sandstone was deposited in a belt about 100 feet wide, along the south edge of the eroded area. The deposit generally becomes finer northward and interfingers with siltstone and gray silty shale, with local lenses of coarser sandstone.

The pattern strongly suggests a small stream channel whose cut-bank lay along the south edge of the sandstone roof area. The finer-grained deposits to the north are interpreted as slack-water sediments, probably including overbank and/or crevasse-splay type deposits.

A layer of very bony, laminated coal is found close to or directly above the Herrin (No. 6) Coal in part of the sandstone roof area. The bony coal is stratigraphically above the Anna Shale and interfingers with Lawson Shale. Therefore, it is not part of the No. 6 Coal, but was formed during Lawson Shale deposition. Its presence indicates local marshes existed in the slack-water areas near the stream channel.

The sandstone-filled depressions in the Herrin Coal are not erosional channels, but appear to be slump or load features. The coal is folded downward and displaced along curving slips beneath the sandstone "rolls" This shows that the No. 6 Coal was still in a peat stage when the erosion and sand deposition occured.

INTERPRETIVE CROSS-SECTION



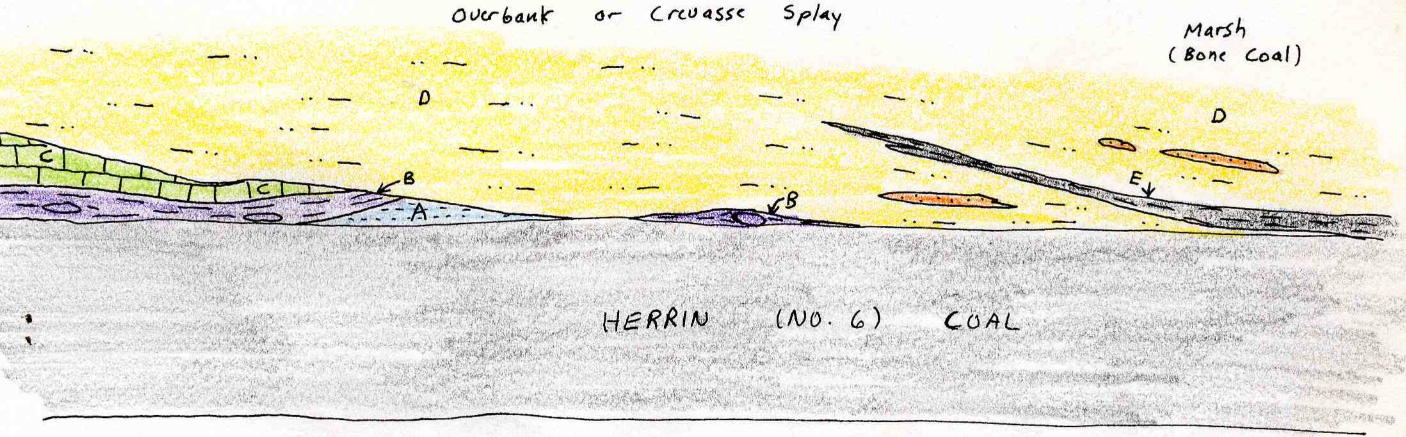
A - Anna Shale

B - Brereton Limestone

C - Anvil Rock Sandstone - Massive

D - Lawson shale (with sandstone lenses)

E - Bony laminated coal in Lawson Shale sequence



A - Energy Shale

B - Anna Shale

C - Brereton Limestone

D - Lawson Shale, with sandstone lenses

E - Bony coal in Lawson Shale sequence

Mine Notes - **Freeman Crown II, Macoupin Co.**

Trip: March 28-30, 1978 by Phil DeMaris & John Nelson. Notes by both.

Coverage: (inc. Map A)
<u>Sample Study Area on E. Mains</u>
<u>N. Mains Mapping</u> (inc. Maps B+C)
<u>Samples; Crown II B-1 to B-10</u>

Intro;

This is first full day of operation at Crown II (midnight was first in) but the slope drive is out. Mine Const. Union has a separate tentative agreement & have stopped picketing.

<u>Sample Study Area on E. Mains</u>

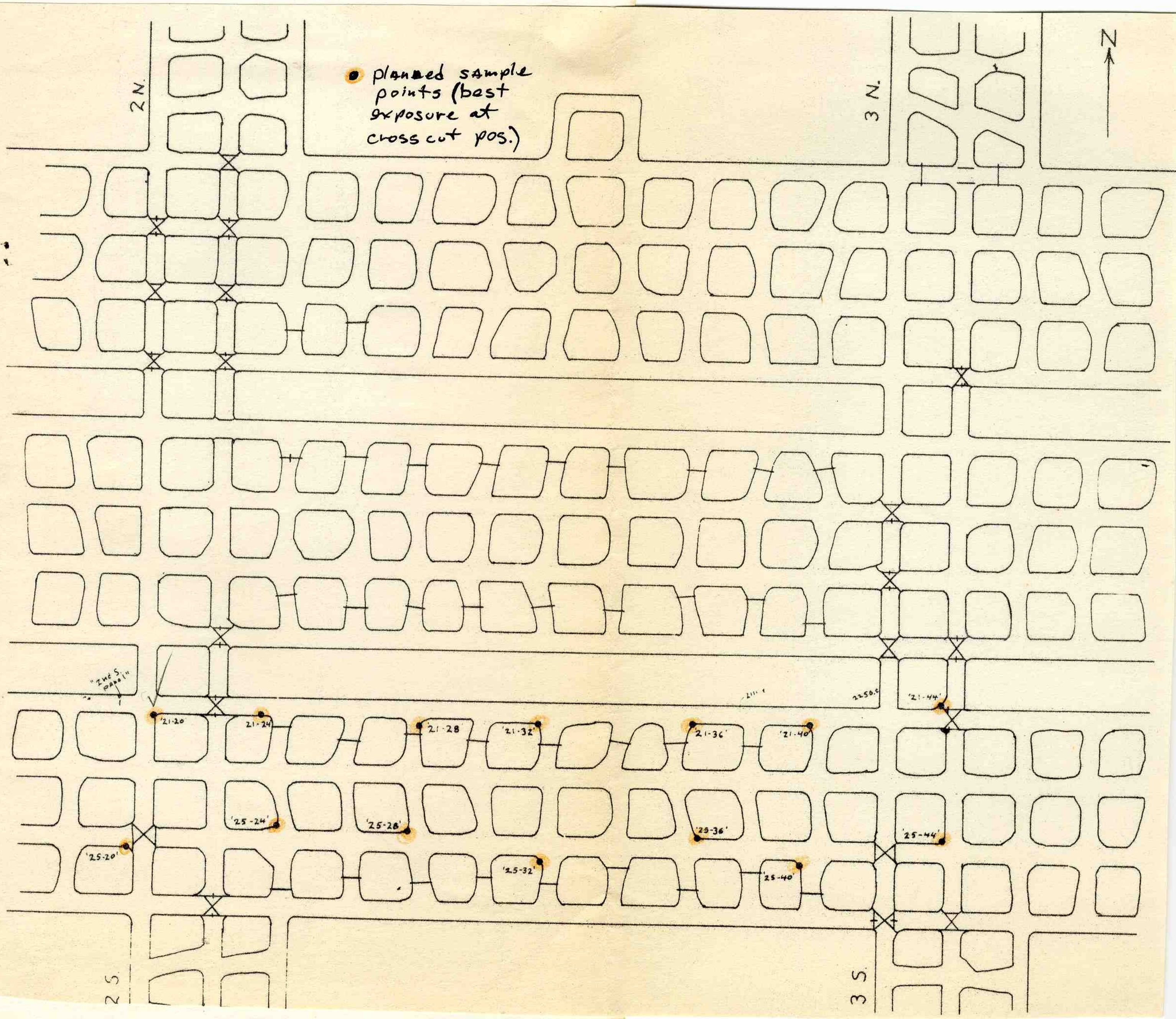
The AM of the 28th was spent in laying-out in a rough 150' grid of sample points on the E. Mains. One third of the points were laid out. The basic 6 X 7 grid of points is expandable to the E & W, but not to the N & S; more point density can be achieved within the grided area by sampling on roughly 75' centers which correspond to entry & crosscut spacing. The sample area will be used to examine short-range vertical and lateral variation of coal thickness, coal petrology, and clay mineralology. Grid location 21-20* was checked for basic thickness & parting positions. Position 21-20 has about 2½' Anna under normal Brereton roof. Coal th. is 5.4'/2.6' Sh. Partings are at (" down from Anna contact) 14" (weak, pyritic), 19" (stronger & pyritic), 30" (3/4"-1" shale), 41" (<u>fusain</u>), 55-58" (poss. pyritic bands under rock dust), 65" (not pyritic; th. varies ½-1"); 31" more to u/c (no bands).

