1874

B.N.H.B.C.

General Diary &
Note Book

George M. Dawson
May 1874

British North American
Boundary Commission.

May 20. 1874.

May 20. 1874. Received orders this morning to move out in the afternoon & camp on the Marais R. After a good deal of hustle & confusion got off at about 4 o'c. The evening of the 19 I had decided to go to Pembina Mt Cutting & round by the South trail with Capt. Featherstone, so as to see more of the structure of the escarpment. We hope to join the main trail about Turtle Mt. Had to get 14 days provisions & oats packed amidst the general hustle this morning for the trip. The general plan of commissariat is as follows. About 50 teams of oxen go with the parties to woody Mt. The rations of each party are packed in seperate wagons. Depôt men accompany the wagons & deal out the rations every three days.
Had to go several miles further than intended & camp on the Pembina R. about 12 miles from Dufferin, there being no water in upper part of Marais. Got to camp long after dark & did not get "dinner" till half past eleven. Shared tent with Capt. Anderson.

Duckworth shot a male & female of the Carolina dove this morning; a bird totally distinct from the ordinary wild pigeon which is the only one I have heard of here before.

May 21. A fine morning but overcast. Afternoon showery. Featherstone left camp at 5 a.m. to go to his work on the line. Got things seperated from Andersons, stuff packed & ℔ & sent

Off team & Cart early in afternoon.
Cart Lad had a bad overturn yesterday.
It was shaky from the start but on coming in
had wheels loosened & my shaft broken. The
Commissioner coming into camp early in the
afternoon took several teams from the parties &
fortunately got a cart of which Ashe was
deprived, in exchange for my bad one. Started
in Buckboard at 4 & caught up to teams at
Grants at 6. Got some eggs from Grant at the
usual rate of 50¢ a dozen. Found Jk.
Camped about a mile beyond Grants at a coulée.

The country remarkably dry. Grants well dried up
which not known to have occurred before.
All swamps are dry. Some inhabitants say
never knew so dry a spring. A poor lookout
for water ahead.

Much green grass now growing up among
the old & pretty good feed for animals. Where
the ground has been burned over however, though
very green, very thin, & hard for horses to pick
up enough.

Prairie covered in places with Anemone patens
nearly past its best. Also many specimens of
Lecanoe Triflorum?

Found lines of small pretty hard nodules
in clay bank shown in section at Pembina
R. where Camped last night.

May. 22. Wagons & left Camp at 8 o'c. Waited about an hour & then started on with buckboard. Passed train on the road & reached Camping place at foot Pembina Mt. at 1.30. Day warm & mosquitoes very troublesome. Collected some plants by the way, & in the evening went about 3/4 mile W. on the line to see an exposure in a brook bank.

Found Viola cucullata? Saw V. pedata but not fully out. Found several other flowers new to me. In thickets at base Pembina Mt. Amelanchier just blooming, common Choke Cherry & wild Cherry, wild plum, & Gooseberry just about to bloom. Seems that the dry & warm season is forcing things on very rapidly.

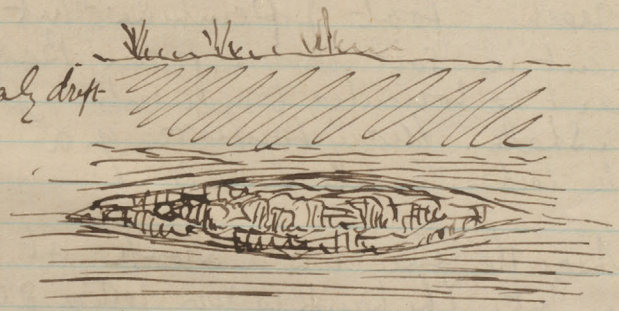
Following the line, near the - m. flag & several miles before reaching foot of Pembina Mt. Pebbles become frequent in soil thrown from Badger holes &c. Most appear to be rounded fragments of Cretaceous like Long R. Shale. Many however of L. & H. Metamorph rocks & all small.

Exposure where the line cuts a brook at the foot of Pembina Mt. The bank is very rotten & crumbling for is much covered by debris. Some feet at the top composed of mingled fragments of underlying Shale, & boulders of gneiss &c.
The Shale resembles that seen at Long R. & called Long R Shale previously. It contains

fragments of small Teleostean fish in great profusion but all quite small. Seperate scales, casts of vertebrae &c. The shale is darker than the trid Lory R. Shale, though weathering light. It also appears the softer & in all probability represents the lower beds in Pembina R Sect. of last autumn. The fish remains are exactly similar.

Selenite occurs in abundance in well formed clear crystals often several inches in length. (Selenite found in quantity in beds above referred to though crystals there seem small).

Several large lenticular septarian nodules occur in the section. The general substance of the nodule nearly black & very hard. Traversed in all directions by veins of white & amber coloured gypsum. One nodule seen about 6 ft long. Presented appearance below.




The brook in which section occurs is one of those running streams which flow E. over Pembina mt & disappear below the level of the plain. Barom. at 9 P.M. 28.68. (for height of camp & beds above described).

May 23. Left Camp at 7.45 with Capt. H. King & Sappers. All mounted & with a pack horse to carry tools &c. Capt H. going to put in pickets on the line agreeing with the 24th meridian used in all Manitoba Surveys. Went into Pembina Mt by the trail used last June for running the line. Got to Pembina R. Valley about 12 P.M. Examined Sections &c. Collected plants & got back by the same trail with Wilson about 8 P.M. After a very fatiguing day. The remainder of party stayed behind till last moment to run the line & have not yet (9.30) turned up. The trail is a very rudimentary one, & to learn the full value of Red R. Carts one has but to see it. In many places it seems dangerous for horses. Much of the riding through bushes taller than the horse, & descending steep hills or pitches. Several deep coulée's & gulleys are crossed, showing sections more or less complete

The greater part of the region between the brow of Pembina Mt & Pembina R. (over 7 miles from Camp to Pembina R on line) is wooded with groves of small poplar now vividly green. Much burnt wood however disfigures the general appearance. Many open glades, often swampy & sometimes with ponds. General run of these, & of longest axes of poplar groves nearly N & S.

The terrace levels spoken of last autumn are very distinct here. Got Barometric levellings for them, though day rather bad, being overcast, changable & showery. The first terrace is about 1/3 above the level of the plain. The second forms the apparent brow of the Mt, & is 3/3 above level of plain (say)

A still higher though less definite level is found on ascending the mountain.

The exposures in gullies & on the bank of Pembina R itself all show typical Long R. Shale, differing somewhat from that seen yesterday & resembling that found overlying the fish-bearing Shale at the Crossing of the Regular trail with Pembina R.
No fossils found or any appearance of organic remains except brownish irregular markings common in some places which may represent fucoids.

At Pembina R. Valley the upper few feet of section show drift, chiefly local, but with many erratic boulders & pebbles. Below this a great thickness of the Shale in place but crumbling.
Banks in some places show great thickness of a yellowish, light, drift with few boulders.

Many boulders on plateau of first terrace level & also numerous everywhere from this upwards. Mostly Laurentian. a few small of limestone.

Barometer Readings. Camp foot Pemb. Mt. 7. Aug. 28.75
1. Top first terrace. 28.66
2. Edge second terrace 28.46.
3. Third terrace? or plateau about 28.27
4. East lip Pembina R. Valley at 1.30 P.M. 28.08
5. Second Terrace, (higher part than 2. which on edge merely) 28.27
6. First Terrace 28.51
7. Camp at 8 P.M. 28.58

Sunday May 24. Capt Featherstone rec't having finished work in the Mountain went up again this morning while Camp remained here. Did not move my camp waiting to go with his party round by South Pine.
Changed plants, & worked at various little jobs in Camp all day.
Evening Lost came in on his way to Pentwia depot with a mail. Got letter papers &c. Offer he had left on tour a two. Sent word back that his wagon stuck in a mud hole about 3 miles from here & wanted a doubletree having broken his.
Day fine but showery at intervals.

Bar at Camp. 8.30 AM. 28.62. 1.30 PM. 28.62
9 PM. 28.84. Thermometer at 9 PM. 57°

May 25. 74. Ready to leave camp ~~about camp~~ about 6 a.m. but horses belonging to Whitewater wagon had strayed away & Stuart out searching for them. Capt Fo party moved off punctually. Waited till nearly 7 but as no sign of horses got buckboard harnessed & decided to go as far as St Joe, if the horses really lost & teams do not come on during day, to drive back to old Camp. On way to St Joe met Stuart with horses.
St Joe consists of a few houses in the usual Red R. style & a small building used as a R. Catholic Church. Forded the river with wagons & not without difficulty the water coming up to the floors of the wagons, & the current very

strong. Bottom fortunately hard. Several very steep & bad hills to ascend giving much trouble & loosing time. View from the cut over the plain very extensive, much of country along base of mountain wooded with small growth of oaks, poplars &c. Stopped about 2 hours for lunch & to rest horses, about half a mile from the last steep ascent of the mountain. On gaining the top the country comes to resemble much that already described on the line trail. Groves of poplar, willow &c thickets of Plum, cherry, choke-cherry, Amelanchear, hazel &c. Between these open grassy glades. Passed place where water supposed to be, came to branching of U.S. Boundary trail from the old road from St Joe to Ft Zollers. Left the latter, & came on over a mile or half to a coulé which is one of the numerous branches ramifying from Pembina R valley. Plenty water.

The vegetation on Pembina is slightly but distinctly in advance of that on the Red R. plain. Not in solitary instances but by comparison of number of plants. Red R probably serves as a trough for the natural flow southward of cold winds from the north?

Near St Joe banks of Pembina R appear to be all composed of yellowish drift, though did not go close to examine very carefully. Pebbles in River valley derived from drift & very varied. Laurentian & all sorts of metamorphic rocks

also Cunisiform (Farr?) Pabens gleodiles from the Cret. Clays. (Cypress) Found a fragment of Silicified wood exactly resembling that so abundant on the other side of Colman.
The terrace plateau very well marked on the lat. when ascent made, but do not seem to tally very closely with the measurements made ~~on~~ ~~Day~~ on the line trail.

Baron g. Am. Pembina R. Crossing. Water level. = 29.03.
Temp. of River 62° F.
Edge of Plateau corresponding to 2nd Terrace? 10.15 Am = 28.77
Somewhat further west, same plateau = 28.72
This plateau must be at least two miles wide & is open & prairie-like.
Plateau of 3rd Terrace (highest plateau in this part of mountain). 4 P.M. 28.22. Somewhat farther west say 3 m. from Eastern edge of plateau 4.30 P.M. Bar = 28.18.

Odometer. Wheel = 13 ft Circumference.
From camp on line to Pembina R Crossing at St Jos. 3077 revolutions. = 7.57 m.
From same camp to near the foot of 3rd? Terrace level. (lunch stop) odom. 6431 Revolutions = 15.83 m.
From same camp to branching of Ft. Tolten & Boundary trails 8110 revol = 19.97 m.
From branching of roads to first coulé on the trail to the line (camp) 690 Revolutions = 1.70 m.

Camp at 10 P.M. Bar = 28.15

May 26. Wagons left camp about 6.30 Stayed behind to examine a bank in the coulé about half a mile up. Bank crumbling & through showing long R. Shale impossible to say whether in place or drift. Probably both.
Followed the American trail N. westward toward the line. It passes as close to Pembina R as possible on account of coulées & bough far from the stream there are several very steep soft bottomed valleys to cross. As day warm very trying to the horses. Stopped at the 1st coulé for a couple of hours to rest horses & lunch. Shortly after crossed the largest coulé on the road. It has quite a stream over which the W.S. party have placed a little bridge.
Got to camp on line near W. bank of Pembina R. after a tolerably days work, due to heat & coulées.
This morning about 3 o'c a very violent thunder storm passed over. Some flashes fell very close to tents. Noticed in one instance after the passage of a flash that its course marked by an inst-chute & a row of luminous spots like heads.
The edge of the Great plains may be said to be just where the Tolten & Fortmussaum roads fork. East of this lie clumps of willows, poplars, etc. West a great open undulating grassy prairie. The wooded region of Pembina but so called owes its existence to the protection afforded from the great prairie fires by the Pembina R & its many tributary coulees & ravines. The wooded region in question has however suffered much from local fires. The generality

of the trees now seen are quite small, while traces of former heavy forest growth are frequently apparent.

The last coulé passed today (that with bridge) shows a high bank of crumbled Fort R. shales capped with drift covering of usual character. The coulé crossed in the afternoon shows similar structure, as do also several seen during the earlier part of the day. The drift wherever turned up in badger mounds &c. shows fragments of Fort R or similar shales with pebbles of limestone granites &c. &c.
Seems to establish that all this part of Cut. at least has substratum of Fort R. beds. (Compare heights of different localities.
Barom: at camp 6 a.m. 27.92
Barom: at dinner stop. Edge of coulé no from camp of morning. Noon. 27.64
Thermom. in shade. Noon. 85° F.
Barom: at camp on line 8 P.M. 27.88.

Odometer at dinner stop no coulé from morning camp 4272 revolutions =
Odom. Large coulé with bridge. Fort R. shale &c. from morning camp 5260 revol. =
Odom from morning camp to camp on line 7810 revolutions. =

Found Astragalus Caricarpus? in flower. Many miles of prairie covered with tufts of Anemone patens. Senna bicaulis also common.

A ducks nest was found today near the trail on the dry open prairie with as far as could be seen no water or marsh near. The bird flew off but could not tell what species. The eggs three originally. Nest merely a hole, (apparently accidental) in the ground. In this a circle of blackish down with a space in the centre where lay the eggs.

May 27. Did not move Camp. Morning hazy & with a good deal of rain. Afternoon finer, but very strong wind all day. Evening wind continues. Thunder storms passing along horizon. Pressed yesterdays plants & collected some more in woods near here. Many banks covered with wild strawberries in blossom. Lithospermum canescens first observed in flower today. Found also a specimen of Platanthera bractata with a few blossoms out. Many more specimens but only in bud. Found Trillium cernuum in flower.
Collected some land shells.

| | | | |
|---|---|---|---|
| Barom at | 9 AM. | 28.05 | Showery changable |
| " " | Noon. | 28.12 | |
| " " | 8 P.M. | 28.17 | |
| Thermom at | 9. AM. | 59° | |
| " " | Noon | 63° | |
| " " | 8 P.M. | 53° | Strong E.N.E. wind. |

May 28. Much rain in the night. Morning cold with rain & fog. Strong SW wind. Left camp about 9 am. & travelled west along the line about 16 miles. About noon cleared up & ceased raining though wind continued. Stopped about an hour & a half at noon & got into camp early.

Country passed over, undulating prairie with occasional small swamps willow fringed & very viridi green with strong long grass. Crossed several coulees which run into Pembina R. the timber of which is clearly visible to the North.
Country has been completely burned over last fall or early this spring. On such ground the flowering plants come up early & soon bloom but remain small & stunted.

Drift. At wg. camp 54 M. west of principal Manitoba Meridian. Pebbles gathered promiscuously from badger hill consisted of. Limestone white of usual appearance 40. Granitoid & gneissic rocks generally of pink tints. 25. Felspar 1. Pebbles chiefly or entirely of quartz 8. yellow chert. 2. Dark rocks. probable Huronian 4. Soft reddish decomp. rock 1. Grey. probably part of a nodule from Cretaceous shale 1. Many small splinters of Lowy R. shale, fragments of fossil pebbles.

Many old buffalo roads running N. westerly.

Baron at 8. A.M. Camp W. bank Pembina R. 28·18
" " Noon 10 m. W. of last camp. 28·12
" " 8 P.M. Camp 54 m. W of Larry Mound or
64 m. W of Red R. 28·11
Thermom. 8. A.M. 53°
" Noon 58°
" 8 P.M. 58°.
Odometer. At dinner Stop 10½ m. W of Camp by
line = 3890 revolutions =
At Evening camp. 16 m. by line 6620 =

9. P.M. Lightning flashing round the horizon in all directions. Clouds drifting N Eastward against the wind.

May 29. Started about 8 o'c. & travelled on West along the line while Capt. & some Sappers did ~~[illegible]~~ chaining & put up pickets. Stopped for lunch after going about 13 miles. Camped about ½ mile from the western boundary of Manitoba. Long 99°. Crossed Long R. which on the line is comparatively shallow valley with pools but no stream at present. Found on banks of R a Phlox resembling P. Caruscens.

The country passed over, undulating prairie with many small & large basin like swamps. The area of which however is quite unimportant compared with the Total.
Many Boulders of limestone & metamorphic rocks show strong glaciation.
In the bank of Long R. a section, poor, but showing crumbling Long R. shale in place &

capped by drift.