(See map A)

5.42 .06
2.58
T= 8.06

3/28-30/78

ap A



planned sample points (best exposure at cross cut pos.)
N
2 N.
3 N.
"2nd S. Panel"
'21-20'
21-24'
'21-28
'21-32'
'21-36'
'21-40'
'21-44'
'25-20'
'25-24'
'25-28'
'25-32'
'25-36'
'25-40'
'25-44'
2 S
3 S

N. Mains mapping (Maps B+C)

A recce. of this area had been done previously and the threat of having the area "temporarily" sealed prompted us to map it before this happens (in a couple months?).

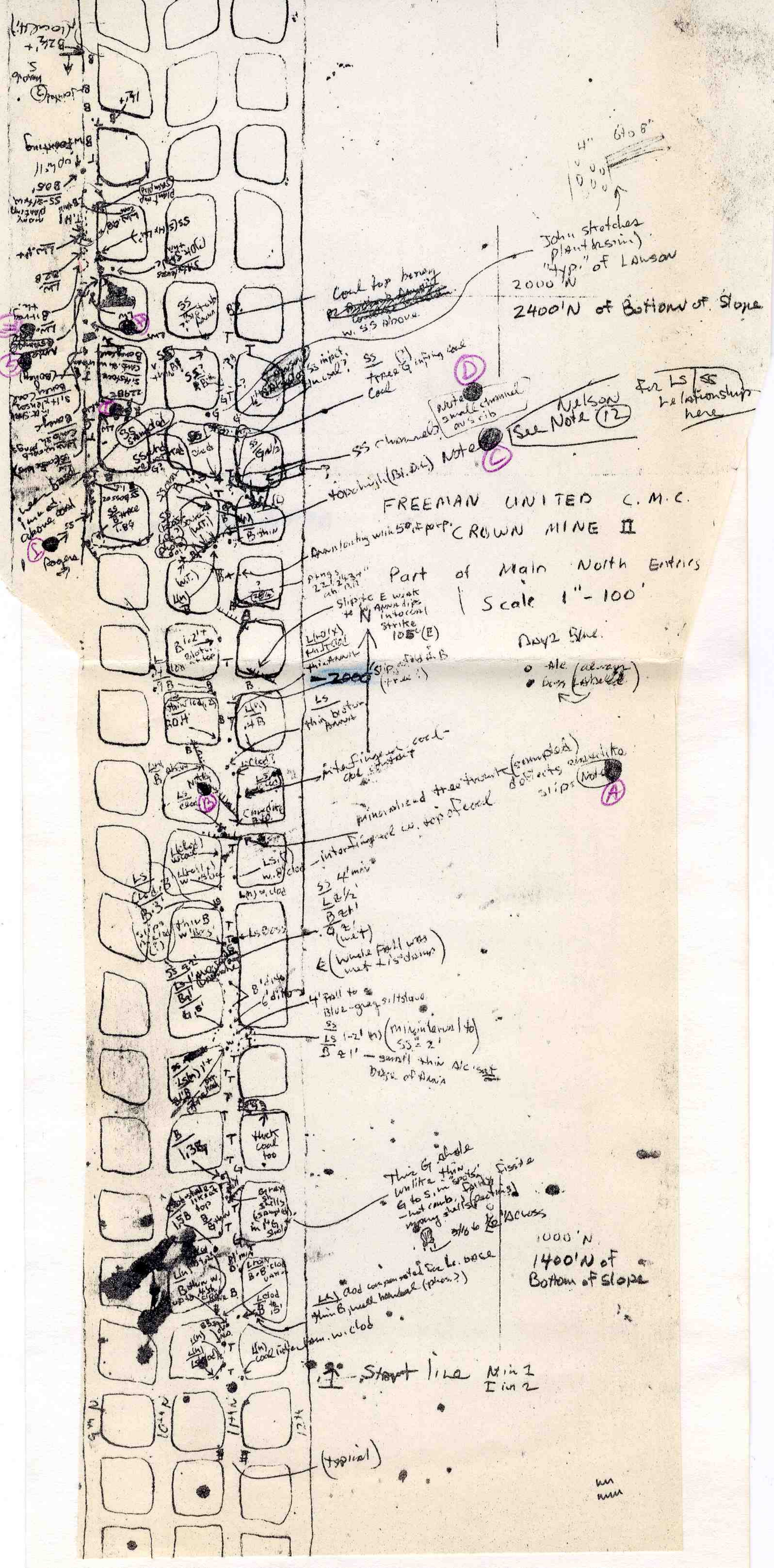
John took me through some of the odd features we would map in the 9th-12th N. Mains to familiarize me with them.

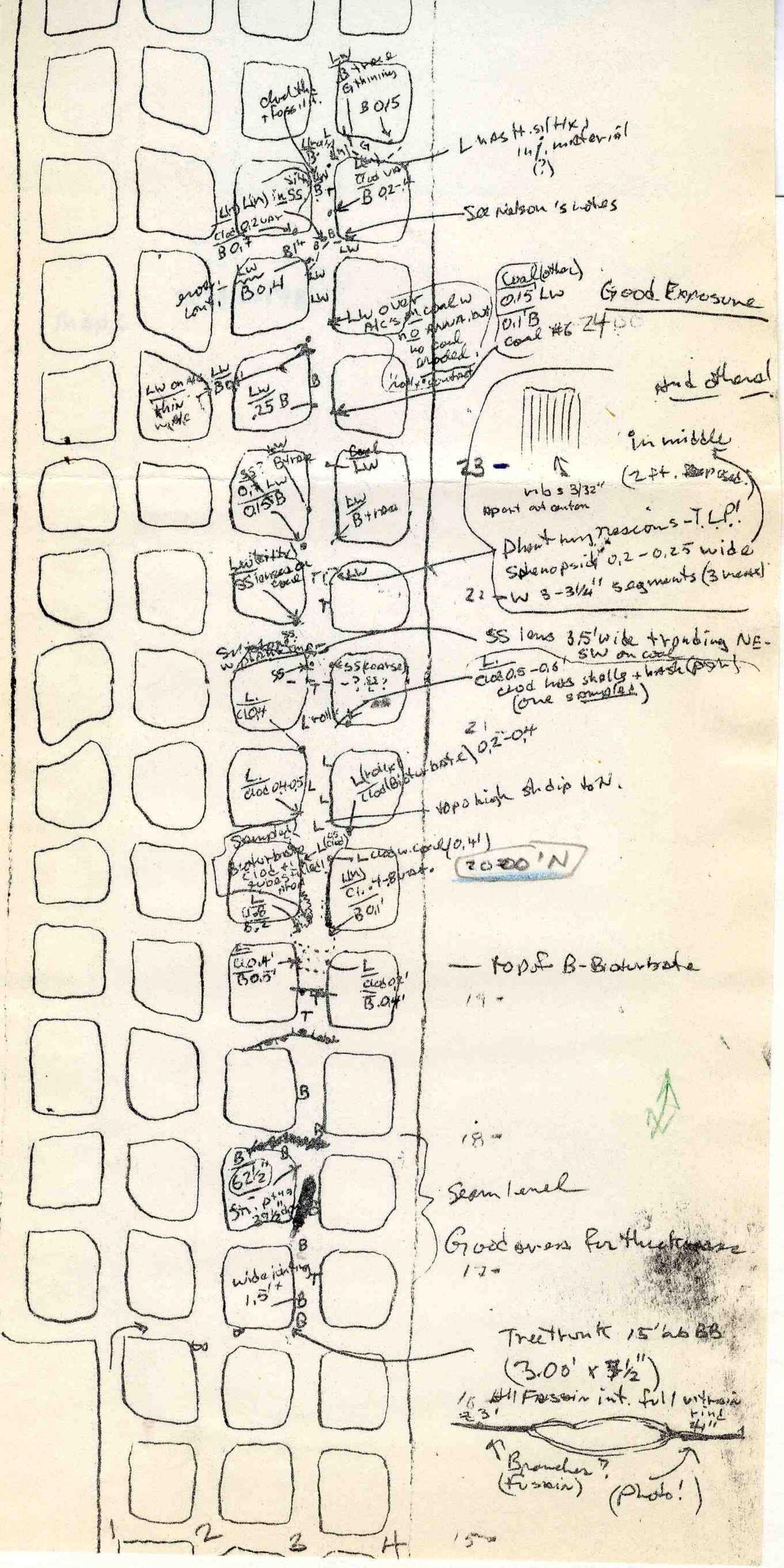
Among these are large clay-dikes, Lawson shale overlying Anna shale, and sandstone lenses (channels?) both in Anna and on top of coal.

We began mapping at about 850' N. on the 11th & 12th N, (I & Nelson, resp.) working N. Anna was thin, w. base of Brer. often exposed. Hit an area of Energy shale roof at about 1000' N. which was less carb. than we had been seeing further south. Here I sampled the Energy shale, which was full of pectins (B-1a,b,c,d,e,), for further examination. Fall in this area reveals thin Ls. with Anvil rock/Lawson interval well developed above.

(Day 2) Continued mapping to N.

A. Mineralized tree trunk (?) sim. to one seen in O.B.#24 and here in the third S. panel. This feature appears to be solid fusain inside. Coal bedding deflects above and below feature which is 0.65' thick and 2.4' across. It (ie) is 0.50' above B.B. (base of feature) and 0.35' above a shale parting which dips and is squeezed out below it. The central fusinized area is only partially surrounded by a vitrain "rim" (See O.B. #24 occurence). A clay-dike just above the site seems to deflect from the object, as if the object were solid at the time of the clay-dike event. I mentioned this and


FREEMAN UNITED C.M.C.
CROWN MINE II
Part of Main North Entries
Scale 1"-100'
2400'N of Bottom of Slope
2000'N
John sketches plant (resin) "typ." of Lawson
Coal top barren w. SS above
See Note 12
Nelson for LS / SS relationship here
note small channel on E rib
SS channels
Note
D
C
B
A
N
Strike 105° (E)
~2000'
LS thin bottom Annul
intertongued w. coal
mineralized tree trunk (sampled)
interfingered w. top of coal
4' fall to Blue-grey siltstone
Thin G shale
1000'N
1400'N of Bottom of Slope
Start line
(typical)



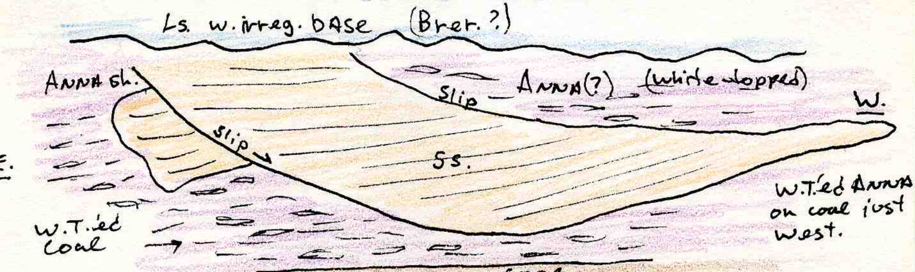
L has H.sil(Hx)
See Nelson's notes
Coal (other)
0.15' LW
0.1' B
Coal #6
Good Exposure
And others!
in middle
ribs 3/32"
apart at center
23
Plant impressions - T.L.P.!
Sphenopsid 0.2 - 0.25 wide
W 3 - 3 1/4" segments
22
SS lens 3.5' wide trending NE-SW on coal
clod has shells + trash
21
2000'N
Top of B-Bioturbate
19
18
Seam level
Good area for thickness
17
Tree trunk 15' ab BB
(3.00' x 7 1/2")
16
Branches?
(Fusain)
(Photo!)
LW
B 0.15
B 0.7
B 0.4
LW 0.25 B
wide jointing 1.5'
1
2
3
4
15

other cases to Fred Krausse as probable "tree trunks" due to their geometry. I was uncertain about the selective fusain/ vitrain situation at the edge of these objects, and he suggested fire burning out the wood of a tree, but not all of the bark. This hypothesis seems to have merit in this case where the vitrain "rim" is only partial. If the fusain was created by fire one might expect more of a stratigraphic control to the fusain in the #6 & around these objects; I argued that this didn't seem to be the case. Fred suggested that the charcoaled wood could have floated some distance before deposition; this may be a likely explanation for some of the fusain we see which seems to be randomly distributed; certainly the 4 such objects so far seen are in a horizontal position if they are trees. (Fred will examine 1 or both of thse objects noted in the N. Mains in May so far.)

B. Clay-dike goes into rib; seems to weaken in effect downward but still present to vis. base of coal; just to the S. the roof sequence is confused but seems to have only traces of Anna (& perhaps Ls.) grading rapidly to a coarsely interfingered mix of clay dike material (lt. gray & silty) and med. gray about 2' seen shale - poss. "lawson"? (some of it in large lenses). It does not resemble Energy sh., esp. the darker phases common here. The clay dike is rather linear in the roof (Brer.), but irreg. in the coal having the appearance of injection and not interlamination. There are small pieces of coal in the clay-dike material.

C. Seam dips ot N.-Dk. gray sh. wedges in quickly (gets to 1-1½' but it varies quickly) but the Anna above reamins under a foot thick with L(n)(w. bosses?) above. See Nelson's note 12; just to the N. what I thought was prob. a "Boss" was a sandstone nodule.

D. The small , course sand cut-out on the S. rib is even more perplexing than the sudden appearance of Ss. roof. To the E. this is a simple case of thin Anna overlain by Knobby Brereton. Here the top of the coal is "white-topped" ("w.T.ed") (irreg. interlaminated by a lt. gray shaley material) with an apparent downcutting relation ship betwee the Ss. lense and the "w.t.ed" coal. The Ss. is faintly banded with bands dipping slightly E. w. a set of sm. W.-dipping slips on the E. side;

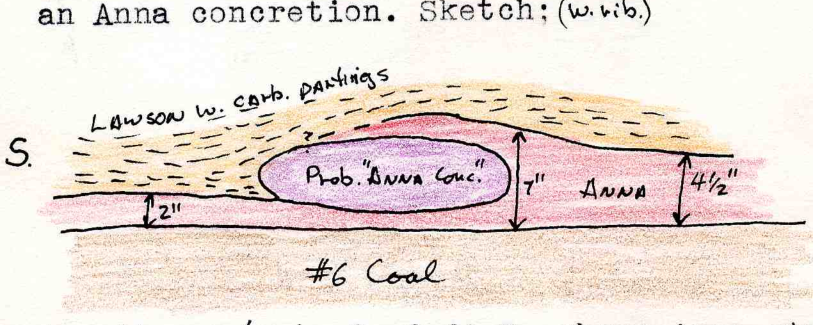


I interpret the Bk. "w.t.ed" shale to be the Anna (0.3') and the Ls. above to be Brereton. The micaceous "clod" beneath knobby Ls. is one of the few hints that the exposure is unusual (outside of known stratigraphy). The incongruous Ss. apparently has been injected into the Anna along the edge of the Ss. channel feature on the otherside of the crosscut, even though the Anna appears to rest cpnformably on the S.S. lense.