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| Barom. | Camp. Morng | 7.30. | 28.13. |
| " | Noon. Dinner Stop. | | 28.23. |
| " | Camp Evng. | 8 P.M. | 28.38. |
| Thermom. | Camp Morng | 7.30. | 70° |
| | Noon | | 67° |
| | Camp Evg. | 8 P.M. | 58° |

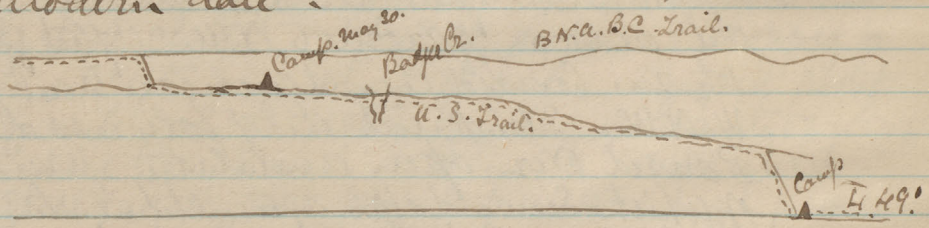
Odom. Cross old road running N.20°E towards Dr Dance Hill. Granite boulders in swamp.
3146 revol. =
Noon. Dinner Stop. 5380. =
Long R. astronom. Station. 5896. =
Camp Evng 7225. =

May 30. Last picket at S.W. Corner of Manitoba put in this morning. Struck out across prairie to N.W. Offset long about 1½ m. Crossed an American trail going about W.N.W. Struck out thro & followed it all day. Passed over open undulating prairie the character of which seems better agricultural than that seen yesterdays. Soil however every where rich & good but a gravelly subsoil. In some localities seems rather dry but might not prove so.
Found a very large White Crane in one of the swamps. He rose slowly & unconcernedly & gradually soared to a great height against the wind, taking no notice of a Rifle bullet fired at him.
The association of hills or hillocks & swamps & ponds is curious. Wherever the ground rises slightly & forms little elevations basin like swamps &c.

ponds are sure to occur. The do not therefore occur in the lowest parts of the prairie as a rule but rather the reverse. The bells seem to follow indefinite lines forming miniature ranges.

Also curious that the hill tops & swamps should be equally characterized by boulders, while the general prairie is as a rule nearly free from them.

Can this have been caused by the action of marine currents on the mounds deposited by icebergs? The might scoop out hollows in some places leaving the boulders; & at the same time wash away the finer matter from the hill tops. Analagous collections of boulders are seen in the coulées & River Valleys of more modern date.




General sketch of route

Camp. 6.30 A.M. Bar. 28.39. Ther. 52°.
Camp. Sq. 8. P.M. Bar. 28.44 Ther. 62°.
odom. at Badger Cr. 6390.
odom. Camp. Sq. 8650.
Stormy Cold W.NW. wind all day.

Sunday May 31. Left Camp about 7 A.M. After following U.S. Trail for several miles got into a swamp in which some teams mired. After getting them out turned Northward & struck Commission trail after about 1/2 mile. Stopped at Duck Ponds 10 A.M. & of Turtle depôt for lunch. On again to Turtle Depôt. Mosquitoes terribly thick & importunate there being no wind. Found a note from Anderson at Depôt saying that passed on Friday & meant to rest Sunday at Turtle Head Creek. Came on about 4 miles West of Depôt to first Stream & Camped. An indian camp near, & we had soon some fine cooking Scout as visitors.
A Half Breed train of Red R carts camped near us. Going E. Have come from Woody Mt where they had wintered in 27 days or 19 days of actual travel. Carrying furs & robes the result of winter trade. Spoke to the head man who exceedingly polite, constantly using the word "pardon."

The common flowers on the prairie now are. Viola Cucullata & V. pedata. Ranunculus abortivus. Anemone patens now going to seed in some places whole prairie covered with its brownish green woolly heads. Geum triflorum becoming less common going west. Astragalus carpocarpus becoming more common since leaving Pembina R. & now to be seen almost everywhere. ~~Geophyllum~~ Antennaria or Cudweed? & Lithospermum canescens just coming out.

Nota. Composition of superficial pebbles taken promiscuously from badger hills. Duck Ponds 10 m. East of Turtle Mt. Composed as follows.

Limestone 47.
Granite & gneiss & similar rocks. 28.
Quartz & Quartzite 7.
Dark coloured & greenish compact rocks & schists probably all Huronian. 17.
Crystalline diorite 2.
Nodule from Cretaceous (probably) 1.
Reddish decomposed rock 1.

Camp. 7 Am. Bar. 28·62. Ther. 55°
Duck Ponds. Noon. Bar. 28·40 Ther. 65°
Camp. 8·30 Pm. Bar. 28·65 Ther. 54°

Odometer at swamp where wagons mired 2370
on reaching commission trail. 2723.
Camp. evening 10123.

The tendency of the prairie to clothe itself with timber if the course of the fires could be stopped evinced by the thickets of seedling poplars, seen in the vicinity of Turtle Mt where the fire has not passed for a few years. In other parts of the same prairie every bush & shrub, the young poplars included, dead from effect of last seasons fires.

June 1. Left Camp at 6.15. Had not gone far when light medical department Spring Cart broke down. Iron axle broken. So had the pat in seperate pieces in various wagons. Halted for lunch at Col Forrest's 15 mile west of Depot picket. On again through one bad coule after another till reach Turtle Head Creek. Another small party of traders gone E. passed this evening. Had wintered at Little Rocky Mts. Fine view of White water Lake from camp. Some of coules bridged & road making part but many had to do when teams stuck & much time lost.
Day with light & variable winds & appearance of a storm.

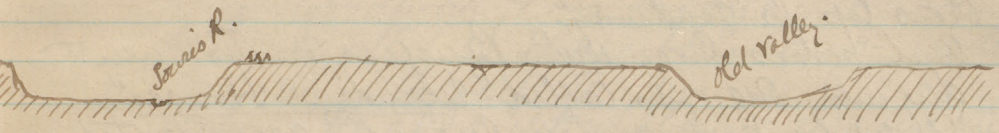
Camp 6 AM. Bar. 28.12
" " " Ther. 52°
Col F's 15 m. stake at Noon, Bar 27.91
" " " " Ther. 74°
9 PM. Camp Turtle Hd. Cr. on prairie level. Bar. 27.85
" " " " Ther. 56°.

Odometer at 15 m. stake 5910
" at Camp. Evg. 10400

June 2. Left Camp at 6 o'c & travelled over gently undulating prairie of fine appearance to Souris River. The soil appears good throughout many little ponds & swamps.
Passed a party of Sioux indians travelling from Turtle Mt to the Souris. Their goods packed on the back of a small pony & on a travaille behind. Several dogs with similar triangular drags also carried a part of the stuff.
Caught up with the Ox train shortly after lunch & on arriving at the Souris found all the parties just camped.
The river is so high as to be unfordable. Found on sounding 7'3" in middle & stream 150 ft across. Preparations to build a bridge commenced Rowe & Burgess attempt twice to take a rope across by means of two boats together carts lashed together, but did not succeed. Rowe finally swam over with a rope.

The long wide valley passed over about 2 miles west of here is evidently an old alternative valley of this stream. (See note of last year) Took distances by odometer & elevations by Barometer to ascertain how much the R had cut down since leaving the old valley & to obtain data for making a section across.
Bar on prairie level E. side of old valley 28·13 a gradual slope for about 200 yds. Odom at E. lip of valley 10175. Bar at lowest part of valley 28·21. Odom at W. lip 10545. Bar = 28·15.
Bar at summit between old valley & Souris valley =

28·14 Odom. at edge Souris valley = 11435. Bar at water level Souris R. 28·23.




Saw first stone circles indicating position of old lodges today. No such observed E. of this though in many places & especially in vicinity of Pembina R & but abundance of boulders large & small.
O'Donnell tells me prairie here much better looking than in Dakota where Western trails cross it.

Day showery with variable wind.

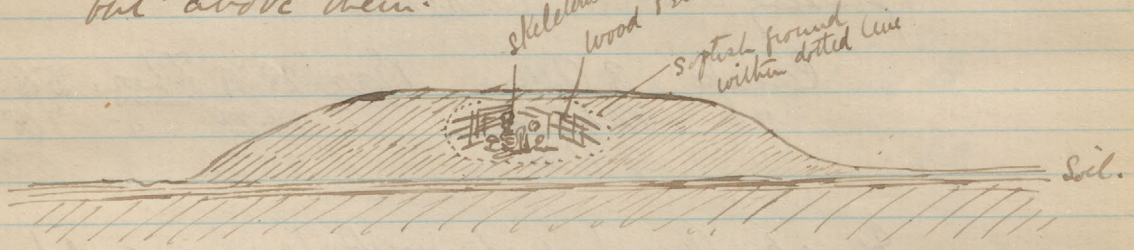
Camp 5·30 A.M. Bar 27·90 Ther. 56°
Noon Odom 6100. Bar 28·10 Ther 64°
Camp Souris R. Top bank. 8 P.M. Bar. 28·18 Ther 61°

June 3. All available hands at work at bridge this morning. Parties cutting wood & other men engaged fitting together & sewing stuff.
Afternoon went collecting plants with Burgess & got quite a number of new things. Pressed plants & changed papers of all already collected.

Camp 7 A.M. Bar. 28·18. Ther. 57°
" Noon. Bar. 28·09. Ther. 72°.
" 8 P.M. Bar 28·04 Ther. 55°.

June 4. Bridge progressing though not so quickly as expected. Cribs being put together & towed into place. Stringers laid on, then smaller cross laps for roadway.
Went across River with Burgess & two men & dug into one of so called "Mandan Houses". The greater part of these mounds are situated on the tongue of land between the Souris & S. Antler Creek, on the general prairie level. A few are on the N side of the Creek & near the road. One of these checks. Diameter of mound a little over 50 feet. Height above general prairie level about 6 feet. The ground round the mound showed evident traces of having been dug into for the materials. Found remains of three skeletons. One probably adult but much broken up & not much of it found. Another that of an infant. The third nearly perfect appeared to have been buried in a sitting or crouched position. The dimensions of the bones very small though from teeth &c evidently adult. Very probably a woman. Skull short & broad. Sloping in front. The interments did not bear aspect of very great antiquity. Sticks of wood with which a sort of covering had been built up over the bodies being still visible though rotten & crumbling. Found near the skeletons a flat smoothed piece of deer skin, used perhaps as a scraper & a mussel shell. The ground near the skeletons comparatively soft & yielding. From this was at first tempted to conclude that the interments found had been made long

Subsequent to the construction of the mound. It may however very well be that the ground has been kept from contact with the bodies at first & the woodwork & has subsequently tumbled in & closely filled the space. This seems rendered more probable by the fact the ground is not only hard below but at a little distance around the skeletons, but above them.




Neil arrived today with some Scouts coming out.

Water up Souris R. about Noon 62°.

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|---|---|---|---|---|---|
| Camp. | 8 am. | Bar. | 28.17 | Ther. | 60° |
| " | 12.30 Pm. | " | 28.19 | " | 62° |
| " | 8.30 Pm. | " | 28.34 | " | 54°. |

Day fine. Strong & rather cool wind from west.

Had a visit from some Sioux Indians, including one said to be chief over 100 lodges.

June 5. Bridge building going on actively. Spent day reading & writing letters home & in with some returning ox wagons tomorrow. Rowe & I & interpreter talking with some Sioux who came into camp about the old mounds. It seems that they belong to the Sioux

themselves & that they still bury there. Points out mounds as being graves of so & so. A strange departure from the habits usually ascribed to the plain Indians. They said that in mound we had opened a woman & child buried. This was correct, but seemed also as stated yesterday the remains of a third skeleton. possibly an older interment.

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|---|---|---|---|---|---|
| Camp. | 8 AM | Bar. | 28.39 | Ther. | 58° |
| " | 12.45 PM. | " | 28.23 | " | 75° |
| " | 9 PM. | " | 28.32 | " | 58° |

June 6. Men had at work from an early hour & finished bridge by 10 A.M. Bridge built on 5 timber cribs fastened with treenails. Long & strong logs laid from crib to crib, one on each side. Small logs roughly fitted laid across for roadway. Then all covered with fascines & stones & earth.
Crossing began about 12.30 & before 2 PM. all over, except East & Scouts who went to hunt up four lost (or stolen?) horses.
Filled up mound opened day before yesterday in passing that the indians' prejudices might not be offended.
Travelled on & camped on N. Antler Creek about ten miles from the Souris.

Took census of constituents of surface drift on E. bank of Souris valley this morning collecting pebbles over a considerable area.

| | | |
|---|---|---|
| | Limestone (usual type) | 186 |
| Probably Lau. | Granite & gneiss | 56 |
| | Mica schist. | 2 |
| | Black hornblende rock | 2 |
| | Quartz | 8 |
| | Gneiss with garnets | 1 |
| | Quartzite & jasper like rock | 7 |
| | Diorite (Crept) | 1 |
| | Coarse light coloured quartzitic sandstone | 2 |
| Probably Hur. | Dark greenish crillentt fragmental rock | 8 |
| | Hard green & greenish-black rocks with much hornblende & some schist | 22 |
| Cret? | Fragments of ferruginous concretions | 3 |

Camp 8 AM. Bar. 28·29 Ther 60°
" Noon " 28·18 " 72°
Camp. Bank N. Antler. 10 m. from Souris
Bar. 28·11 Ther 52°.
" " " " from Camp S. bank
Souris. Odometer 4445.

June 7. Started early & travelled across S. Antler Cr crossed it the ford being easy though signs on the bushes of flood water say ten feet above present level; we went on about a mile. Lunched by S. Antler & then went on to the "Big Slew" a valley about 8 miles W. of it. Camped.

Camp. 5·45 AM. Bar. 28·08 Ther. 52°.
Bank S. Antler 1 m W of Ford. Noon. Bar 27·92 Ther. 72°.
Camp "Big Slew" 8 PM. Bar 27·89 Ther 58°
Sky Cloudy.

odometer at ford S. Aulter 5400.
" " Elms End (Tracklane Creek) 6925.
" " Big Slew Camp. 9173.

June 8. Morning with strong & very cold N. wind. Cloudy but gradually cleared up & turned out a fine afternoon & evening. Started early & arrived at Souris by 9.30 A.M. Examined old ford. Water rather deep & the approaches very bad being steep & now soft. Almost impracticable for ot train. Leatherstone afterwards crossed by lassing the wagons down one side with ropes & men & doubling up the other. Found that lower ford used by W.S. party early year much better so remainder of party went round to it & ot train crossed there also.
Found skeleton of old boat made by Crompton & scouts for crossing when river much higher.
Camped on W. bank of River.

A scarped bank at a bend of the river near camp showed section of bottom of main valley about 20 ft deep. Whole bank consisted of fine alluvium distinctly & regularly stratified. The upper part very distinct, bands of yellowish shade alternating with blackish layers somewhat filled with vegetable matter. In the lower part of the bank the stratification though still apparent not marked in same way, prevailing colour being yellowish.
In a black layer about 4 inches thick & situated 6 (six) feet below the top of the bank found a layer of chipped quartzite or flint. Attention first called

by finding chips evidently artificial showed on front of bank & tracing them up again to come from the layer mentioned. Found in this layer many in silt & none in place anywhere else.
The chipping extent in the layer along the face of the bank for more than 30 yards & the layer itself can be traced distinctly & with the same magnitude & position some distance further, in fact as far as the bank is exposed.
Buffalo bones are seen imbedded in the bank both above & below the layer in question, but saw none far down.
The layer is 15 feet above the present level of the Souris which must still be over 2 feet above the summer level.
Curious that the actual banks of the Souris so much higher here than at the first crossing, while the banks of the River valley are low in proportion.
? as to whether alluvium in which the remains found caused by flood of the river as at present, or whether belongs to bed of ancient river valley now cut into by Souris flowing at lower level.

Camp "Big Slew" Bar. 28.19 Ther. 42°
Souris R. at lower ford water level Bar. 28.23
Temp of air 57° Water 62°.
Camp 8 Run. 20 ft above river. Bar. 28.30 Ther. 46°.