Day 3

E. (not on map) Quick visit to C.B. locality to the NNW of the bottom. Three lg. coal ball in top 0.6 -0.8' of coal near edge of gray shale area - on W. rib. Gray-to-Anna contact here is problematical- appearing to be gradational as previously noted in the 3rd. S. panel & elsewhere. The "gray" shale here appears to have concs. identical to "Anna concretions"; we have not mapped this area & prob. should before we are done. Ledvina mapped this area as "G" roof with "no ls. above for at least 6 feet" based on extended bolt hole tests. At fall in cross-cut (where C.B.'s are seen) he notes "3' S. & 4' siltst." meaning 3' black shale under 4' siltstone. Thorough examination of this area (at least) should be done before sampling the C.B.'s.

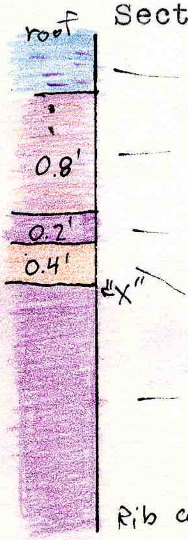
F. Area of variable th. Anna roof with Lawson sh. above. Lawson characterized by abundant plant parts (here oxidized yellow). At this point is a clear case of differential erosion of the Anna, i.e. on the S. side of an Anna concretion. Sketch; (w. rib.)



Another a/c in roof 6' E. shows Anna stripped away from top and SE side. See sample B-6

Site F confirmed for me the presence of the Lawson immed. over Anna, with definite erosion of the Anna and prob. that Lawson would directly overlie the #6, which Nelson had already seen. Further notes recognize the Lawson as noted above. (See H for elaboration)

G. Section desc. at rib corner;



Ss. w. carb. partings

Boney Coal

Coal, Br. B. (Lower 3/5ths sampled as B-8)

Carb. Dk. Gray sh. w. coal stringers, ID unkn.

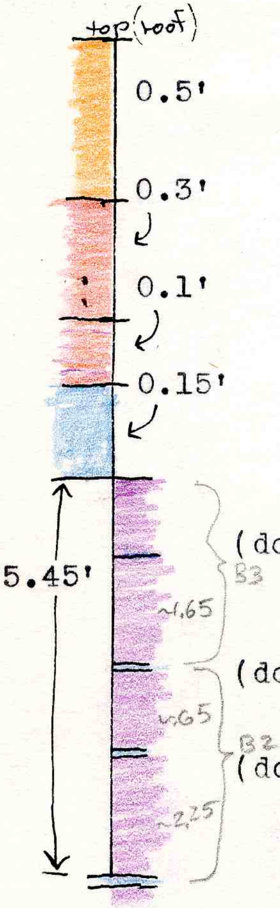
Coal (Local check by Nelson & I later, shows Anna at "X" locally w. a/c's.)

H. I have called the med. gray shale w. abundant plant fragments/parts (which have oxidized yellow) the Lawson judging from site F and area just N. Locally there is a dk. gr. to blk shale above boney coal but below the Ss.- I believe this is not Anna but its relationship to the Lawson is not yet clear - called "carb. shale" on map.

I. Section showing details of the Lawson-Anvil Rock interval & the #6 coal. (over) This seems to a typical coal thickness under (former) Anna roof, so there is not likely very much if any missing coal. (over)

Later analysis suggests as much as ½' could reasonably be missing. Having B.B. → u/c thickness would help. RDD 12/81

Section:



Gray sh. (Lawson) in sharp, irreg. contact to:

Ss., coarse & micaceous (Anvil Rock)? grades to

Ss., micaceous, carbonaceous (fusain?)

Gray shale, silty (not Energy sh) - Lawson?

← Coal (#6) top

(down .90') trace of pyrite

(down 2.55') strong sh. ptng. (½-1") w. pyr. nodules

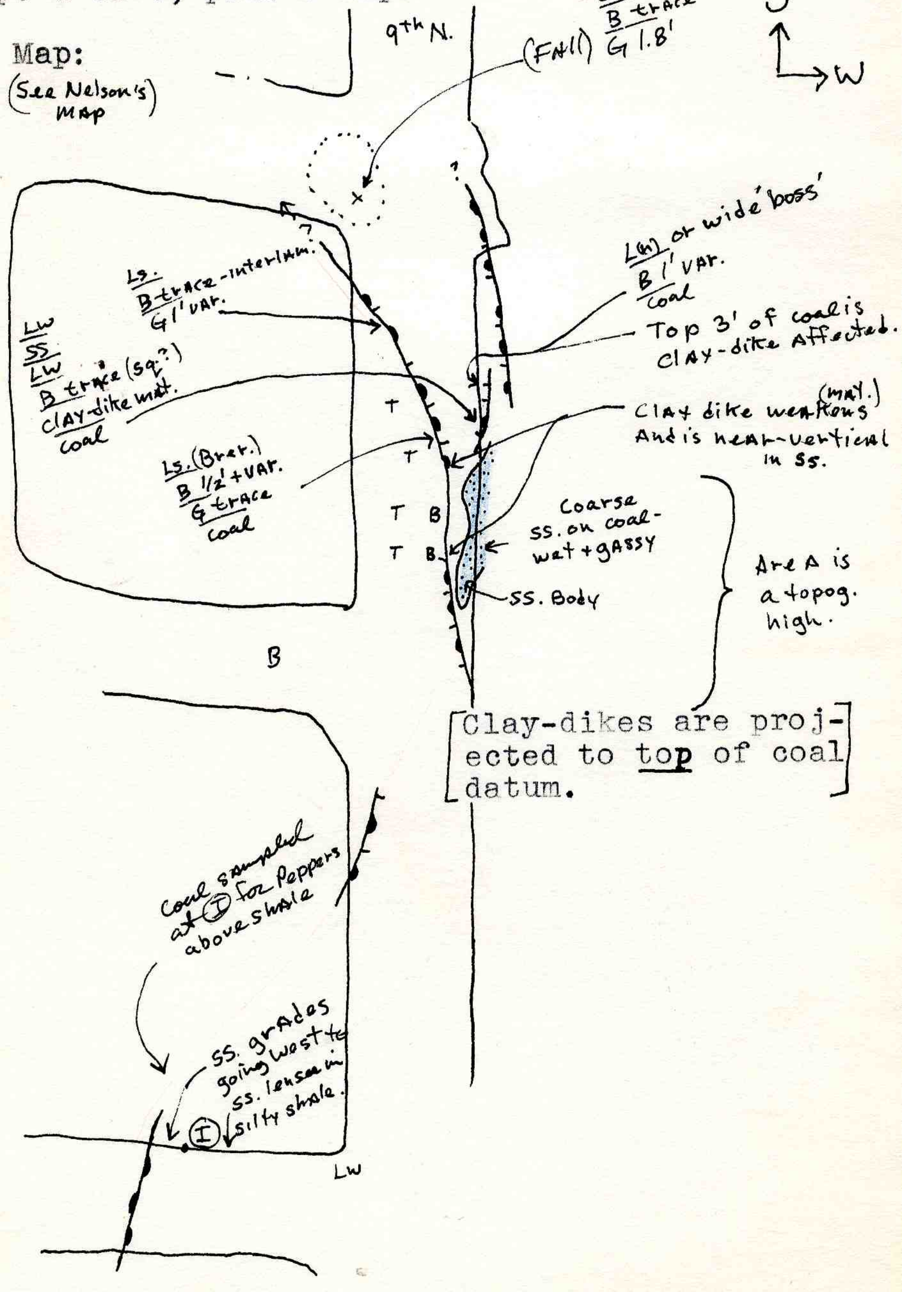
(down 3.20') weak shaley ptng.

Blue Band (0.06')

Laterally (to W.) there is a dull 2" coal at the "top" position marked here. Sample B-7 taken there. (see text map, over)

J. Complex area of clay dikes and/with? Ss. body . Mapping done on the 10th N, by Nance was found to be inadequate & will have to be adjusted. The two gray shales were not differentiated & thus some of this may need remapping. (text map <u>over</u>)

Map:



[Clay-dikes are projected to top of coal datum.]

Before lunch (day 3) John had found large pyrite crystals growing in the edge of a probable Anna conc. <u>on</u> the coal- apparently an erosional remnant- under Lawson shale roof. Site sampled (B-6) on near SE rib corner under min. 2½' Lawson (Nelson #8)
PM Day 3 spent mapping in 3rd + 4th m. N. (See MAP C)

Samples; Crown II B-1 to B-10

B-1 (A to E) Fossil shells, mostly pectins in Gray (Energy) shale. For loc. see text.