June 9 All parties broke camp early [illegible]
[illegible]
[illegible]
[illegible]
Had agreed with Ashe last night to go on quickly to R. des Lacs at the Hill of the Murdered Scout. to get some shooting. Started about 6 am passed all other parties & arrived at R des Lacs by 8:30. Ash riding. Self driving in buckboard with Nelson. Saw two antelopes in the distance. Left horses on bank & walked some way down the R. des L. Great numbers of ducks & some geese, but when disturbed flew up & down over the water. Those shot above the water impossible to get, the lake being deep & bottom soft & no retrieving dog. Shot several but unable to get them. Ashe managed to bag two flying overland. Found a well preserved & cleaned Pelicans skull.

The R. des Lacs, so called, must have a valley nearly half a mile wide even in the upper end where the road goes round it. Where the line crosses it the water alone is nearly 3/4 m. across. It resembles a long lake reedy at the edges & lies between high banks, & is frequented by large numbers of wildfowl. It is said to extend Southward 70 m. & to join the Southern bend of the Souris giving issue there to a running stream. The present condition of affairs however will not at all account for its formation. It does not look like the valley of an old river tributary to the Souris as it bends Northwards

so sudden & has few branch coulees. A stony tract of low ground however extends N westward of it towards the Souris, & it may be an old bed of the Souris itself. In this case either the northern end of the valley has been nearly filled again some way, or the River being dammed back has spread out into a lake like expanse on the lower ground in finding at last exit to the south has formed the R des Lacs valley.
Came westward about 6 m. further after lunch & then camped.
This morning on rising between 4 & 5 in the Souris valley the ground in the shade covered with white frost & a thin film of ice on water in vessels. Frost on 10th of June rather anomalous. Can cases be accounted for. Strong northerly wind of yesterday brought flood of cold air which, the day being subsequently cloudy & calm was not warmed or removed. Night clear & radiation lowered temperature still farther.

Camp Souris valley 20 ft above R. 5.30 A.M. Bar 28.44
" " " " " " " Ther 46°.
Bank R. des Lacs 12.45 P.M. Bar. 28.17
" " " " " Ther. 60°.
Camp on prairie of R.M. Bar 28.20
" " " " Ther 49°.

Odometer at R des Lacs 6270. revolutions
" at camp on pr. 8765. "

Hill of Hundred Scout situated on W side of N end of R. des Lacs. Rises perhaps 100 ft above prairie. Potter Butte elevation 3.0 ft. N top rough representation

of sleeping Indian 15 or 20 ft long & footsteps cut out in the turf. (For story see Last years Notes.

June 10 Left Camp Cach. Stopped at St Peters Spring for a while till teams came up then went on to valley about 4 m. E. of Stott Cr. Lunched. Found here many new flowers among others a magnificent Penstemon with delicious fragrance. Also a fine Showy blue Penstemon

Sandstone like that of the Roche Percee occurs in this valley. It is hard on top & soft below in the same way & has the same arrangements of lengthened domes of Nodular hardening, here running nearly E & W. Gives rise to two or three small & but picturesque masses of Rock. About 1/2 m down the valley & below the Sandstone series in clayey beds a lignite a few inches thick is exposed.

The Sheepnus now in full bloom & scenting the surface of the prairie wherever little groves of it occur.

Bar. Camp. 5.15 A.m. 28.23
Ther. " " " 48°
Bar about 4 m E of Stott Cr. Noon 28.11
Ther. " " " " 62°
9 P.m. Bar. Camp. W side Stott Cr. prairie level 28.25
Ther. " " " " " 54°
Aneroid at Peters Spring 4237.
" " Camp 8130.

The difference between the Barometer at Leaving Camp & at St Peters Springs may be taken as representing the height of the Plateau step caused by the outcrops of Roche Percé Sandstones.

June 11. On leaving Camp heard that Lieut Rowe had been hurt. Drove on quickly with Ward & found him about a mile West. His horse had stepped into a badger hole while in full career & threwn him very heavily. Dr Burgess almost on the spot at the time & Mellmann sent for in haste. Lieut put up on Spot & Rowe's party halted. In swoon at first but gradually became sensible. Burgess does not think very serious. Generally shaken & bruised & face cut.
Rest of party came on to Wood End. Now very deforested from when seen last Autumn. Valley full of lilies & beautiful green contrasting finely with the pale yellowish or reddish clay banks which so frequently occur. Collected some new plants &c but prevented from doing much by bad attack of toothache. Mosquitoes & Black flies very bad in valley.

The Souris valley though where seen at the first & second crossings lower down, it appears almost more water than at present in the river to excavate it about Wood End & Roche percée is in active process of formation, as the numerous scarped clay cliffs with bends of the river excavating at their bases show. The present

water supply is therefore sufficient for the excavation of this part of the course. The valley is however comparatively narrow & may be more recent than that lower down. The valley above Wood End is also shallow & open & the present dam of water would appear to have little effect on it.

men occupied cutting wood for 10 or 14 days there bin work on Yukon Road for over 200 m. at wooden mt.

Camp Stort Cr. pr. level 6 Am. Bar. 27.92 Ther. 51°.

Camp. Stort-Cr. pr. level 6 Am. Bar 28.16 Ther 52°.

" " " " " " Ther 52°.

Wood End. pr level. Noon Bar 27.94 Ther 72°.

" " " " " " Ther 72°.

" " " " 8.30 Pm. Bar. 27.93 Ther 58°.

" " " " " " Ther 58°.

Odometer at Wood End 3570. (deduct about 1/2 m. for a detour.)

June 12. Teams left by 6 Am. Waited behind to hear news of Rowel by a scout sent down for the purpose. Returned at 8.30 with report that a little better if anything, but has been worse hurt than at first imagined. Burgess will not move him for a day or two. Ward stays behind with him & party furnished with ten days provisions.
Came on about 13½ miles to lunch & then went on to place where Commission trail through Colean branches off.

Camp. Wood End 6. A.M. Bar. 27.92
" " " " Ther. 51°
Bank Creek. Noon. Bar 27.81
" " " Ther 69°.
Camp 26 m. W of Wood End. 8 P.M. Bar 27.80
" " " " " " Ther 59°

Odometer at halt. 5420
" " Camp. 10460.

June 13. Did not move camp till afternoon having only 14 miles to go to camp with ox train. Also waiting news from Rowe. Capt Anderson having arranged that scout should go back to meet another sent out westward & Ward. News that Burgess thinks a little better & hopes to move westward on Monday.
Started along from bend to bend of Coleau Creek or the Souris R, by the traders road. Camped at a large tributary coulé with good grass. About 39 m. W. of Wood End.

Bar at morning camp 8 A.M. 27.95
Ther - - - - - 66°
Bar - - - Noon 27.90
Ther - - - - 76°
Bar Camp 39 m. W. of Wood End 8 P.M. 27.89
Ther - - - - - - - - 60°

Odom at Camp. 6635.
Prairie undulating considerably being near the base of the coteau. Covered with close growth of short green grass.

June 14. Left Camp about 7. & travelled on by Traders Road. Crossed the Souris San easy ford soon after leaving Camp. Found on the Bank a recent grave with a little wooden cross set up over it & an inscription in french that So & So had left Wood, but in company with —— at such a date & that several other traders (names subscribed) coming a few days after had found his body by the side of the stream & buried him. He had been drowned while trying to cross the swollen Creek -

Saw an Antelope & had a pretty good shot at it at 300 yds but did not hit.

A chain of lakes in an old valley runs N of the Creek for some distance after the ford.

After noon halt started at 3 P.M. & again forded the stream this time rather difficult for the oxen being a steep slope on the landing side Came on about two miles more before could find a place with good enough grass for horses. Oxen stayed some miles behind.

Country after first ford & especially after second becomes less favourable in appearance. Between the fords undulating with short poor grass. After second ford much of road over dry clay bottomed swamps, often strewn patches of alkaline efflorescence.

Passing along close under foot of Coteau which here has a very well defined & abrupt edge. To the N broad less level plains. No timber anywhere larger than willow wands in

the stream.

Bar. Camp. 6.45 am. 27.93
Ther — — —
Bar. Noon halt banks of Souris Traders Rd 27.81
Ther. — — — — — 77°
Bar. Camp. Traders Rd about 62 m. W. of wd Lud 27.77
Ther — — — — — — 58°.

odom. at halt. 5175.
" " Second ford 5225.
" " Camp. 9680.
Day very sultry cloud light & changeable.

June 15. Morning fine with westerly breeze. afternoon partly cloudy & with local rainstorms passing.
The Coteau foot passed over today has an improved appearance, the grass growing with some luxuriance.
Very many old buffalo wallows everywhere.
right River Souris on the ~~left~~ all day through plain at some distance. The edge of the Coteau on the left 2 to 3 miles distant.
Camped near a good swamp at the foot of a conspicuous hill. having made about 17 1/4 miles.

Bar Camp 7 A.M. 27.71
Ther. " " " 75°
Bar. Noon halt 10 3/4 m. W. of morning Camp. 27.56
Ther. " " " " " " 83°.
Bar. Camp. 6.45 P.M. 27.52
Ther. " " " 68°.

June 16. Some oxen lost this morning as their watchman had gone to sleep. Delayed starting of train till 6 A.M. Travelled 5 3/4 miles to where the road crosses a stream tributary to the Souris. It is evidently of importance at times but now has only water in pools. Found some dead willows of greater than usual size which cooks utilized by making a baking of bread. After the halt followed the road S. West wd along the stream & into a deep bay in the general contour of the Coteau. The road then leaves the stream & ascends the western side of the bay, rising in fact onto the Coteau level. The appearance of the coteau here is very favourable as compared with that assumed on the line. It is not stony & though some parts are arid, many are quite the contrary & sloughs & swamps abound.

A thunder storm coming on we camped early just getting the tents up before the rain which was very violent & lasted till 8 P.M.

Scarped banks in the brook crossed today show drift clay of pale brown colour with some pebbles & boulders but not markedly stony.

Camp. 7.45 A.M. Bar. 27.57
" " " Ther. 74°
Noon halt 5½ m. from morning camp. B. 27.47
" " " " " " T. 80°
Camp. 8.30 P.M. B. 27.20
" " " T. 64°

June 17. Started at 7 A.M. & came about 14 miles to halt. Then travelled on again making in all about 20 m. The country much broken into deep basin like swamps & lakes with out cutflow & high ridges & hills. Passed a very prominent butte to the left which seems to run Southward a long way. At its base are many circles of old lodges. Also appears to be a spring. After noon halt country descends again & is less grandly broken but becomes very stony in places & even resembles the coteau seen on the line. The country passed over in the morning has a good growth of grass & herbage, though no shrubs or trees.

Camp. 7 A.M. Bar. 27.04
" " " Ther. 69°
Halt. 1 P.M. 14 m. W of last camp Bar. 26.71
Ther. 90°

Strong S.W. wind
Camp. 8 P.M. Bar. 27.06
" " " Ther. 69°

Odometer 8100. revol.

June 18. Country passed over all day much broken but not as a rule stony. Over large areas very dry & covered with selaginella? among the grass. Other parts are greener & more fertile looking & there are many swamps & small ponds which would yield good hay. Passed several alkaline lakes. In the evening a range of scarped highlands visible to the South showing white banks like those of

the lignite tertiary. Apparently 5 or 6 miles distant.
Found an Indian silver ornament on the prairie this evening. It had evidently been beaten out from some coin.
Saw two dead buffalo today with skin still hanging about them. Must have been killed last season.
The vegetation here on the uplands of the Coteau is apparently slightly behind that on the plains below.

Camp. 7 A.M. Bar. 27.26
" " " Ther. 57°
Noon halt. 13 1/4 m. West. Bar. 27.20
" " " " Ther 69°
Camp. 8 P.M. Bar 27.14
" " " Ther. 54°

odometer 7212.

June 19. For about ten miles W. of Camp passed over Coteau country with some small ponds & swamps with grass. The hills rather dry & barren. Then came on a great valley running apparently S.E. ward, & with alkaline lakes in it.
It seems to be a valley bounding the Coteau proper from the country S of it which is shaped by valley courses. In lateral gullies of the big valley is some good timber. Elm, ash & c. Also fresh water though none in main valley.
Came a long way before lunch halt being unable

to find water & grass. Stopped at last after coming about 20 m. near a large saline lake. the shores of which are already white in broad patches. The local whirlwinds raise the dust in pillar like clouds with curious effect.

Got into large valley running W. Found small stream of water & camped having come about 24 m. (Otom. broke fastening band & could not be used)

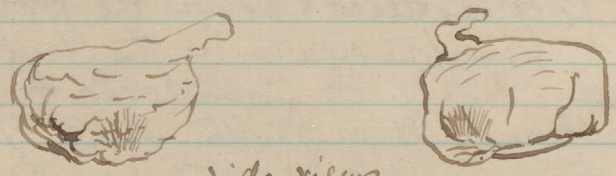
Cacti of at least 3 species common on all the hills.

Great number of young grasshoppers not yet able to fly covered the country passed over today & are rapidly destroying what little grass there is.

Drift. "Siliceous pebbles" may be said first to appear in any quantity about Wood End, which may be considered to be on the foot of the Coteau. Much limestone occurs in the drift of the Coteau proper also metamorph. rocks & siliceous pebbles. (Compare with drift S of Coteau)

| | | | |
|---|---|---|---|
| Camp. 7. A.M. | | Bar. | 27.39 |
| " " " | | Ther. | 54° |
| Halt. 2 P.M. | | Bar. | 27.39 |
| " " " | | Ther. | 75° |
| Camp. 8 P.M. | | Bar. | 27.39 |
| " " " | | Ther. | 61° |

June 20. Halt today to give oxen rest & feed.
Heavy thunder storm passed just at dawn.
Arranged various little matters. Changed plant papers.
Visited a hill about a mile S. which shows an imperfect section of sand & sandy clay with one plant bed (containing nothing recognisable) & a seam of impure lignite 2 ft thick. Also much selenite in crystals & some ironstone.
Whittaker with a scout & light spring wagon arrived from Wood End for provisions for Ward Burgess & Rowe. Latter progressing but slowly & much troubled by heat. East & party reported on the way.
A sudden squall with thunder & very heavy wind & rain at 6.30. Lasted only a few moments but hailstones of great size fell with force against the tent.



Side views.

Some of about size & shape shown & with drop like tails & a nearly opaque vesicular part like a nucleus, in one corner or at the bottom.

| | | | |
|---|---|---|---|
| Camp. | 9 A.M. | Bar | 27.26 |
| " | " | Ther | 74° |
| " | Noon | Bar | 27.21 |
| " | " | Ther | 88° |
| " | 8 P.M. | Bar. | 27.25 |
| " | " | Ther. | 60°. |

June 21. Travelled on today in all about 18 m. over a broken country mostly very arid. Characterized by ranges of flat topped hills seperated by broad flat valleys, in which there is little or no running water.
A large alkaline lake N Westward during the afternoon.
A good many sections in hills but imperfect & uninteresting showing only stratified sands & clays of the Lignite formation.

Saw roses & bluebells in flower for first time today.

A scout from Crompton at Woody Mt came in this morning & in the afternoon Tompkins appeared. Also Valette one of the settlers there.

| | | | |
|---|---|---|---|
| Camp. | 7.45 A.M. | Bar | 27.27 |
| " | " " | Ther | 68° |
| Halt 11 3/4 m. from Camp. | Noon. | Bar | 26.98 |
| " " " " | | Ther. | 76° |
| Camp. | 8 P.M. | Bar | 27.17 |
| " | " | Ther. | 57. |

Odometer. 7100.

June 22. Arrived at Woody Mt. Settlement & depôt before Noon. The road approaching it being very hilly & tortuous. Only two or three families here now the others being "out on the plains" The settlement consists of a few log shanties in a valley which has a small stream. The latter is pretty well wooded along its banks with fair sized poplar.
Found Crompton & scouts here all right. Have explored a road nearly 80 m. west from here for next depôt. Oats delivered here by Contractor in Montana about 3rd June.
Woody Mt has probably seen its palmy days. Buffalo & Indians already too far west. Most of families speak of wintering next at Cypress Hills.
Capt Featherstone has fixed his station ~~here~~ S of here & hopes to move west about 27th.
Galway has passed on to establish his next.

Wild oxen so called found about here. Have escaped from American forts &c & live on the plains. Winter out & now quite fat. One of parties killed one riding it down & shooting it like a buffalo.

| | | | |
|---|---|---|---|
| Camp. 7 am. | B. | 27·14 | |
| " " " | T. | 65° | |
| Woody Mt. Noon | B. | 26·66 | |
| " " " | T. | 78° | |
| " " 8 PM. | B. | 26·67 | |
| " " " " | T. | 70° | |

June 23. A heavy thunder storm in the night with gale of wind which prostrated several tents. Collected some plants & some land shells in the wooded coulé.
Strong W. wind during day. Calm & fine towards evening.
Crompton & Scouts started this morning to explore beyond White Mud R. for next depôt. East arrived.

| | | |
|---|---|---|
| Woody Int. | 8 AM. | B. 26·53 |
| | | T. 73° |
| | Noon | B. 26·46 |
| | | T. 79° |
| | 8 PM. | B. 26·60 |
| | | T. 63° |

June 24. Reading. Wrote letters home for transmission by 1st train going back. Collected a few plants &c. Day fine.

| | | |
|---|---|---|
| Woody Int. | 8 AM. | B. 26·83 |
| " " | " " | T. 60° |
| " " | Noon | B. 26·77 |
| " " | " | T. 73° |
| " " | 8 PM. | B. 26·88 & 26·90 |
| " " | " " | T. 58°. |

Compared reading with Mercurial Mountain Barometer at 8 PM. Mercurial read 27·07

June 25. Got things packed up & after considerable delay arising from Commissariat Carts &c. also from S. Got off about 10 O'c. Came on on so called S road from Woody Int about 7 m. to a large wooded Coulé where remains of several shanties occupied last winter. Halted for lunch. Capt Anderson who had stayed behind to arrange various matters here caught up. Thunder storm with heavy rain between 2 & 3 O'c. Magazin & travelled till late. The road kept disappearing on the hills & gave much trouble. At length struck into a well marked trail & reached the wooded Creek. Camped, having come in all about 20½ m. Say deduct about 1½ for detours made.
Told that all half breeds of this region now at "big camp" which situated northwards of Cypress hills. Engaged in hunting buffalo. They club together for protection & form as it were a tribe of themselves. As many as 100 to 200 families congregated there now.

Country passed over dry & barren on hills. In valleys & low ground good growth of grass though rarely sufficient to cut for hay.

Sections seen at a distance banks of canal light tint character. Appeared to be very uniform of whitish clay. Plateau forming watershed in some places evidently capped by hard grey sandstones belonging to this series.

Woody Int. S Coln. B. 26·82
" " " " T. 71°

Noon halt. Large wooded Coulé. bottom. B. 26·64
" " " " " " T. 73.

Two readings at different points on height of plateau forming watershed. Second at 5.30 P.M. First about an hour before. B. 26.40 B. 26.44.

Camp. Cvg. of Rlw. Wooded Creek. B. 26.73
" " " " " T. 58°
Strong N.E. wind.

Odom. at Salt 3000
" at Every Camp. 8730.

The watershed passed over is a sort of plateau of which not much now remains. The valleys running N & those going S. seem almost to interlock & give rise to much broken ground below the general level of the plateau. The streams flowing N for the most part if not entirely lose themselves in Salt Lakes &c.

June 26. Got wood cut & loaded up the commissariat carts with it. Got away at 7.5. Travelled on by a pretty good road considering the broken nature of the country & reached Featherstone's Astronomical Station before noon. Found it unexpectedly near the place where the S. road crosses the line, being only about 1 m. East of it. The S. Road goes to Fort W. J. Turner so called which is merely a trading post. Saw two or three antelopes this morning but did not succeed in getting a shot at them. Country passed over worse than yesterday being drier & with wide clay bottomed valleys with much cactus now fast opening its large yellow flowers.

Sections at Camp this morning showed clay with some

impure lignite mingled with selenite. No fossils.

Camp 6 Am. B. 26.74
" " " T 58°
Astronomical Stn. 1 Pm. B. 26.97
" " " " T. 75°
" " 9 Pm. B. 27.07
" " 9 Pm. T. 55°

Odometer. at Crossing of Flowery Creek 2220
" at Astron Station 5600
Total distance by road from Woody Ind to Astron. Station 38. m.

Changed all plants this Pm.

June 27. Afternoon rode down valley of Stream southwards several miles with Dr Hillman. Found a number of new flowers.
The valley wide & open. Clayey bottomed but dry. Often large bare clayey patches. Supports chiefly sage brushes & cactus (Opuntia? with large disk shaped leaves.) The latter in flower abundantly. Flower large yellow (pale) turning orange on fading.
Started 3 sage cocks large birds with general habit of prairie chickens. Had a shot at an antelope at 500 yards but unsuccessful. Saw a large jackass rabbit. & many ducks with flocks of young ducklings on the stream.
The flora & fauna in the vallies approximating to that of American desert proper. The hills with scanty growth of grass & frequent cactus. Often very

Stony.

Sections along E. side of valley. In some places a considerable thickness of beds exposed. Regularly stratified though not always manifest. Consist of dark coloured sombre little consolidated clays in which no appearance of fossils of any kind. Much sandstone lying about but could not ascertain definitely that it belonged to the beds seen. ? if these beds lower than Cl. Sert.
One of men found on hillside a stone containing a large cephalopod like a baculite & evidently Cretaceous. ? if connected with beds in question though found loose. May have travelled some way.

| | | | |
|---|---|---|---|
| Camp at Woody Mt. Astron Stn. | Noon | B. | 26.95 |
| " " " " " " | " | T. | 74° |
| " " " " " " | 8.30 Pm. | B | 27.02 |
| " " " " " " " | " | T | 56° |

June 28 Start on a trip Eastward to visit some much broken country 10 to 15 miles from here. Leave camp at 8 Am. with McDonald & Red River cart. Nelson & Buckboard. Also Ward & Watson photographers & their team & teamster.
Followed the trail by which the astronomical parties came W. along the line. Road follows the valley of stream on which Capt. H.'s astron. station now fixed & crosses two tributaries from the North. Road very bad being hard & very bumpy, also hilly in places & crossings of streams steep.! Red R. Cart wheel which had been patched up yesterday

showed signs of giving way altogether & required frequent stoppages for wedging & tying up with rope. Came about ten miles to where the road crosses the main creek & though had intended to go a mile or two further stopped here on account of state of cart. Arrived about 12.30. Had lunch & fed horses & started off about 2 P.M. with buckboard & photographers wagon. Drove on about 3 m & set photographers to work. Went about a mile further on buckboard examined sections &c. Returned to camp about 6.30.

On way to & out about 9 A.M. saw two antelope & had a shot at 300 yds without effect. Photogs followed over hill & after long chase managed to shoot one. An old buck. Had several shots on arriving at camping place at another pair but without apparent result.

Geology. The country rises into a sort of plateau which is much broken especially along the edges. A mass of steep clayey hills, some supporting no vegetation but seamed in all directions by runnels from rain. The clays & sandy clays of greyish yellow & purple shades chiefly. On some horizons comparatively hard sandstones give features & form cappings to hills. The beds often so thick & uniform as to show little trace of stratification. Much ironstone in thin layers.
Saw no lignites but many red topped hills. The colour caused by clays baked by combustion of lignite to colour & consistency of brick. The tops

yellow hills all about on a level & show evidently that the whole produced by the combustion of one large seam. Must have taken place ages ago as wide valleys now passing & even have been scooped out between them. In the red "brick" found some remains of plants but not at all perfect. In large flat topped hills & N would expect to find the lignite intact which has caused combustion &c over the area now in question.
"Clinker" is found in some places among the red rocks evidencing the mode of formation.

The uplands show an example of a country shaped by rain. The clays being incapable of supporting much herbage wash away into conical or rounded hills which are scored from top to bottom by runnels of water. In dry weather the surface cracks & crumbles. If any capping of sandstone or hardened clays (as by combustion) conical hills formed (like pyramid Butte, Great Canon &c. If not rounded "mud lumps" are produced.

Diagram "mud lump"

The streams in the valleys at lower level have wide beds but are very tortuous & are still widening them &

cutting into their banks. Small ravines run from the main valleys up into the uplands. County has all the aspect so far as I can judge of the "Bad Lands" proper & owes its character to combination of similar circumstances.

Ashton. Station 7.30 Am. B. 27.025
" " " " I. 63°
Camp about 10 m. E. at Crossing of Creek
1 Rlu. B. 26.83 I. 81°
Same place 8 Rlu. B. 26.84
I. 63°

June 29. Set off from Camp about 8. AM. with buckboard & photographers. Followed trail E. for about a mile & then turned north into "bad land" region. Examined hills which showed sections but found time very short. Photographers got a couple of views but not so many as intended the sky clouding up for a thunder storm. Got back to Camp about 12.30 & started back towards Ashton. Station by 2 Rlu. Cart wheel nearly played out & time reached camp. Heavy thunder storm. Picked up two or three new flowers by the way.

Geology. The hills visited today showed much better sections than those of yesterday. Same beds but can see relations here better (See sketch of general appearance) The section in general way as follows.

A. Yellowish sand & sandy clay sometimes indurated in layers so as to form a soft sandstone. Forms tops of highest hills seen. Tops flat & plateau like. Say 50 ft.

B. Clays & sandy clays with thin layers of lignite near the top & beds with well preserved fossil plants. In the lower third bones of turtles? & of some large vertebrate. Much ironstone in thin layers. Beds with poorly preserved plants. Some sand & sandstone showing false bedding & rather abrupt undulations. – The whole from a distance of a purplish-grey colour. Say 150 feet.

C. Lower yellowish sands & sandy clays exposed in brook & lateral ravines. Often nodular in horizontal lines. Could see no fossils. Say 60 to 100 ft.

D. Underlying the last & forming the lower part of sections in brook valley near our camp. Greyish black clays of very homogeneous aspect, but broken up into small fragments wherever exposed to the weather. Found a few fossil shells poorly preserved but of marine aspect. Seen above level of brook Say 40 ft.

The whole to all appearance on the large scale horizontal.

The lignites mentioned in division B. Are on a level with the tops of the red hills spoken of yesterday & confirm previous supposition. There are three beds of 1 or 2 feet each in thickness. Seperated by rather wide clay partings. The lignites themselves not pure. The lignites on the same horizon can be traced by the eye for miles along the higher hills. Where exposed seem hardly able to account for great alteration of strata where burnd out, but probably best & thickest parts have suffered combustion leaving such parts as such. Too poor to burn. The partings preventing access of air &c.
The richest plant-bed immediately overlies the upper lignite. Consists principally Clay. Plants very beautifully preserved but clay crumbling & had very little time to collect.
The vertebrate remains are generally closely connected with the ironstone layers & are often converted into that substance. They are also unfortunately apt to be connected to or partly incorporated in the nodules of ironstone & are traversed in all directions by lines of fracture. Picked up a few which found lying loose & which seemed capable of identification. A prolonged search in these hills would probably reveal localities where the bones are more abundant & better preserved. They occur so far as I know, or as section shows below the lowest lignite some distance.

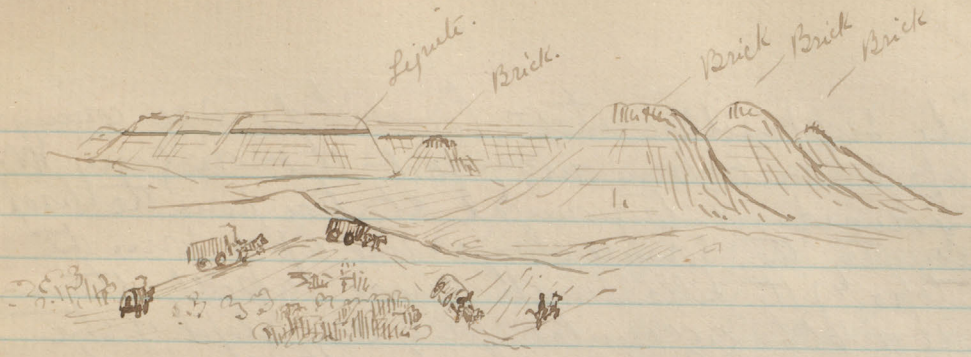
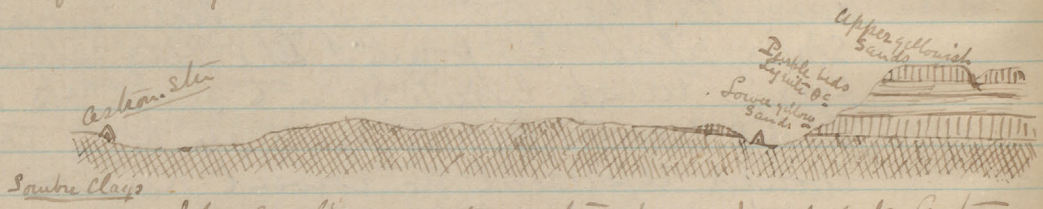



Diagram of lignite bed in distant flat topped hills. Burned out over prepound leaving conical hills with red brick like tops.

The General character of sections in this region appears to point to conclusion (as at present translated) of dying away of lignite bearing series about this point. The beds below those bearing much lignite seem to come up to surface. In this case the lignite seen in hills today would represent the lowest known. & the vertebrate remains would come from lower beds than any seen last year. Perhaps verging on Cretaceous. If this conclusion just should come on well marked Cretaceous should be west of this.

It would appear that the dark clays seen in lowest part of section in Brook today below the same series as the dark & sombre clays so extensively developed in the valley of the Creek at the astronomical station 10 miles west. From marine aspect of few fossils found there sombre clays may even represent the top of the Cretaceous.

The supposition that lower beds are coming up to west bore out by fact that on going W. towards Astronomical station from the broken country the scoriac clays rise up & form the tops of the hills much more rapidly than would be accounted for by any slope of the ground. Sections showing the scoriac clays occur at intervals all the way to prove their continuity. In some places they hold a good deal of selenite.
The same absence of thick lignites characterizes sections seen along traders road & may indicate the edge of the basin in that direction, nearly following the Coteau.




Ideal diagrammatic section from Woody cut. Astron Station to point about 10 m. E.

June 30. Engaged writing up diary & Geological notes. Packing specimens & changing paper of plants. Took a walk with Wilkinson & collected some new plants.
Sent off letter this morning to P. by Howard the American expedition scout who is going to Ft Peck on the Missouri. He has not yet heard anything of the arrival of the party in these

Wyeons & goes to enquire as to their movements. They seem rather behindhand.

| | | | | |
|---|---|---|---|---|
| Camp | 8 Aftn. | B. | 27.10 | Clear fine |
| " | " " | T. | 67° | |
| " | Noon. | B. | 27.06 | Fine small cum. clouds. |
| " | " | T | 76° | |
| " | 8 Mn. | B. | 27.08 | Fine. calm. cloudless. |
| " | " " | T. | 64° | |

July 1. Morning & Evening employed getting specimens packed & put in order. Afternoon rode out with Wilson down the valley fossil hunting.

Geol. By carefully examining the sections of sombre clays in this valley found a good many fossils, clearly proving Cretaceous age of beds. Found many baculites, one ammonite & several smaller forms. They occur in connection with the nodular layers of ironstone which are frequent. The are generally imbedded in the stone. The fossils often crushed but sometimes perfect. Baculites filled with ironstone but retain pearly lustre of shell.
Seems certain that these clays & portion D of sect of 29th June, are the same & that top of Cretaceous must lie at top of D or in yellow sands above it.
The difference of level between camp on Creek 10.m. E of here & this place by comparison of Barometer readings = 0.14 or about ~~130 ft~~ 127

V

The top of the Sombre clays being above the first mentioned clays & the base, so far as seen here, below this camp; & the dip Eastward if any. the thickness seen must be at least 200 ft.

It seems probable that this series may overlie the Long R Shales seen 2. or may form their upper part, or represent them. The nature of the sediment not much different, but the clays less consolidated. The ironstone often septarian. Clays may represent Hector's Septarian clays division C. but in this case according to him would underlie Long R. Shales. (See Palliser P. 226.) These clays seen by him at Elbow S. Saskatchewan qe fn (See Palliser pp. 226 & 54.)

Probably the same division as No 4 (as given in Palliser) of Haydens Missouri Section. Said to be principal fossil bed of region & might very well be in favorable localities from perfect preservation of remains.

Selenite crystals diffused through the sombre clays

Seem to have in Sect of June 29. functions of Cret & Tert well shown.

Division C of section may represent Haydens No. 5 & would not differ much from it in thickness.

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Error of Aneroid Barometer by comparison with Mercurial at this Station.