B-2 Fusain from interior of prob. tree "trunk" in #6 from 11th N., day 2.

B-3 Plant Impression of ____________ in "Lawson" about 2300' N. in 11th N. (held by DiMichele)

B-4 Fossilif. Brereton in bioturbation cast, 1950' N. on 3rd N.

B-5 Fossil solitary horn coral ____________ from the Brereton "clod", 2100' N., 3rd N. Donated to I.S.G.S. collection

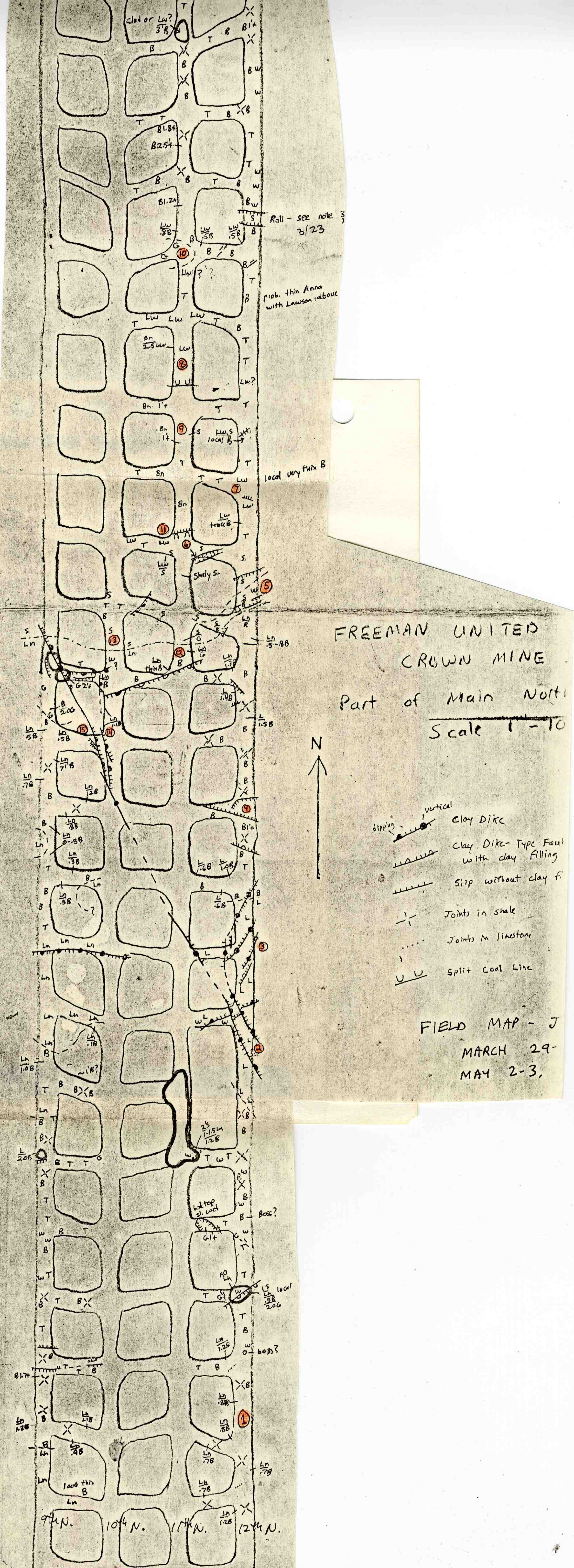
B-6 Rim portion of prob. Anna conc. in Lawson shale (eros. rem.?) containing large pyrite crystals; Nelson site 8.

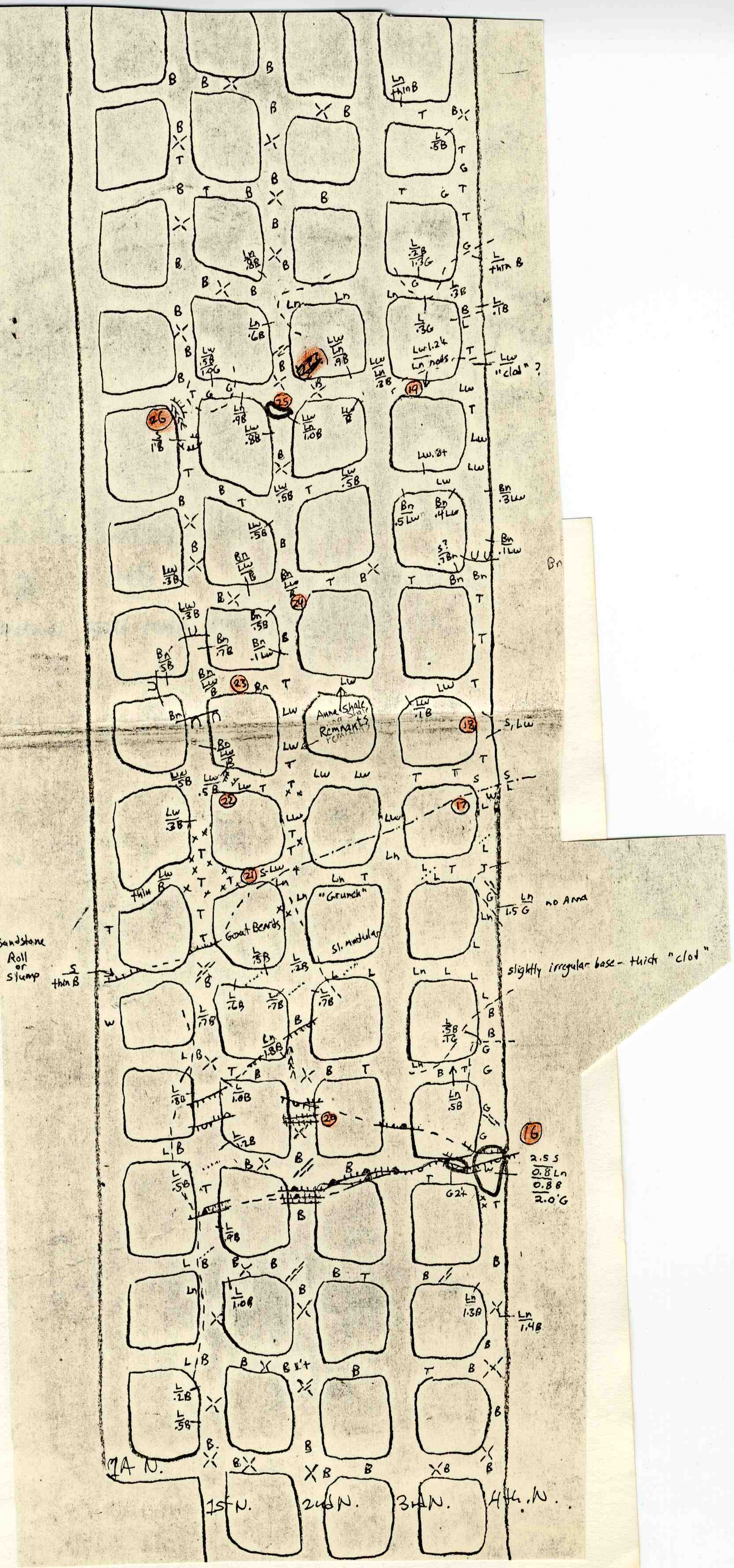
B-7 Coal sample of "rider" coal; site I.

B-8 Coal sample of part of "rider" coal; site G. [C20292]

B-9 Ss., coarse (Anvil Rock) from sheet-sand just above coal; 2200' N in crosscut just W. of 11th. (CP-2037) "Insufficient sample" 8/80

B-10 Frond of ____________ from Lawson sh., just above #6, 2500' N. on the 9th N. Main. (Held by DiMichele)


FREEMAN UNITED
CROWN MINE
Part of Main Nort
Scale 1 - 10
N
dipping
vertical
Clay Dike
Clay Dike-Type Faul
with clay filling
Slip without clay f
Joints in shale
Joints in limestone
Split Coal Line
FIELD MAP - J
MARCH 29-
MAY 2-3,
Roll - see note 3
3/23
Prob. thin Anna with Lawson above
local very thin B
Shaly S.
local thin B
9th N.
10th N.
11th N.
12th N.