Add to readings 0·13

| | | | | |
|---|---|---|---|---|
| Camp. | 8 Am. | B. | 27.04 | |
| " | " " | T. | 64° | Wind S.E. Fine. |
| " | Noon | B. | 26.89 | Stray S.E. Wind. Fine. |
| " | " | T. | 88° | |
| " | 8 P.M. | B. | 26.83 | Calm. Fine. |
| " | " | T | 74° | Thunder storms on horizon. |

July 2. Left Camp by 7 Am. with Capt H's party to go West to White Mud R. or Frenchman's Creek. Took only White water wagon & left all heavy things in tent under charge of that part of Capt H's party who remain behind to build mound at the astron. station. Left Red R. Cart also. Sent off note to Depôt man at Woody Nut by Commissariat carts going for oats &c for Capt H's party. Asking 5 days rations of food & oats. Also a new wheel for cart. The carts to meet us in a day or two on their way back.
Travelled W. over a very rough road & arrived at Ashes deserted camp on a Creek 13 m. W of Astron. Stn. about 1 P.M. Camped.
Crossed two other Creeks on the march but none have any flowing water now.
The hills are barren & very dry, the valleys stony or clay bottomed & barren. Some fair pass however along the streams.

Geol. From hill tops can see hills belonging to Eg. Tertiary plateau running from the point I visited the other day W. N.W. & forming the sky line.
Saw occasional indications of the Sandstone claps.

At Valley where camped 13. m. W of Astronomical station. Clays of same series pretty well exposed. but now very much resembling the Long R. Series. Colour not so dark as before & texture somewhat finer. Show well marked white bands produced probably from alteration of clays by decomposition of Iron pyrites. Much shattered & with many rusty faced cracks traversing in all directions. Hold some selenite, generally in fissures. Little or no crystals where seen. Small rusty markings running through the stone exactly like those found in Long R. Shale (? fucoids) Other fossils extremely scarce. Think found some fish scales. Found also one bacculite badly preserved, but showing form of two gasteropods in outer chamber.
May not this represent the Long R. Series, & the bacculite beds, & sombre clays proper of Astoria, this valley &c be concealed between Long R. & Wood Land?

It seems likely that the clay has had a good many fossils originally, as suspicious traces are very common. (as in Long R. Shale) The clay however being non-calcareous? had allowed absorption of lime (white) in the plastic state & filled up the casts of remains. The bacculite found had none of the shell, like those of yesterday, but was merely a cast. Owed its preservation to concretion round it of impure iron stone. The two shells caught up along with it would tend to show that common if only preserved.
Saw no pyrites, but very likely has been sufficient to in decomposing change all the carbonate & sulphate of lime which in the process redistributed.

Many boulders of granite gneiss S.E. in the stream beds & on the fells about here.
Saw one of limestone, weathering pinkish white, but fine internally, in the bed of this creek, which has following dimensions 10' x 6' x 2' 8" neither the length or thickness fully exposed. Indicates great carrying power of ice.

| | | |
|---|---|---|
| Astronomical Station 7 Am. | | B. 26.88 |
| " " " | | T. 77° |
| Camp on Creek 12. m. W. 1.30 P.m. | | B. 26.50 |
| " " " " " | " " | T. 97° |
| " " " " " | 8 P.m. | B. 26.77 |
| " " " " " | " | T. 66° |

7. Am. Wind light E.N.E. Fine.
~~Noon~~ 1.30 P.m. Wind S. Strong. Fine.
8 P.m. Wind which has been veering round all day now N.N.E. ~~fine~~ strong. Fine.
10 P.m. Calm Clear & fine.
A very hot day.

July 8. Left Camp at 7 Am. & followed Ashe's trail toward the West. Country very rough. Cut up by great valleys. Hills barren & stony. Valleys clayey often scarcely supporting vegetation & what is found mostly Artemisia. Trail in consequence very tortuous. Capt Ft. King & some of men engaged running the line.
Came across 4 "wild cattle" about half a mile N of the road. Immediately Chase & Wood no doubt have got one or more, and the scout, who alone

was mounted, headed them off as he should have done. As it was managed to surround them on the S. & E. when meanwhile people to them within 300 to 400 yards they began to walk off quickly. Firing commenced but most of men being very bad shots they got away, quickening their pace to a lumbering gallop. One appeared to be slight wounded & ran rather lame.
Found ashes old camping place on the Eastern bank of White Mud River. Camped. Had lunch. Started with Dr Mullman & Nilson at 1.30 to ride across the valley to some good sections seen at a distance. The valley very deceptive though looking steep sided & very broad from the bank gives no idea of its real character. Constantly encounter clay banks so steep that almost impossible to ride down them, & often encumbered by masses of boulders from drift. Lateral gorges & ravines ramify in all directions & cut ditch-like through the shales & clays rendering great circuits necessary. The banks of the stream itself, which is exceedingly tortuous, are difficult, often being sheer cliffs of shale. The stream is a large one & the water though with the prevailing muddy tinge, good.
The rough character of the banks of the valley increased by numerous land-slips which have brought the upper beds down varying distances & left conical hills & ridges innumerable.
Though a strong wind blowing on the heights many of the hollows almost perfectly calm & riding among clay banks & cliffs almost or quite destitute of

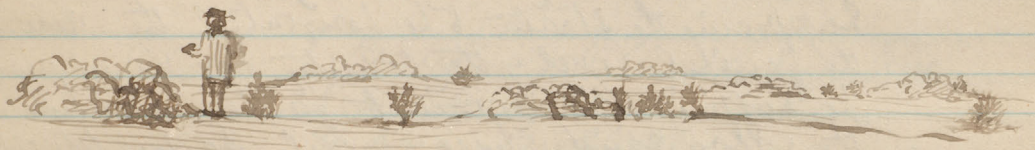
vegetation with the thermometer considerably above 90° in the shade, no joke.
White Mud R, also called Riviere blanche or Frenchmans Creek & well known among half-breed traders &c. Elk must have been very abundant here at one time. Saw a great many ~~horns~~ antlers lying about in different parts of the valley. Saw also traces of recent slaughter of buffalo. Many jackass rabbits. Crompton explored this valley before our arrival at Woody Mt. & reported it utterly impracticable for crossing of carts near the line. Ashe seems to have found same thing & made detour to N. Crossing. We shall have to go back eastward to get out of range of lateral coulées & then strike N Westward to Traders Road running W. from Woody Mt. & cross the White Mud at a favourable place some 15 m. N of the line.

This season must be an exceptionally dry one here as I notice that where grass has ripened seed last year on the hills, this year it is showing no flower & even the leaves are scarcely green.

Geology. The tops of the banks on both sides of the valley of the White Mud are formed of yellowish sands, in places hardened into layers of sandstone & nowhere very soft. Land slips have brought these sands down to various levels, but their original position can be clearly traced on both banks & as far up & down the valley as can be seen

I could find no fossils in these beds, of which 60 or 70 feet must be visible in places.
Below these come dark clay & shale beds which have a very uniform appearance from top to bottom, & go down to the level of the water in the creek. They must represent the sombre clays seen E. of this. No part of section resembles exactly the shale banks seen in the brook 7 m. E. of here which bore so close a resemblance to Long R. shale. However I think the whole must belong to one series, unless indeed the shales resembling those of Long R belong to a lower part of section than any exposed here.
The sombre clays in this valley like those at the astronomical station hold layers of impure ironstone. The nodules are however much bigger being often 12 or 15 feet in length. Septarian & holding Ammonites & Belemnites, some of the former about 2 feet across & belonging apparently to the Clypeiform group. They cannot be preserved entire on account of the numerous cracks which intersect them. The shell still remains & preserves in all its beauty the nacreous lustre & play of colours.
The nodules are so large that where the clays are washing away on the gentler slopes they remain as hummocks of broken & sheltered brown stone, giving a peculiar appearance.
(The nodular part of the section is chiefly confined to a layer about 2/3 rds up the series, from the river etc.
(The large size & septarian character of the

concretions seems to favour the idea that these beds represent Pectoro Septarian clays. See also notes on similar septaria seen at Pembina Int Astronomical station.)



Weathering away under rain of the nodular clays.

About 100 feet below the base of the yellow sands found a layer characterized by occurrence of Ostrea in great numbers. Also by fragments of inoceramus. Collected a number of the former. Many of them are perfect with both valves lying together showing evidently that they died where now found. They were most abundant on a slope of bare crumbled clay at the foot of a hill. The clay had been drifted smooth by the wind & it required little imagination to suppose that one stood on the actual beach where the shells had been thrown up.
Much selenite in the sombre clays as here developed & in some places horizontal white streaks like those described in the valley of Mr. East.
The fibrous mineral also occurs here in quantity forming layers parallel to the stratification, & to which the fibres stand at right angles.

discontinuous

The upper beds in this valley must represent division C. in Section of June 29.

The thickness of the sombre clays as determined by aneroid (Mean of two obs.) from the water level to the bottom of the yellow sands about 273 feet. (0.30 Bar.)
Supposing the strata to be horizontal the rise in the general level of the country would appear to be sufficient to account for the recurrence of the yellow sands here, nearly 30. m. W. of their first appearance.
The Camp, which is situated a short distance down the Eastern slope of the ravine is 0.34 Bar above the stream (White Mud) or about 309 feet.
The camp, by the mean of 7 observations at each place, is 445 ft (0.49 Bar) above the Astronomical Station 19. m. E.
The water in the White Mud being therefore 136 feet above the astronomical station.
The bottom of the yellow sands are here therefore about 409 feet above the Astronomical Station where first seen 10. m. E of the Astronomical Station they were about 170 feet above the level of that place leaving a dip amounting to about 239 feet in the 30 miles from here to the broken country visited June 28 & 29.

Camp on Creek 13. m. E of Astron Station
7. a.m. B. 26.94 Calm Cloudless
T. 67°

Camp E. bank White Mud R near line.

Noon B. 26.61 Stray S. wind. Clear
T. 91°

1.20 Rm. B. 26.52

Water in White Mud R. B. 26.83 at 2.10 Rm.

Top Sombre days on W. Bank. B. 26.50

Water in White Mud R. 5. Rm. 26.79

Camp. E. Bank White Mud R. near line

5.30 Rm. B. 26.41

8. Rm. B. 26.47 Wind S. dying away
" T. 84. partly cloudy.

Two antelopes Killed today. One by Sapper Watson & one by Carvele.

July 4. Occupied changing plants & writing up diary. Also walked out & examined some exposures near here without however finding anything remarkable.

Men dug up a couple of indian graves today. Piles of stones on a conspicuous ridge. Found in one some remains of bones of a child & one bone bead. In the other discovered nothing though from hardness of ground & number of imbedded stones difficult to explore thoroughly.

Found ripe strawberries in sheltered grassy valley today also Amalanchear berries nearly ripe.

Stuart called attention to curious star on night of second. Looked at it with telescope & saw

that evidently a comet. Could not see it last night as cloudy, but tonight clearly visible forming the lower angle of the base of an isosceles triangle of which the pole star is the apex, & the most northern pointer the other basal angle. In my sketch made night before last & to be twisted must be approaching the sun. It also now appears to be brighter & to have more visible tail. Brightness of nucleus remarkable being equal to star of 3rd magnitude, & the light quite concentrated.

Camp. White Wind R.

| | | | |
|---|---|---|---|
| 8 Am. | B. | 26.47 | Cloudy, clearing, wind |
| " | T | 82° | S.W. |
| 12.30 Pm. | B. | 26.53 | Cloudy. Strong |
| " | T. | 80° | S.W. wind. |
| 8 Pm. | B. | 26.71 | Clear. Wind W.N.W. |
| " | T | 66° | dying away. |

Geol. The part of the section of dark clays most resembling those seen in the B. M. Valley further E., & the Long R. Shales, is situated almost immediately below the yellow sands. In this comparison is just the Septarian clays occupy a somewhat superior position as they do at Section at Pembina at Astron. Station, & as Hector makes his Septarian clays to do (I think)

July 5. Capt. Lt not yet done, the line crossing the valley obliquely & great difficulties being encountered. Our rations up today, so thought best to start E. again & meet the cart coming down from Depot at Woody Int.
Intended to make early start but horses stray, & various delays prevented getting off till 9. Came on to 13. m. Creek where stopped for lunch. Started again at 3 Pm.
Saw a young antelope & shot at it without effect. Saw a number of young foles playing round a hole & several old ones at some distance. At the crossing of the wet Creek came on the same band of wild cattle met with a few days before. (4) Mc Donald mounted, Nelson hastily unyoked Jerry from buckboard. Duckworth & I crept up behind bells while the others went to head them off. Mc Donald & Nelson shot at them several times & wounded some slightly. After a run of about half a mile, during which they did not come near us, the became moderately tame & Duckworth & Mc Donald herded them along the road without difficulty. Having crossed the valley in pursuit I walked on expecting every moment the buckboard to catch us. Nelson however thinking I was still behind waited a long while & I walked on carrying my rifle till we came to the remainder of Capt. Lt's party camped on traders Road between Lt Turney & Woody Int. The day very hot & the walk long.

The oxen were herded into Camp easily enough but the difficulty now was to tie them up & secure them. Hearing that Lieut Green & the U.S. party were camped at the Astron. station a mile & a half further on, got the buckboard, now arrived, unloaded & went to see them, & so missed the sport with the oxen. They finally became quite furious, one large bull tied up broke away & rocked Buckwoot down, fortunately without hurting him. Then all dispersed & disappeared in the twilight. The men scattered in pursuit & finally shot two not very far from camp but on opposite sides of it.

Green supposes Gregory by this time to have established his station W. of White Mud R. Zerincy with or Cones are following up the mill R. to the line. Got back to camp before dark.

Got a note from Boswell dated July 3. Woods hut, stating that he & Herchmer had arrived also that Rowe not much better when they passed. Burgess recommends him to go to New York for advice. Enclosed a note from P. & a letter from W. The former dated May 27 & stating that Report at last out.

Geol. Census of diff pebbles in bed of brook at Creek 13. m. W. of Astronomical station.

Limestone weathering white 78.

4

Granite, gneiss & similar highly metamorph. rocks. Probably Laurentian. Much white felspar a notable feature 101.
Garnetiferous gneiss. (two with much black mica) 4.
Quartz, crystalline 6.
Chert. 2.
Crypt. hornblende & felspar rock 3.
Soft yellowish sandstone (local) 5.
Fragments of crawfordite nodules (local) 18.
Blackish hornblendic & felspathic rocks some might be called diorites. Probably Huronian. 15.
"Quartzite" or "Siliceous pebble" drift. Some almost homogeneous, some still saccheroidal. Some almost chert in character, others banded with black often strat lines. Colours brownish yellowish, purplish, blackish-grey. ~~xxxxxx~~ 159.

Some fldge may possibly belong to lower coloured strat. & sandstone but cannot be seperated.

Iron discript 3.

Some saccheroidal pebbles of Quartzite drift resemble exactly the stone called "Coarse light-coloured quartzitic sandstone" in E. Sowris Census.

Sections in Pampkin Creek of last autumn showed Quartzite drift almost distinct from all other. Have seen none such this season, but some in which fragments from all sources mixed, & with local drift.

The quartzite drift has very generally quite the appearance of beach shingle, being well rounded & polished & not showing any evidence of glaciation.
The largest bowlders are always of granite, gneiss or limestone & the latter often have well preserved glaciation.
Notwithstanding the shingle character of the siliceous pebble drift it must be ice borne & belongs to some formation unknown to me. It may come like the granite gneiss from the Northward & be prevalent on the heights S of the Coleau & on the coleau itself from circumstances of elevation of source, or some other reason; it may come from flanks of Rocky Mts to West.

Siliceous pebbles never attain size of large bowlders

The pebbles in the drift everywhere from Lake of Woods to this point are almost invariable crusted with carbonate of lime, a circumstance doubtless due to the abundance of limestone fragments.

Camp White Mud R. 8 A.m. B. 26.81 S.W. Light.
" " " " T. 68° Clear.
13. m. W. Camp on creek. 1.30 P.m. B. 26.87 S.W.
" " " " T. 80° Cloudless.
Camp 2. m. W. of Astor Stn. 9.15 P.m. B. 27.00
" " " T. 64°
Calm clear.

July 6. Occupied changing plants & packing away three finite dry. &c &c.
Found on arriving here yesterday that Red R. Cart had been broken past repair in moving my heavy stuff to this camp. Got the remainder brought into camp. Capt Th & party arrived about 4 Pm. Discussed situation & finally decided that best to go round by Woody Mt for a new Cart. As all stuff cannot be crowded into waggon got Capt Th's people to take some not immediately needed & to leave it for me at White Wind R in case of my not catching up, which it is hardly probable I can do when making such a detour.

Camp. 2. m. W of Astron Mt

| | | | |
|---|---|---|---|
| 8 Am. | B. | 26.85 | Calm clear |
| " | T | 79° | |
| 12.30 Pm. | B. | 26.81 | wind light variable. |
| " " | T. | 88° | |
| 8.45 Pm. | B. | 26.87 | wind light S.E. clear. |
| | T. | 74°. | |

A very hot & close day.