Anna Shale Remnants
"Grunch"
Sl. nodular
Goat Beards
Sandstone Roll or Slump
slightly irregular base - thick "clod"
no Anna
"clod" ?
2.5 S
0.8 Ln
0.8 B
2.0 G
7A N.
1st N.
2nd N.
3rd N.
4th N.

Apr, -May

Freeman United Coal Mining Co.
Crown Mine II May 2, 1978
Notes by John Nelson on visit with H.-F. Krausse

Resume mapping three west entries of same map as 3/29-31. visit, stop number continue from that visit. (see above)

20. Three directions of fracturing in Anna Shale - the two usual sets of joints trending 055° and 140°, and a pair of vertical fractures trending 090° (E-W). The latter terminate as "goat beards" in the coal. Probably part of east-west trending series of clay dike-type faults, elements of which are seen both north and south of this position.

Anna Shale has pronounced grayish mottling on some bedding surfaces possibly in transition to limestone above.

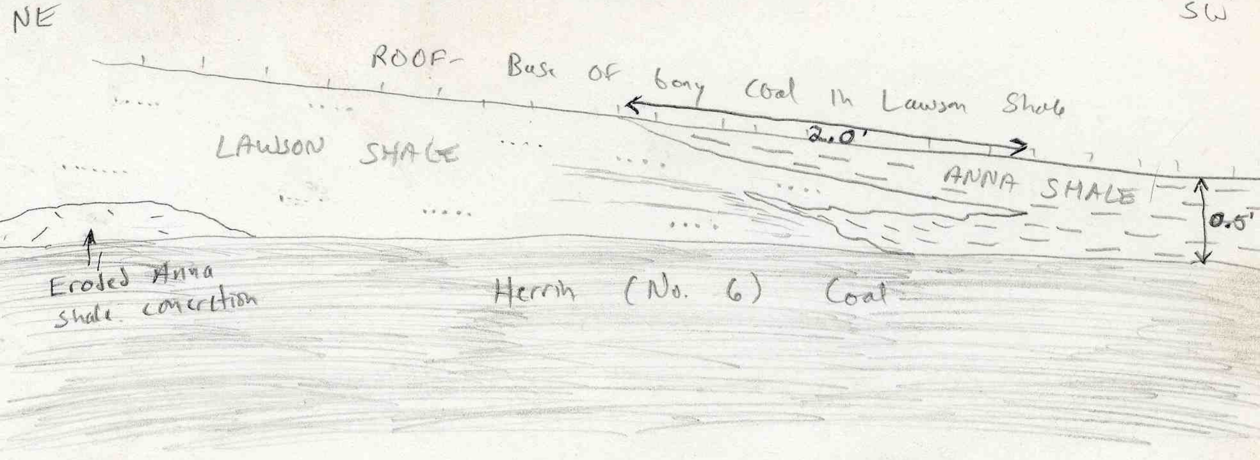
21. Southern edge of Lawson shale - Anvil Rock sandstone roof. Contact to limestone not observed but top coal beneath sandstone roof contains what may be erosional remnants of the nodular limestone along with masses of coal ball material. Some segments of tree stems on top coal are mineralized to coal balls.

22. Good exposure of Lawson Shale in contact with Anna Shale. Contact is very smooth and regular; Anna bedding is cut out at a very low angle. Concretions in Anna Shale stand out as lumps - they were obviously more resistant to erosion than the rest of the black shale.

To the northwest a bone coal layer in the Lawson Shale overlies the Anna Shale.

23. Roof sequence variable; too much small-scale variability to map on 1" - 100' scale.
Anna Shale lies on coal to northwest. Locally it is overlain, with erosional contact, by gray silty Lawson Shale. The Anna Shale is up to a foot thick but the Lawson is a few inches at most and is absent in places.

STOP 24



Lithologies are typical -

Lawson - Gray sandy, micaceous, carbonaceous shale

Anna - Black, fissile, smooth shale w. phosphatic la

Above the gray shale is the bony coal statum in the Lawson Shale. In places it lies directly upon the Anna Shale-to the southeast it lies immediately on the Herrin (No. 6) Coal. The lower layers of the "Lawson Coal" are bright banded so that the contact between it and the Herrin (No. 6) Coal cannot always be picked.

24. Sketch (over) of feature observed on SE rib of intersection. Fingers of Lawson Shale extend between coal and Anna Shale.

Assuming the stratigraphic interpretation is correct, the Lawson Shale must have been squeezed into place. This indicates that the Anna Shale was not fully lithified at the time of Lawson Shale deposition.

Probably not very different from interfingering of sandstone and Anna Shale observed in other parts of mine where sandstone does not form immediate roof.

The same type of phenomenon is present on a smaller scale in several places in the immediate vicinity of Stop 24.

25. Small irregular roof fall. Sequence exposed:

1.3'+ Shale (Lawson) Med. gray with brownish mottling, firm, poorly bedded, very silty, abundant fine mica, numerous slickensides. Contact to limestone uneven. Contact to Anna Shale sharp, uneven, appears scoured.

? Limestone (Brereton) Gray-brown, fine-grained, argillaceous, coarsely nodular. Nodules protrude into Lawson shale above and Anna Shale below. Limestone is eroded to SW.

1.0 Shale (Anna) Lower part black, hard, fissile, smooth, well-jointed. Upper part weaker, mottled, poorly bedded, phosphatic, grades to limestone. Thins to SW due to erosion - bedding is truncated.

Herrin (No. 6) Coal.

26. Northwest exposure of sandstone in this entry, in small area where roof has potted-out along slips. Only base of sandstone seen. Sandstone is light gray, fine-medium grained, argillaceous, coarsely carbonaceous, micaceous, thinly and irregularly bedded. It rests with sharp erosional contact on about 1 foot of Anna shale. The upper part of the Anna is weak, poorly bedded, mottled, and phosphatic. It was probably closely overlain by limestone prior to erosion and sandstone deposition.

This seems to be another small slump structure such as is common at north and south edges of sandstone roof area (compare Stop 5, 12, 13 from March 29-31, and Stop 3, March 23).

Main North Sandstone Roof Area
Generalized Sequence of Events

1. Deposition of Herrin (No. 6) Coal
2. Deposition of Energy Shale in shallow depressions in swamp. Begin inversion of topography.
3. Deposition of Anna Shale over Energy Shale and peat (coal). Thinner over lenses of Energy Shale due to continued inversion of topography.
4. Deposition of Brereton Limestone- thin or absent over Energy Shale due to inversion of topography. Formation of concretions in Anna Shale. Peat and overlying sediments partially but not completely lithified.
5. Erosion locally to top of coal.
6. Deposition of Lawson Shale and Anvil Rock Sandstone. Slumping produces sandstone-filled "rolls" and interfingering locally of Lawson and Anna Shale. Possibly another stage of erosion.
7. Formation of bony coal in limited swamp areas.

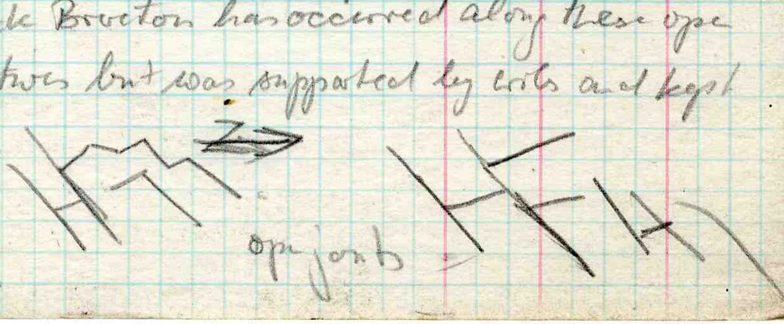
Unknown above this point.