Lieut Greene & party left W. via St. N.J. Turner this morning at 4 Am. Capt Th saw Gregory & party camped on W. bank Frenchmans Cr. or White Wind R. this morning.

July 7. Left camp. 5:30 A.M. with Capt
The party & travelled N on the road to
Woody but as far as the wooded coulee
Halted for lunch. They continued along the
road for some miles before Capt. Ch. turned
off N.W. to strike the road to White Land
Depôt. Travelled on to Creek 7 m. from
Woody wt. Then being anxious to reach there
to see about getting a new Capt tonight. Took
the horses out for a few minutes, gave them
a feed of oats & then went on. Arrived
well before dark having come 32 miles.
Found Boswell at Depôt which otherwise
nearly deserted. The half-breeds have all
left taking their carts with them & seems
impossible to replace mine.

The broad disc leaved Cactus has now almost
ceased flowering having been at its best only a
very short time. Many of the plants are covered
with a white mildew certainly not owing to
the dampness of the season.

Geol. The improvement of the appearance of the
country on passing from the Souhre clays to
the Cretaceous platform is remarkable. Bare
everywhere frequently marl in situ. The bad effect
of the U.S. fels which I correlate with the Souhre
clays has been already observed (I think) in
Hayden's exploration.
In examining the bank at Noon halting place 19 m.

S. W. of Woods Hut found several seams of lignite besides that already mentioned on past West. The precise thickness cannot be ascertained as none are at present. The lignite & associated clays turn out copious springs of good water, which has however a very slight sulphurous taste. It seems very cold this hot weather though only showing 46° F.

X

The Tertiary Series as evident the same here as where seen in the Bad Lands (a m. E. of Ashton Station). The purplish Clays are the lowest beds seen & in them the lignites occur. Yellowish Sands cap many of the hills.

Camp 1 m. W. Pleistocene Stn. 5.30 a.m.
B. 26.89 wind light N.E.
T. 69° clear.

Room Lect. Wooden Coule 17 m. S.W. of Woods Hut.
B. 26.34 wind S. Thunder clouds.
T. 90°

July 8. Heard that two old carts remained near the half breed houses, which they probably thought to poor L. Cake on. Thought however that might be better than nothing. Examined them & took the best. An old stager mended up with poplar, the axle & much of the wheels being of that wood. Also scientifically bound with shaganappe in many places. Occupied some time getting it put in a little better repair

Evidence great Quantity of Cambrian overlapping Laurentian.

The period during which the greatest distribution of Cambrian was taking place may have been that just previous to the formation of the Coteau or while its ~~earlier~~ lower parts were being formed. Dr Hector observed near the elbow of the Saskatchewan a remarkable ~~group~~ line of boulders of Eastern Cambrian crossing the Country in a ~~line~~ direction parallel to the Coteau to the West. "This line" he writes, "has been observed at points 30 & 40 miles apart. The consist of great angular masses, consisting of several of the beds of limestone, the coherence of which being very slight proves that they must have been stranded without any great violence" * One of the blocks was estimated to contain over 3,000 cubic feet of stone.

~~Dr Hector~~

* Palliser Expl. p. 220.

west of Long. 96° 30' Coniferous
trees are not found in the vicinity
of the ✱ forty-ninth parallel, with
the single exception of the mountains
known as the Three Buttes — till the
immediate flanks of the Rocky Mountains
are reached. The oak does not appear
west of the 102nd Meridian. Beyond this
there groves are found they consist of the
various species of poplars or cottonwoods,
the Negundo, & occasionally elm, & birch.

& arranging other little matters. Left two boxes specimens addressed to Dufferin, but if no chance in that direction offered, the depot moved west must not be abandoned but brought along with it.
Red River country carts are little use in this part of the country to anybody but the half-breeds. When broken there is no hard wood to repair them. & from the stony & rough character of the "roads" breaks are necessarily frequent. The sand & grit also rapidly wears away the axles, unless iron bushes are used, & then a poplar axle has to be substituted at risk of break down any moment. The extreme dryness of the air causes them to split & crack in all directions, especially the hubs & when this happens the spokes work loose & nothing will save the wheel. By keeping the wheels always wet this may be avoided but water is scarce! With the half-breeds time is no object & cheapness everything. They put on light loads & travel in large trains so that if one cart breaks down its load may be distributed & the fragments retained for future repairs.

Left woods out at 10.30 & came about 4 m. to a coulée in which a good spring. Last wood also here. Lunched. Set out again & travelled till nearly dark, not finding water at proper camping time. Water found only pools with a strong saline taste & repulsive yellowish colour. Saw next morning that if we had come about ~~half~~ a mile further would have got good water

The country passed over is pretty well grassed & has the appearance of lowly lying the Lig. Tertiary or resting on a good thickness of drift. Mt-Sorrenfat resembles the Coteau foot-passed along on the Traders Rd. & of Woody Mt. A ridge (Coteau?) some miles to N. A second broken edged ridge or plateau point (probably Lig tert uplands) to S. Many coulés now nearly dry running across the track Northwards to Niveland. Saw no good exposures, but probably nearly all may be put down as Tertiary.

Woody Mt. 8. Am. B. 26·67 Wind W. Clear.
T. 74°

4. m. W. of Woody Mt. Noon B. 26·62 Wind W. Clear
T. 79°

Camp 23. m. W of Woody Mt. 8.30 Pm. B. 27·16 clear
T. 60° Calm.

July 9. Did not get away from Camp till 8.30. About 4½ m. West found Capt-S's road joining in. A note to say that he had arrived there at 8.30 the previous morning. Stopped for lunch after having come 11 miles at the usual style of Creek. viz a great wide valley with a little deep ditch meandering in the bottom & some muddy pools of luke warm water in its bed. Found that Tent had fallen out of wagon & had to send Nilsson back for it in the buckboard about 4. miles. Camped for night about 45 m. W. of Woody Mt.

near a swamp with good ~~water~~ grass & a creek with pools of good water.

The grass-hoppers for the last few days very numerous. Now well able to fly & may be seen passing along in the direction of the wind in that part of the sky near the sun, at great heights. When rising from the ground & flying back with the wind in ones face inflict painfull blows, especially when they happen to light in ones eye. Their appearance in passing before the sun more like drifting snow-flakes than anything else.

Geol. Seen dark coloured bank in valley where made Noon halt. ? If it might be a tongue of sombre clays coming in from N.
The ridge to S & N state apparent, that to S. tending southwards.
The country latter more arid than that passed over yesterday.

Spot would be about 34 m. W of woody nut.

Camp. 23. m. W. of Woody nut. 8.30. B. 27.33
T. 72°

Noon. 34 m. W. of Woody nut — wind W. Clear
B. 27.15 wind
T. 75° W NW. Strong. Clear.

Camp 45. m. W of Woody nut 8. Pm. B. 26.79 Calm
T. 55° Cloudless.

The watershed between valley running N wards (the waters of which probably all loose themselves or empty into alkaline lakes) & those running S wards must lie near this evening Camp & probably between 100 & 200 feet above it. Its general direction must be about W.N.W.

July 10. Got off at 7.40 & travelled on over rather hilly roads to a large ravine where stopped for lunch having come about 12 3/4 miles. Found numerous interesting Cretaceous fossils here.
Reached White Mud R. Depot about 6.30 P.M. After a long day, heavy made about 25 1/2 m. Found only Depot man & one other man here. Depot tent & one H.B. Tent. Capt Hallerstone started west yesterday afternoon heavy made very good time to depot. Ox train also started W at same time. Campbells waggon train expected in from W. to load up & go W. again.

The valley of the White R is here very broad but the banks much reduced in height as compared with where it crosses the Cin. Also not of same precipitous character but mostly covered with sparing growth of grass. Bottom of valley a great clayey flat of usual character covered with bunches of Artemisia & with lower parts & old river channels grassy.

Geol. Ravine 6 3/4 m. W of Camp (say 51 3/4 W. of Woody) but shows where upper parts of banks at

all bare; yellow colour almost too definite for drift. Perhaps indicates presence of yellow upper Sands of Cretaceous.
At 9. m. W. of Camp on high ground a small exposure occurs showing yellowish & greyish strat. sandy clays more resembling lig. Tertiary than Cret. Could find no fossils. May be a tongue of Tertiary coming from the S. if yellow sands really appear in valley to East. Or if appearance of yellow sands disregarded may be about the western edge of the Cig. Tert basin.
In Cave valley 12½ m. W of Camp & about same distance from White Wind Depot, where stopped for lunch, found characteristic exposures of Scrubre clays with same colour, gypsum in crystals, the peculiar fibrous mineral in one place forming a discontinuous layer nearly a foot thick, associated with impure crystalline & all usual concomitants. The Erbystone (? how much iron) filled with baculites & many other fossils. Collected quite a quantity. They resemble exactly the fossils which I have seen from the Missouri in appearance & mode of preservation. The nacre of the Cephalopods is well preserved. The stone encloses easily split & leaves fossils clearly. Altogether the best locality for collection of fossils yet found & deserving of more investigation.
About this place the country again begins to be very arid & the grass poor. This ~~too~~ does not come on suddenly so as to show definite edge of Scrubre clays as there is a considerable coating of drift. The same cause may operate in preventing the long R. & beds which I at present correlate with those

from fairly bad character to country there.

A section N.S. through the country N. & extending from S. Elbow of Saskatchewan to line would be instructive.

Camp 45 m. W of Woody Cut. 7.30 Alt. B. 26.87 Wind light
T. 68. S.W.

Noon 12½ m. E of White Hand. Valley bottom B. 26.76 S.W.
T. 84° Clear.

White R. Depot. 8 Pm. B. 26.88 S. Light. Clear.
T. 72°

July 11. Had intended to start W. about 1 Pm. to make half a days march, but Campbells train arriving with intention of starting tomorrow morning put off leaving till that time. Occupied writing up notes, pressing some plants, wrapping up fossils &c. Campbell brought in a copy of Crompton's 2nd reconnaissance showing route to next depot. Reports that he saw thousands of buffalo about a days march W of here. Also Indians. The latter it appears are trying to lead off the buffalo which are moving northwards, & drive them down towards their hunting grounds on the Missouri. The Indians are Sioux. A large party of them it seems came down on Ashe's party, who were obliged to give them flour, matches &c. to some considerable amount. They might have "gone through" them to a still greater extent but for the timely appearance of Campbells train.

Geol. Examined a bank near Depot which shows a somewhat poor exposure of Lowhee clays with no fossils.

| | | | |
|---|---|---|---|
| White Mud R. Depot 8 Am. | B. | 26·85 | wind light |
| | T. | 75° | S.W. Clear. |
| Noon | B. | 26·62 | wind light |
| | T. | 95° | Clear. |
| 8 Pm. | B. | 26·74 | N.W. Clear. |
| | T. | 70° | |

Odometer record from Woody Cut to White Mud River Depot.

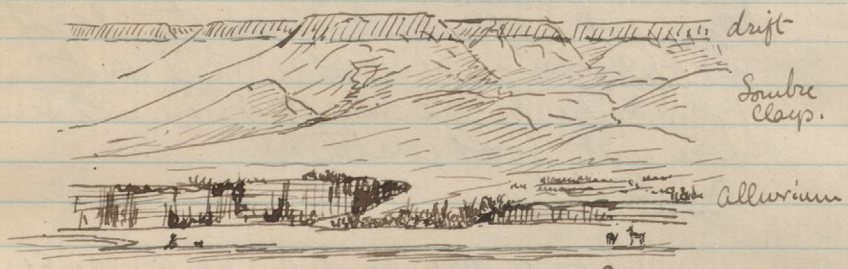
July 8. Springs & wood 4 m.
3320 Creek nearly dry
5090 Pools with water
5470 Creek water in pools
6020 " " " "
6870 Creek. No water
9400 △ water in pools. not good.

July 9.
420 Creek water in pools
600 Creek. Good water.
1840 Capt Featherstonhaugh's road joins in from S.
4527. Noon halt. Creek water in pools.
9100 △ Swamps with rushes. water bad. Good water in pools in creek 200 yds S. or 1/4 m. W off road

July 10.
2700 Ravine with yellowish banks.
exposure of grey & yellowish sands about 9 m. W of camp.
5535 Large valley. Creek. water in pools. Noon halt. exposures with fossils.

10345 White Mud R. Depot.

Distance in all by odometer. 71 miles




Diagramatic Sketch. White Mud R. near Depôt.

July 12. Left the Depot with Campbells waggon train at 6 am. making a party of 10 waggons 1 Cart & 1 buckboard in all & 15 men. Saw several antelope during the days march. Grasshoppers innumerable, can be seen near the Sem filling the air & hovering in dense clouds over all swamps & green places. When rising from the ground make a noise like the distant sound of surf, or a gentle wind in trees.

After leaving the valley of the White R. continued till about ten miles from the Depot passing over hilly country. Then came down on a great gently undulating prairie which continued as far as todays march. Crossed the two branches of Cottonwood Coulé, but the valleys

are not of great size & have gently sloping banks. Water only in pools. The country on coming down on the prairie appears much more favourable & but for the exceeding dryness of the year would be covered with a rich growth of grass.
Camped 27¾ miles from the Depôt beside a stake on which Capt. A. had written 500 m. from Dufferin & 2. m. W of line. A small lake here with good water.
No Sections.

| | | | |
|---|---|---|---|
| White R. Depot. 6 Am. | B. 26·81 | Wind N. | |
| | T. 61° | light. clear. | |
| Halt 12. m. W. of Depot. Noon | B. 26·48 | Wind light. | |
| | T. 81° | variable. clear | |
| Camp 500. m. point. 8 P.M. | B. 26·71 | Calm clear. | |
| | T. 66° | | |

Odometer at noon halt 5000. small swamps
Odometer at 500. m. lake (No 1. on sketch) 11235.

July 13. Saw a camp at some distance S.W. last night & this morning distinctly heard the drums of the W.S. call about dawn.
Left Camp 6·45 Am. & travelled about 12 m. Halted at a swamp till noon. Came on about 5. m. & then Camped there being a stretch ahead of 12. m. without water & that too far to go over today.

For 4½ miles from last night's Camp the road

passes over the gently undulating prairie, which however becomes more markedly undulating westward & then terminates against the foot of an area of elevated & coteau like country. The latter which extends as far as ~~two camp camps~~ we have yet gone consists of abruptly undulating hills often stony & with many small lakes & swamps now mostly dry. Great numbers of buffalo recently killed strew the country & in some places still pollute the air. Half-breed & indian camping places are also frequently seen. marked by circles of lodges. Bare places & heaps of ashes where fires have been. Also heaps of broken bones reduced to about the size of road metal which have been boiled to extract the fat for pemmican making. Piles of buffalo chips are also frequent. This being the sole fuel of the region. It is quite abundant & makes a good fire, especially with a little wood to start it. We depend entirely on it for cooking being now nearly 100 miles W. at of wood.

Country also becomes more arid

Camp. 500. m. point. 6.45 Am. B. 26.74 wind E.
T. 60° light. Clear.

Noon halt 12. m. W of 500 m. pt. B. 26.27 wind S.E.
T. 85° clear.

Camp 17¼ m W. of 500. m. pt 8 Pm. B. 26.13 W. N. W. gale.
T. 79° partly cloudy.

Odometer.

1920 U.S. road made this morning comes in from S.E.

2940 U.S. road turns off S.W.
1/4 m. further Lt Galbraith's track, (following Traders Road which here crosses) comes in from S.E.
Here two Eastern edge of coteau like uplands.
4.910 Noon Halt. Swamp.
7.00 Camp. Swamp. nearly dry.

No Sections.

July 14. Left Camp by 6.30. Night has been exceedingly windy throughout, though clear & fine. Setting out at twilight aps grows about 2 Am. Saw the Comet beautifully half enveloped in a faint auroral arch, below which the reflection of lightning flashes occasionally seen.
Travelled on over hilly & slow roads to Lake 2. 11 3/4 miles from last night's Camp & at the 524 m. point. Howard U.S. scout came in while halted & gave information respecting movements of parties. Also said that U.S. Camp had killed 15 buffaloes yesterday.
Passed a large salt lake during the march this morning which under the violent wind assumed the appearance of milk. The pure mud & salts had been stirred up. This lake & the one at which halted lie in same great valley opening Southward & through which now no stream flows.
Had some difficulty in finding Capt Leatherstone's Camp he having placed it about a mile S of road. Showed him the map & got back some of his things he had carried.