Crow #2 Main West 2nd Entry (Main West)

mapped 05-03-78 H-T. Krausse

(50) Rooffall through Anna Shale to bottom of Brereton Limestone. Anna Shale is 2.7 to 3.9' thick intensively jointed by a set of joints N45° to 50°E / dipping 50 to 80 NW (mainly dipping 70° NW) in places this joints develop into minor slips and faults with slickensided surfaces. The base surface of the Brereton Limestone is smooth slightly dipping to the west locally up to 18° inclination

The Brereton Ls is intensively jointed (spacing about 1 joint/foot locally denser. These joints drain water into the mine. There are two sets N40E (water); N135E (butt joints) all are open fractures, fissure opening up to 1" at places. Some sagging of — probably not too thick Brereton has occurred along these open fractures but was supported by cribs and kept up.



Spacing of joints in Anna about 3 to 4 / foot

May 3, 1978

Morning - Taking photos in Main North with H.-F. Krausse
Afternoon- Mapping face area of Main West to select areas to install piezometers. Ross Brower and Keros Cartwright from Groundwater Section to supervise piezometer installation. Piezometers will be installed in roof bolt holes at working face.

1. Fall at former face (as of earlier mapping) in 1st Main West. 4.4 feet of Anna shale overlain by flat-bottomed limestone. Intense 050/75° NW fracturing along east side of fall in Anna Shale; coal not much affected. Water seepage along minor slips or fractures in limestone no consistent fracture trend in limestone.

Fractures in shale are spaced 1" to 6" apart. They are not ordinary joints. I suspect they are tectonically induced.

2. Roof fall controlled by joints and slips in dark gray shale. Main fracture (joint) direction about 050/80NW, as at Stop 1. Slips tend to run parallel and at right angles to this, but much divergence is seen. Fractures extend to base of limestone (?) which forms top of fall. The limestone (?) itself is not noticiably fractured.

3. At face of 1st Main West water and gas are bubbling from the floor but there is only a trace of seepage from the roof.

The main seepage is along about seven separate bleeders that are almost perfectly is a straight line 3 feet long the line trends 053°, parallel with main direction of fracturing in the roof.

A second line parallel to the first is less well-defined. Also there are a few small isolated bleeders.

Note one open fracture with water dripping on top coal trending about 050°. It appears to line up with main gas bleeders in floor.

About 15' outby face the roof has potted-out along slips, exposing dark gray shale.

I would conclude gas and water seepage are controlled by the NE trending fractures that in turn are related to the strike-slip faulting.

4. Large water bleeder at NW corner of face of 3rd M.W. water is flowing out of coal about 2' below roof, along a NE-trending fracture that extends from roof to floor. It is open in roof and top 2 ft. of coal; closed below.

Report 5% methane readings here - probably gas from same fractures

May 4, 1978

Mapping with H.-F. Krausse. Visit to 1st Panel South. Rooms down west off 1st Panel South have encountered the larger SE - trending fault.

At face of last room they have mined into the fault plane Trend is 143/43NE on fault plane at footwall. Subsidary fault plane tend 115/48NE. General trend is roughly 135/45-50NE overall.

Have only mined about 3 ft. into fault exposing underclay on footwall. Coal on hanging wall is undisturbed; no drag or fracturing. Minor "false drag" is present; indicates this is a clay dike-type fault.

At face of next to last room, the fault shows only about 2 ft. of displacement at the base of the coal. However, very likely the fault plane has split and we see only the northeastern most branch. Trend is roughly 148/40NE-dip varies. All slickensides are vertical.

Slight water seepage from roof adjacent to fault. The coal contains some mineralized cleat like fractures trending 130/65NE and some low-angle shear planes, but roof is not much distrubed.

Freeman will not mine through this fault here. They will mine the coal southwest of the fault from another heading.

Thrid to last room not mined up to fault. Face is not bolted. The immediate roof, about 1 foot of Anna Shale, has slabbed away, exposing the base of the limestone.

In 2nd set of rooms back from face on east side of panel, we earlier mapped a roughly circular area of gray shale roof. Several large roof falls occurred in here and one of them caused a fatal accident several months ago.

Revisit shows no gray shale is present. Roof over most of the area is Anna Shale.

Fall where miner was killed occured at a 3-way intersection. A series of slips trend E-W through the north side of the fall and were probably a major cause of the fall. Roof sequence is about 5 feet of Anna Shale, overlain by flat-bottomed limestone. Gray shale is not present (as mapped) NE-trending fractures are visible in base of limestone.

The next intersection north has also fallen, as has the crosscut between the two falls. Roof fall to base of limestone. Anna Shale is about 6.5' thick and shows two prominent joint directions, as usual. Gray shale is not present. Roof failure probably due to unusually thick shale sequence. Most of the roof bolts did not anchor in the limestone, and therefore, the roof was not adequately supported. 72" resin bolts fell just short of the limestone.

<u>Main South Fault Zone</u>

Continue mapping begun on
Base map scale 1" - 50'. Stop number consecutive from earlier mapping.

12. Large normal fault in 1st Main South. The fracture pattern here is different from that shown in most other places along the fault. The fault system appears to be branching and fanning out to the northwest.

The largest fault trends 105^{o}/66 NE and has about 4.9' displacement in the coal seam. This is a marked deviation from the usual 135^{o} trend. The coal is fractured on both sides of the fault plane and shows peculiar folding with elements of both normal and false drag.

Northeast of the main fault are a large number of smaller faults and fractures (too many to show on map). They strike more northwesterly than the main fault. the northernmost fault strikes 140^{o}.

The smaller faults and fractures are medium to high-angle (50°-60°) and from a series of small complex horsts and grabens. The coal and roof rock are intensely fractured near the faults and pulverized along the fault planes. The base of the Brereton Limestone is fractured and has been offset along one of the larger faults.

The main direction of movement is normal, with slickensides in dip direction, but locally minor reverse movement is present and some slickensides clearly trend oblique or even horizontal. Faults tend to fan out upwards or downwards, forming a series of very closely spaced, sub-parallel fractures, some at which are somehwat open. Blocks or wedges of coal are rotated or bent in brittle flexures.

I believe the fracture pattern is the result of interaction between the main SE-trending normal fault and the EW trending left-lateral fault to the south of h (Stop 13).

13. Strike-slip faults in 1st main south. Two main fault planes and a number of lessor ones are present. Coal, Anna Shale and limestone are intensely fractured along the NE and SE trending fracture planes.

Almost no vertical displacement has occurred; horizontal striations are visible in several places above both main fault planes. The northerly plane shows the effect of compression due to lateral movement (see sketch of west rib, note 6, 1/10/78). Though the coal is nearly at the same level on both sides of the fault, a wedge-shaped block has been forced upward along the fracture zone. The wedge is highly fractured, and is crushed close to the planes of movement. Shale bands in the coal wedge are thickened, probably by N-S compression.

On the east rib the opposite effect is seen. The coal layers on both sides of the fault are bent gently upwards towards the fault, then dragged sharply downwards, with roof shale wedged downwards along the fault plane.

The southerly of the two strike-slip faults is very inconspicuous. On the west rib the fault plane is shaprly but around the edge of a concretion in the Anna Shale. Apparently (as we would expect anyway) the concretion was much more resistent to shearing than was the surrounding shale.

Mine Notes - Freeman Crown II, Macoupin Co.

Trip: May 16-17, 1978 by Phil DeMaris; with Bill DiMichele & James Mahaffy (U of I Botany) on the 16th

Coverage:
- <u>Introduction</u>
- <u>N. Mains mapping & sampling</u>
- <u>E. Mains "fill-in" mapping</u>
- <u>Future research comments</u>
- <u>Samples</u>; C-1 to C-3
- <u>Addenda</u>; ~~notes by DiMichele & Mahaffy.~~ (not received)

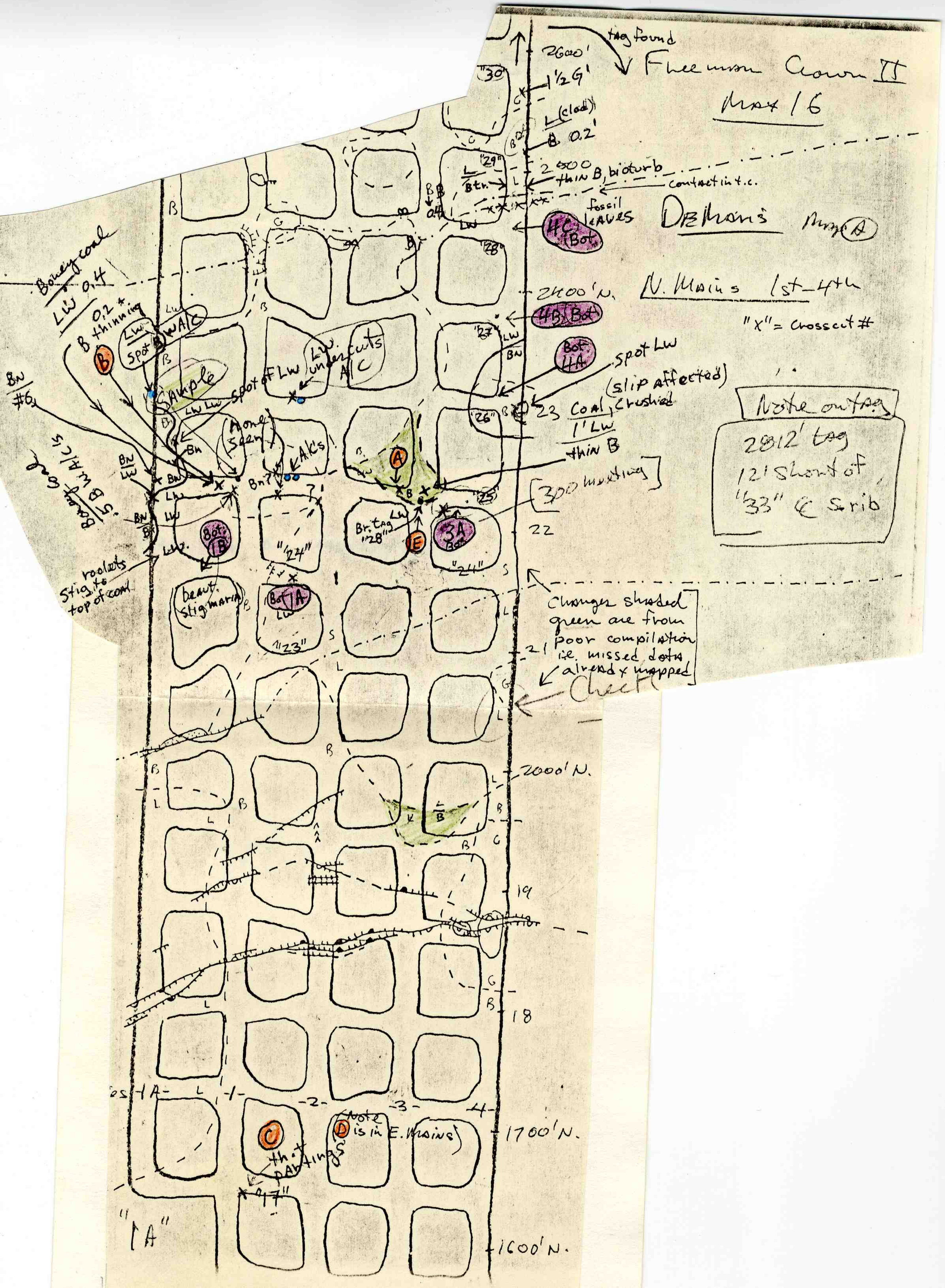
<u>Introduction</u>

This trip had two prime purposes; first, to examine & sample plant compressions from the local area of "lawson" shale roof; second, for me to do "fill-in" mapping of some area missed in the E. mains, which was revealed in compilation stage of our mapping project. We were also able to sample a bag of high C.B.'s (site B; NNW of shaft), and get a couple samples for Dick Harvey to examine vitrainite in.

<u>N. Mains mapping & sampling</u>

DiMichele & I will concentrate of fossil plant impressions in "lw" roof shale; This shale has been mapped as "lawson" because of its assoc. with Anvil Rock Ss. here; a detailed stratigraphy is not available yet so designation is not meant to be definitive.

Site "Bot 1A" (these are areas of exposed roof w. notable &/or sampled plant material) (See Map A); <u>Stigmaria</u> in bedding plane ½' into "lw"; <u>calamite</u> noted also.


tag found
Freeman Crown II
Max 16
Demons
N. Mains 1st–4th
"X" = crosscut #
Note on tag
2812' tag
12' short of
"33" € srib
2600'
2500
2400' N.
2000' N.
1700' N.
1600' N.
thin B, bioturb
contact in t.c.
fossil leaves
4C (Bot)
4B (Bot)
Bot 4A
Spot LW
(slip affected)
23 Coal, crushed
1' LW
thin B
300 missing
3A Bot
Br. tag "28"
Boney coal LW 0.4
0.2 + B thinning
Spot LW
Sample
spot of LW
LW undercuts
None seen
Bot 1B
Bot 1A
beaut. stigmaria
rootlets stig. to top of coal
Changes shaded green are from poor compilation i.e. missed data already mapped
Check
Note D is in E. Mains
th. partings
"1A"

(A) (point) Thin Anna sh, sharp contact to ½" & var. Lw., 0.3' dk. shale with fusain & coal stringers, (prob.) gray siltstone in roof. Further into crosscut- stigmaria rootlets cross bedding planes below root. Root is 0.4' across with up to 4' lenght seen here.

"Bot 4A" - Stigmaria impression in boney coal.

(B) Lawson/Anna contact irregular w. boney coal sitting on top of A/C's - Bn. coal (This coal is generally, but not always a bone coal) must be good roof (thick?) because there are few exposures. Boney coal over 0.5' Anna sh. (over #6) sampled here for Harvey; orientation unkn.

(C) Fissile Anna roof; some bioturbation; pyrite interlam. w. coal on contact.

Thickness:	B		Partings:	(cm.down)
	159 cm.	B.B.	Thin sh. w. pyrite	20
	2'+		Th. shale	62
			Sh. ¼-3/4"	85
			Th. sh.(loc?)	112
			Th. sh.(loc?)	132

(D) (E. Mains work - sev. tags noted on map B on way here)

Slip in Brereton penetrates coal, weakening downward; just to W. displ. is 0.1' & cannot be followed across crosscut. Slip alters dip in Ls. - No time to map other side of belt (was done later, however)

(E) "Lawson sh." sampled over o.1' Anna over #6- about .05' above contact; lawson has stigmaria root impression here.

Day 1 field -work ends here; some work done on E. mains was done N. of Belt (Map B, in blue ink)

E. Mains "fill-in"mapping

(F). (Day 2) 12th E. Main; fall in 11th-12th at base of 3rd N. Panel. Excellent exposures for thicknesses; shows gradual thickening of G under B w. normal Brer. Ls. stability problem show up only where G. is thick (2' plus) - check prev. data; total interval coal-to-Ls. (or topog. high) may be only important variable to L(n) roof. Interval data (continuous) easily obtainable here; need handle on sh. compaction also.

(G). Large circular fall on 11th E not far from F ; no "G" present; thin B (1') with 4' Brer. Ls & sev. feet siltstone above Ls.; The Brereton is knobby at the base & in some spots is nodular throughout its thickness to the siltstone. "G" sh. is present (1¼') half-way to next crosscut E, which has a cribbed fall; what is origin & sig, of 4' of L(n) as opposed to 1' L(n)?

(H). "Evened out" mapping of the 9th and 10th. Wet dk. gray sh. very hard to distinguished from Blk. shale.

(I). Pyritized shell impression(?) in basal Anna shale; piece sampled (white at coal contact); lower 2-4" of Anna here in crosscut is weathered orange/brown. Two prominent ovate shells (prob. Edmondia ← RJJ suggests) seen in Anna sh. (65mm. x 35mm.) Sketch;

pelecypod?

faint rib traces visible; prob hinge (?) hidden

2 pieces ANNA sampled to split – more may be found when split.