Set out on backboard to rejoin train now far ahead. Soon met Spence one of Capt Fs scouts with a cart coming back from East Fork Depot with supplies. He said he had seen three Indians close at hand who had run after him but not close him any harm. Drove on & soon saw two horsemen at a distance. On catching sight of us they set off at full gallop in a direction to intercept us & soon became concealed behind the hills. Thought it best to put rifles in a conspicuous place that they might see we were armed. They came on the road just as we caught sight of the train & turned out to be two wild looking half-breeds with rifles slung over their backs. They asked about Valette & Woody but gave them all the information I could.

About the 534. m. point came suddenly to the western edge of the patch of Cottonwood country. Saw the Three Buttes distinctly though must be 100 miles distant. Also the Little Rocky Mts. Subtending a large angle to S.W. They are about 60 miles distant & look very ridgy & rough.

The broken country ends with a distinct escarpment which seems to run N. & westward.

Saw three or four buffalo about half a mile S of the road, but did not go after them as so far to camp & should happen to kill one. Saw soon after a large bull at 300 yds & was going to try a long shot when he caught sight of us & went off at a rapid gallop.

Met Grant another of Capt Th's men who had been

to depot returning with two or three things packed on his horse's back. His cart having broken down. Soon after saw an indian on horseback, he approached but with great caution. & when not repulsed followed us to camp, watched operation of camping with great interest. Stayed long enough to have something to eat & then went away. His pony had a very sore back. The Indian a young fellow & said he was a Dacotah.

Camped at Smale creek with a little water still remaining in pools at the 538. m. pt having travelled nearly 26 miles.

Geol. (See todays note for description country of) The western edge of the Coteau shows at some distance N. of the road exposures of whitish, reddish, & grey beds. They as a whole resemble those of Sig. Tert. as seen from a distance. Time unable to visit them. The colours however appear more marked. The red appears to occupy a broad deposits zone but may only arise from burned out lignites. The white is paler than that of most beds of Sig. Tert.
The upper beds appear white, next below red & reddish & those underlaid by grey & yellowish stratified clays resembling exactly those of lower part of Sig. Tert. On the whole inclined to put whole plateau from about 507 m. pt. to 534 m. point down as due to outliers of Signal Tertiary.
Up So. Stoddard and Sanborn clays exposed again Shortly.

Camp 516 miles pt. 6·30 Am. B. 26·57 Gale from W.
T. 69° Clear.

Noon. Halt 524 m. Lake. B. 26·57 wind N.W.
T. moderating clear.

Camp 538 m. P.L. 8 Pm. B. 26·80 Cloudless
T. 66° Calm.

Odometer at Noon Halt 4800.
(Lost count of distance & gave down to Capt Th's Camp).

July 15. Started at 6·30 Travelled West over the same wide flat plain covered only with Cactus & Sage bush with a little dry grass. Road hard as iron the ground being composed of hard sandy clay & fissured in all directions. The level of the country rises somewhat on approaching the East Fork but without improving in character.
In passing through the patch of Colean hills to the Eastward of todays march the country was of somewhat better character, there being frequent swamps with grass, & no appearance of Cactus.
The East Fork of the Milk River on which the Depot is situated flows in a valley with nearly precipitous banks but not more than 50 feet below the plain. There is still running water in the stream but it is drying up very fast, like all the streams or pools in the country.

Geol. In the valley of a brook about 6 miles E. of the East Fork good sections of drift, but nothing of underlying rocks could be seen. The drift brownish or greyish in colour & with many stones of all sorts imbedded roughly in it. Some appearance of imperfect stratification, & many of the stones glaciated. Found here fragments of Cretaceous ostrea, crystals of gypsum showing that a great part of material derived from the Lignite clays & that it cannot be far removed from its original locality. Found also some angular fragments resembling true coal & differing from the lignites so far seen. They may be derived from the North.

Found ashe & party at Depôt. Capt A. arrived from West this evening. Visited Capt Feilden & Dr Lowe, & others of American party who are camped near here.

| | | | |
|---|---|---|---|
| Camp 538 m. point | B. 26.93 | wind light. | |
| | T. 61° | W. clear. | |
| Noon valley of Cr. 543 m. | B. 26.87 | SW. clear. | |
| | T. 80° | | |
| Valley E. Fork Depôt 8140 Pm. | B. 26.975 | Calm | |
| | T. 68. | Clear. | |

Odometer. 1100 Creek Some water in pools.
1300 " " " " "
2070 Creek. water?
3270 " Good water. Noon halt.
6980 East Fork Depôt.

July 16. Day very warm. Examined clay banks in vicinity of depot. Got various little things put right. Visited U.S. Camp in evening. Great numbers of Grasshoppers in the valley. Found a few small molluscs in the stream but none living & all indeed with a rather waterworn appearance.

Camp East Fork Milk R. Valley.

8 A.M. B. 26.87 S.E. Cloudless
T. 72°

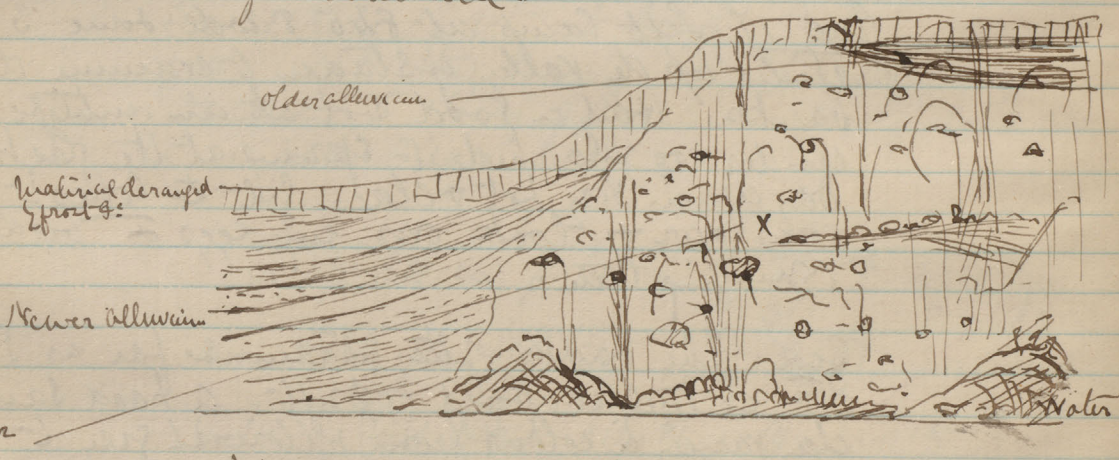
Noon B. 26.29 S. Light. Cloudless.
T. 92°

8 P.M. B. 26.58 Light N.E.
T. 65° Clear.

July 17. Left Camp at 8.45 & rode some 3 miles up the valley of stream to examine the banks. Had a good shot at an antelope under 100 yds. but it sprung at the flash. Day again very hot & clear. Got the Cowes to come over & look over my eggs & birds. Warning them.

Geol. The banks of the stream so far as I can see entirely composed of drift. A hard sandy clay varying in colour from yellowish grey to bluish grey & with rusty cracks traversing it. On weathering banks has a tendency to assume vertical forms & a rude columnar appearance. Seems plain to have been moved subsequent to deposition. Stirred up as it were.

stones are scattered irregularly through it in all positions though here & there some appearance of horizontal or false-bedded arrangement. The stones, some of which might be called boulders, are of the usual highly metamorphosed rocks, mingled with "quartzite" pebbles, limestone, ironstone, selenite, & fossil ostreas & cephalopods from the Cretaceous Shrubre clays. Also lignite & fragments more closely resembling true coal. Many of the fragments of rocks are well glaciated & the whole has the appearance of very heavy ice action. It would seem that this boulder clay has been formed by the poaching up of the Shrubre clays pretty much on their original locality & the admixture of its materials with foreign drift material.




Diagramatic section Boulder Clay banks in East Fork Mill R. Valley. Showing River alluvium of two different ages & present level of water.

Camp E. Fork Milk R.

| | | |
|---|---|---|
| 7.40 Am. | B. 26.22<br>T. 79° | nearly calm. |
| Noon | B. 26.44<br>T. 96° | wind NW. light<br>clouded. |
| 8 Pm. | B. 26.43<br>T. 84° | SW. Thunder<br>storm near. |

July 18. Left Camp about 8.45 & travelled on to Creek 6 miles W. Stopped to examine some sections & lunched before going on. The geology proving interesting. On returning from measuring the section found that Stuart had shot a yearling antelope a steak from which was very acceptable. Antelope exceedingly numerous about here.

Started again at 2 Pm. & went on to the West Fork 14¼ miles from the E. Fork & the road. The W. Fork does not occupy so deep a valley as the E. Fork & appears to be a smaller stream, though water still abounds in large pools. The banks which are low show only drift deposits. In the valley several trees of Negundo aceroides with stems more than 18" diameter but very stunted & gnarled, having probably been affected by winds frosts & fires. Found however that a very good growth had taken place this year, some shoots as much as between 3 & 4 feet in length. Found here also Ribes aureum growing luxuriantly & the berries beginning to turn dark. Also Ribes rotundifolium covered with very large fruit nearly ripe.

The country from E. Fork to here is very arid much gil-covered with cactus & a sparing growth of wiry grass. only green in cold bottoms. On the West Edmonson passes on thro very dry prairie as a Stipa it is now quite yellow & appears to have dried up without maturing seed.
The Little Rocky Mts & Three Buttes clearly visible. Also the Cypress Mts to the north. A not very well defined but rather high ridge or plateau comes coming in mile or two of the line, a few miles West of this place & runs S. Eastward.

Camp E. Fork. 8.30 Clem. B. 26.72 N.N.W.
1 P.M. T. 68° Cloudless
Valley bottom 6 m. W of E. Fork. B. 26.71 N.W. Fresh
T 76° Clear.
Camp Valley bottom W. Fork. 8 P.M. B. 26.99 N. Clear.
T. 7.56°

odometer E. Fork to W. Fork 5800. revolutions.
Camped with Campbells Waggon train which arrived before us & Capt Andersons party which got in after us.

Geology The banks near the line on the valley 6 m. W. of E. Fork show good sections of beds resembling the Sombre clays on Long R. Stables. Most places more closely resemble the latter, the rocks being somewhat hard, shaly olive grey in colour. Showing evident horizontal stratification, very well marked by whitish lines similar to those seen in same beds in Creek W. of Woody Mts Asbrow's Station.

On following the creek Northwards from the line rather more than a mile the beds are seen suddenly to take a bend upwards, & inferior beds with sandstone layers come to the top & form the banks.

The section appeared to be fairly clear & there was no reason to suspect the existence of a fault. The beds there exposed consist mainly of greyish & yellowish sandy clays with however several layers of sandstone & ironstone & beds of Carbonaceous shale, thinly cleavable some of which might almost be called impure lignite.

It does not appear whether these beds are altogether inferior to the Sony R. shales, or whether they merely form an important intercalation in them. The former seems most probable & in that case the Sony R aspect cannot be compared strictly to any horizon of the Sombre clays as it was previously observed to be common near their upper part.

The strike of the beds is N 270 E & they dip S. East-ward at angles of from 45° to about 30°. But for the discovery of what appear to be authentic opalin remains in both of the beds superior to the Carbonaceous shales, would have been tempted to put beds down as Lignite Tertiary & look very closely for a fault or dislocation. It is evident that such carbonaceous clays as those here represented might at a short distance coalesce into a bed or beds of lignite of good quality. The Carb. shales. exactly resemble many of those seen in undoubtable Lignite. Even

to the occurrence in them of Spots of Amber
flay like leaf markings &c. Now of the vegetable
impressions however seemed capable of
identification.
Made a paced section of the beds across the State
coming down the Valley on S. Eastward, &
consequently passing from older to newer beds.

| | | | | | |
|---|---|---|---|---|---|
| 170 ft. | | | | | |
| 45° 1 | 41-Vat | | | Impure ironstone & valgin softer beds | 18" |
| 2 | 26-6 | 15 paces. | | Earthy clays | |
| 3 | | | | Impure ironstone | 1' |
| 4 | 127-3 | 72 | " | purplish Shaly Clays | |
| 5 | | | | Impure ironstone | 1' |
| 6 | 47-7 | 27 | " | Purplish & brownish Clays shown stratification clearly | |
| 7 | ~~35-4~~ 34 | 20 | " | Yellowish even bedded sandstone sometimes approaching the character of flagstone. Grey for about 18" at the top. ∠45° | 1'6" |
| 8 | 134-4 | 76 | " | Brownish Sandy clays crumbling & rotten when exposed! | |
| 9 | | | | Sandstone | 3' |
| 40° 10 | 121-10 | 69 | " | Greyish & yellowish Strat. Sandy Clay Bed with fragments of bivalves! | |
| " | 88-5 | 56 | " | Grey & yellowish Strat. Sandy clay. Nodular brownish-red sandstone a few feet. | |
| 12 | 24-4 | 15 | " | Softer beds with some thin sandstone layers | |
| 13 | | | | Nodular brown sandstone 6' | 6' |
| 35° 14 | 6-5 | 4 | " | Grey soft sandstone | |
| 15 | | | | Red-brown sandstone | 2' |
| 16 | 34-5 | 21 | " | Grey & yellowish Sandy clay with some thin ironstone sheets. | |
| | | 37 | | | |

17 Fine grained grey-yellow sandstone with dendritic markings 2'

18 12-10 9 paces. Softer sandy clay beds

19 Sandstone breaking into large rectangular fragments & weathering into pot-holes. 4'

20 45-11 32 " Greyish sandy clay

21 12-10 9 " Grey sandstone, weathering yellow. Full of joints.

22 35-9 25. " Softer beds, probably yellowish sandy clay but not well exposed

23 9 6. " Grey sandy clay

24 11 9. " Yellowish sandy clay

25 20 16 " Yellowish & grey sandy clay

26 Laminated Carbonaceous shale with spots of amber & impressions of plants 2'

27 3-6 3 " Grey sandy clay.

28 Brown shale with indistinct impressions of plants. Thin bed.

29 30 24. " Grey sandy clay

30 Blackish plant bed 1'

31 12-6 10. " Dark shales with carbonaceous bands

32 Black carb. shales 2'

33 2-6 2 " Grey sandy clay

34 Carb. shale 1'

35 8-6 7 " White-grey sandy clay with irregular ironstone sheets

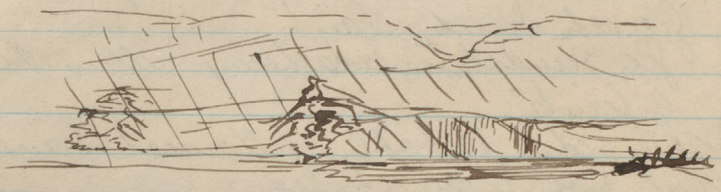
36 21 17 " Grey & yellow sandy-clays with some remains of ostreas? in the lower layers.

15-9

Beds again become horizontal in about 50 feet. The last mentioned layers appear to graduate into the sombre clays, but are not very well exposed.

NB. The numbers on the left are paces, & each figure relates to the line following it. The numbers to the right are

feet & express the thickness of the bed at right angles to the dip, as estimated.



Beds arranged somewhat thus. The sandstone forms prominent hills & projections.

The valley of W. Fork through with some scarped banks shows drift only.

July 19. Started about 6.30 A.M. & travelled west over a sandy plain composed of hard sandy clay & dry flat bottomed ponds almost destitute of vegetation. Cactus abundant. Some stretches sandy in character & then various species of sage brush abound most. The sand seems to form hillocks & low ridges superficial to the clayey matter which is probably derived from disintegration of Long R. shales or sombre clays.

Leaving the water at the point 8½ miles W. of our camp on the W Fork bed & most of the grass in the hollow (where alone feed) cropped by oxen going ahead, decided to water horses & go on. Travelled 22 m. & then reached Galways

Geol.

Camp near two moderately large lakes, around which splendid feed & the first really good hay grass seen. The Camp near the Southern lake. Found Ashe over on a visit, his camp being about a mile distant on the Northern lake. Arranged to meet him in the morning when he starts W. for Milk R. Camped.

The "Big camp" of half-breeds about half a mile from our camp & on the same lake. Visited it in the evening. Must have been at least 200 tepés most of skin but some of canvass. A great many carts. The carts arranged in a great circle enclosing a place for the secure keeping of the horses & into which they are all driven at night. The camps arranged around the outer edge of the circle. Each family with its own tent or group of tents & camp fire. Being Sunday all in best clothes & no work of any sort going on. They have a priest in the party who holds service on Sunday & no doubt conducts all marriage ceremonies &c. He also teaches the children to read & write &c & helps to settle any points in dispute. Told that part of the camps now seperate & hunting on other grounds so that not so many as usual. The half-breeds say that they have about 2000 horses & ponies & certainly it appears not improbable.

They speak French & some of them indian. Most understand a little English & all were anxious to know about Red R. troubles &c.

They spend the summer hunting on the plains & taking pemican during the summer & collecting

robes when they are prime in the Autumn. They are mostly well armed with repeating & breech loading rifles. In the winter they resort to woods but & such places where there is timber & they have shanties built. Most of them winter on the White Mud R. S. of Ft N. G. Turner & consequently will into U.S. territory, & take goods out via the Missouri. They guard their camp with great care having two or three lines of scouts out. The Indians naturally do not like the half-breeds to come out hunting like a seperate tribe, though they do not object to trading. They have just held a council & decided to go N to the Cypress Hills scouts having reported plenty buffalo in that direction. They have not come from there hills more than a ~~[illegible]~~ week or two & were then engaged in an indian fight. They took sides with the Sioux against the Blackfeet & drove the latter off killing 8 or 9 of them. It would appear however that the Sioux did the hardest part of the fighting. About 6 m. E. of our camp we found the trail of their carts train & were at a loss to account for the fact that instead of following in one road & making a well beaten track for at least some of the carts; they had made 10 or 12 parallel roads within the distance of a few hundred yards. Learnt however that this a precaution against indian attack. So many hundred carts would

offer but a weak line, but & travelling abreast & surprised they can drew up in a solid phalanx & put the women & children in the centre in comparative safety. Capt A. wishing to get some interpreters & men who knew the country let it be known in the camps & soon had some applicants but all very independant & with the idea of very high pay. Only one man thoroughly understood the Blackfoot language & he was finally engaged at the exhorbitant rate of $5.00 a day. Others as guides at less sums.

They value the communist ponies at from $40 to $60 & for Couriers or buffalo runners all sorts of fancy prices are asked up to $150 & $200.

The hills or rather mountains called on the map the Three Butts are universally known to the half-breeds & even on the Missouri as the Sweet-Grass Hills or montagnes de l'herbe sucrée.

pain sucrée

du foin de sucre

Scol. at 5½ miles W. of West Fork near the trail exposures of Sombre Clays like Fory R Shales occur.

The escarpment or plateau edge spoken of yesterday approaches nearest the line about 2 m. W of West Fork & is not then more than 2 m. South. It sends indeed a low ridge northwards which crosses the line. After forming this point it retreats S. Westward

& probably blends with a plateau to the west, which runs S.E. & N.W. just on the W. side of the lakes. The latter is very marked as to its edge & indicates the appearance of another set of beds. (See Milk R. notes). The lesser plateau just mentioned may owe its existence to the same cause

Valley of W. Fork. 6.30 Am.
B. 27.21
T. 54°
Wind light. S.E. Clear.

Camp at the two lakes 5.88 m. W. 8 Am.
B. 26.92
T. 64°.

Odometer.
3500 Slew. a little water. poor feed.
4900 Half breed trails going N.W.
9000 Camp.

July 20. Started at 5.30 & moved N to ashes camp. Found him just moving off. Travelled about 9 miles west & camped on the E. side of the great dry Coulé which according to Palliser's maps runs up to Lake Lakopee. This being as near the Milk R as possible to approach with teams on the line. Camped at a small Gorge the banks composed of Stratified Clays & Sandstones almost perpendicular. & a small stream originating

from a spring at the bottom but the water rather saline & tasting so even through the strongest tea.
During this morning march passed where the half breeds had been running buffalo a few days before. The hillsides & valleys strewn with carcases. Those in best condition had been completely stripped, while the poorer ones & old bulls had had only the tit & bits removed.
Left Camp at 1 Pm. & rode with Ashe & Mc across the Big Coulé & over into the valley of the river itself. On a prominent point found an indian grave, evidently very old. An immense mound of stones piled over it.
The valley of the Milk R. is exceedingly curious & picturesque. The banks of the gorge are at least 150 feet high where the line crosses & the flat bottom between them about half a mile wide. The banks are almost entirely bare of vegetation & cut up by lateral coulés & ravines, darkness most of which one may pass on horseback by following the buffalo tracks. The clays & sandstones of different colours lying nearly horizontal as far as the eye can see.
The river itself winds in broad curves from side to side of the valley, & northward from the line is fringed by large poplar trees (P. grandidenta?) & by willows.
Rode down into valley Ashe looking for Capt A's picket & mound while I examined sections &c. The river is now quite shallow & small & surrounded by wide borders of sand & ants. In most places

with a soft treacherous bottom but by choosing the buffalo fords can easily pass with a horse. The lowest bottoms over which the river must constantly pass in flood show a luxuriant growth of grass & afford splendid feed. A level slightly higher than this which the river can seldom or never touch is clad chiefly by Artemisia & several species. A third level forming a sort of low terrace at the foot of the cliffs is very barren being composed of hard clay & only supporting a few drought loving thick leaved plants. The upper prairie is also dry but covered with a good sod of Stipa & (?) the short curly grass common everywhere.

Many antelope in the valley & all the soft bottoms poached up with innumerable buffalo tracks. Rode back to camp at a good pace after having followed the R. S.E. for some miles. & just on arriving at camp near the tents found a horse terribly mired in a mud hole. The mud had been softened by spring & dried & caked on the surface, giving way like pie crust under any weight. The horse right side up but literally bottom more than its head & a portion gets back above ground. Got several men together & managed to haul it out with a rope & by the aid gets over tail.

Jul. Found some fossil lamellibranchs resembling limas in a layer not many feet above the bottom of the valley & a mile or so S. of the line. well below the Sandstone zone which will describe tomorrow. With the shells some vertebrate bones of large size

but poorly preserved.
The edge of the plateau which runs N.W. & S.E. (See map) spoken of yesterday is quite distinct & is the Eastern margin of an area of elevated & hilly country extending several miles with Milk River.

It is caused by the appearance of clay sand clays & sandstones instead of the shale clays, but not serving seem the junction between the series cannot tell perfect an whether above or below them in order.

Camp at 2. Lakes 588 m. W. 5:30 Am.
B. 27.03
T. 54° Calm Cloudless.

Camp on top of bank near the great Bz Coule
noon B. 26.82 S. light. Cloudless.
T. 89°
8 P.M. B. 26.76 E. Clear.
T. 77°

July 21. Left Camp at 8 Am. with Ashe & party. While he coursed the bank of the Milk R. I rode down along the valley into the Coules &c examining sections & looking for fossils. The day very warm & the riding of the roughest possible character. Lead horses up & down some clay banks which appeared almost impossible. Furthest point reached about 8 m. from where the R line meet. Saw many antelope, Also a large herd of buffalo which came slowly down a ravine on the W. bank not half a mile

from where we were stopped for lunch: Rode round topping find them drinking & fet a shot, but by the time we had arrived at the ford saw that they had crossed the river & were several miles away. Long after all the rest had passed an old bull who had been left behind in some way appeared following the herd as fast as he could to catch up.
The buffalo paths are very useful as guides up & down such valleys as that of the Milk R. They are found guiding to every practicable route & are generally followed with horses without difficulty. They also follow the courses of the valleys choosing the best fords & making as straight lines as the nature of the ground permits.
Saw a curious indian grave in the bottom of the valley. A nearly cylindrical concretion from the sandstone had been buried obliquely in the ground & painted with vermilion. Other stones surrounded this & many offerings or gifts had been left & apparently recently renewed. Beads, a spoon tobacco buttons, & strips of various coloured calico paints. Also a flat ornament composed of porcupine quills woven together & a number of eagle feathers.

Geol. The beds exposed in the banks of Milk R are undisturbed & regular. The section is divided into an upper & lower part by a zone of sandstones which are about 1/3 from the top of the bank near the line, but which dip following the R. westward for about 8 m.

form the very summit of the bank; showing a gentle dip of the formation Eastward.

The sandstones though often well & evenly bedded are not regularly hardened but exhibit a nodular character & are in some places false bedded as well. Thus the sandstone strata may be almost quite hardened at one place & a mile & two away may show only certain hard layers seperated by ~~sofr~~ unconsolidated sands.

Below the sandstone occur clays, sands & sandy clays well stratified & individual beds of which may be traced a very way up & down the valley. The colours are generally light but there are some zones of darker carbonaceous clays & in one or two places impure lignite of no great thickness was observed. It appeared to be more discontinuous than the other beds & to thin out soon & disappear in both directions.

Above the sandstones a considerable thickness of sands & sandy clays much thicker in their bedding & the stratification of which is less plainly marked. The general colour of this upper beds is pale yellowish buff, but in some places chiefly greyish.

No fossils were found in the upper series or in the sandstones. In the lower beds fossil shells of various kinds occur (see specimens) those observed not far below the sandstones occurred in large concretionary hardening of which the matrix was yellowish. They appeared to include <u>paludinas</u>

Small Lamellibranchs were the most common however. In lower layers large unio like shells were found in some places (as already mentioned) in connection with vertebrate remains. A small ostrea is also very common. If the greater number of the shells are as I suppose fresh water they must be mingled with those (ostrea) of salt water origin. No clear seperating line can be found between different parts of the section. Probably estuarine conditions.

From the appearance of this formation one would put it under the Eocene Tertiary, which it closely resembles in every respect. I believe it is the lower part of that formation. The occurrence of oysters is anomalous, but agrees with Hayden's accounts of marine & semi-marine conditions in the base of the Western tertiary. The exposures along the line of the R. being few however & the dips so moderate & undisturbed it is impossible to be stratigraphically sure that the formation in question overlies the Sombre clays. No junction observed. The section observed near the East Fork renders it just possible that these beds may underlie the Sombre clays.

It seems far from probable however that two formations so exactly alike & so extensive should occur one below & the other above the Sombre clays, & that such water (? supposed) conditions should prevail in the middle of the Cretaceous.

The two methods of arrangement may be shown as below but the first seems in every

very the most probable, the second only requiring consideration from the Section near E. Falk showing to all appearance such beds underlying the Sombre clays.

In any case the appearance of this formation with its sandstone layers causes the ridge or plateau edge marked on the map as running N.W. some distance E. of Milk R.


The country rises towards Milk R. so that even with a fairly lasting dip lower beds might form the surface west of older, as at White Mud R.

<u>Section of Milk R. beds. Ascending.</u> About 7. m. up the River from the line & on the N. bank.

(Section measured by hand level in heights of eye from ground. Smaller beds estimated in feet. Numbers on the left refer to former standard, those on right to latter. Height of eye = 4'5½").

Level of base say 30' above water of R..

No 1. 7 heights. Yellowish sandy clay.

2. Nodularly hardened sandstone 1'

3. 1 " Yellowish sandy clay. Some remains of Astrea in this & several beds above it. (see. sp.)

| | | | |
|---|---|---|---|
| 4 | 1 | " | Greyish Sandy clay. |
| 5 | | | Thin layer of Sandstone. |
| 6 | 1½ | " | Greyish Sandy clay. |
| 7 | ½ | " | Purplish Shaly bed. |
| 8 | 2 | " | Yellowish Sandy clay. |
| 9 | | | Purplish Shale - - - - 1" |
| 10 | 1 | " | Yellowish Sandy clay. |
| 11 | 2½ | " | Greyish Sandy Clay, Shaly at the top. |
| 12 | 1¾ | " | Greyish Sandy clay. |
| 13 | | | Purplish-brown Shale - - - 1" |
| 14 | 2 | " | Purplish Shale with some thin layers of impure lignite |
| 15 | 3/3 | " | Grey Sandy clay |
| 16 | | | Brown Shale, badly preserved plant remains - - - - - - 6" |
| 17 | 1¼ | " | Grey Sandy Clay |
| 18 | | | Purplish Shale - - - - - - - 18" |
| 19 | 1 | " | Grey sandy clay. |
| 20 | | | Yellowish Sandstone, thin bedded 2' |
| 21 | 16. | " | Greyish Sandy clay in which stratification scarcely apparent. |
| 22 | 2½ | " | Yellowish grey Sandy clay. |
| 23 | 3. | " | Greyish & Yellowish banded Sandy clays. |
| 24 | 5 | " | Whitish grey sandy clays. Selenite in lower portion. |
| 25 | | | Reddish nodular Sandstone 2' |
| 26 | 1 | " | Grey hard Sand. |
| 27 | 1 | " | Red-brown concretionary Sandstone large flattened nodules. |
| 28 | 1 | " | Soft grey Sandstone forming tops of bank. |

Beds 25 to 28 may be considered as belonging to the Sandstone zone.

The next section was taken in the valley of the Gorge at which we were camped, & where a considerable thickness of beds overlying the Sandstone horizon are exposed; owing to the easterly dips. It may be considered as nearly forming the last & forming a continuation of it. (Ascending)

| | | | |
|---|---|---|---|
| No 1 | 8 heights. | | Sandstones hard & soft, brownish yellowish & grey. Often concretionary frequently well stratified but sometimes false bedded. Jamming clefts in the Gorge & weathering out into overhanging ledges & horizontally fluted walls. |
| 2 | 3¼ | " | Grey soft Sandstone |
| 3 | 4 | " | Grey Sandy clay somewhat banded. |
| 4 | | | Thin rusty layer. |
| 5 | ½ | " | Rusty irregular layer. |
| 6 | 2 | " | Grey green Sandy Clay |
| 7 | 1 | " | Grey Sand. |
| 8 | 1½ | " | Yellowish Sandy clay. |

All more or less banded though not conspicuously the colours not being striking.

Camp on top of Peak near Great Dr Lorlé.
8 Pm. B. 26·52 Calm Clear.
T. 78°

Walk R.

| | | |
|---|---|---|
| | 30 ft | 0 in |
| Yellowish ~~sandy~~ arenaceous-clay | 31 | 0 |
| Nodular hardened Sandstone | 1 | 0 |
| Yellowish arenaceous-clay (numerous pebbles!) | 4 | 5 |
| Greyish arenaceous-clay. | 4 | 6 |
| Sandstone (thin layer) | — | — |
| Greyish arenaceous-clay | 6 | 9 |
| Purplish Shaly bed | 2 | 2 |
| Yellowish arenaceous-clay | 8 | 11 |
| Purplish Shale | 1 | 0 |
| Yellowish ~~Shaly~~ arenaceous-clay | 4 | 5 |
| Grey arenaceous-clay. upper part-shaly. | 11 | 1 |
| Greyish arenaceous-clay | 7 | 7 |
| Purplish brown Shale | 1 | 0 |
| Purplish Shale with some thin layers imp. lij. | 8 | 10 |
| Grey arenaceous-clay | 14 | 8 |
| Brown shale with imperfect preserved plant remains) | 0 | 6 |
| Grey arenaceous-clay | 5 | 6 |
| Purplish shale | 1 | 6 |
| Grey arenaceous-clay | 4 | 5 |
| Yellowish Sandstone, thin bedded, | 2 | 0 |
| Greyish Sandy clay in which stratification is scarcely apparent) | 71 | 4 |
| Yellow-grey arenaceous clay | 11 | 0 |
| Greyish + yellowish banded arenaceous clays | 13 | 4 |
| Whitish ~~Sand~~ arenaceous clays with some selenite in the lower layers) | 22 | 6 |
| Reddish nodular Sandstone | 2 | 0 |
| Grey hard Sand. | 4 | 5 |
| Red brown Conglomerate Sandstone with large flattened nodules | 4 | 6 |
| Soft-grey Sandstone forming the top of the bank about | 4 | 6 |
| ~~274~~ | ~~10~~ | |
| 284 | 10 | |

Sage near Camp.

| | | |
|---|---|---|
| Sandstones &c. | 35 | 6 |
| Grey soft Sandstone | 14 | 5 |
| Grey sandy clay somewhat Varnished. | 17 | 10 |
| Thin rusty layer | | |
| Rusty-irregular layer. | 2 | 3 |
| Grey green Sandy clay. | 9 | 0 |
| Grey sand | 4 | 5 |
| Yellowish Sandy clay | 6 | 8 |
| | 90 — | 1 |

7/90
13

July 22. Measured the Section given last in yesterdays notes before starting. Ashe moves his camp round by the Crossing of Milk R. S.W. S by the line to the W. bank & complete his Survey. He himself riding across on the line & find a camping place with water. Got off by 7 a.m. & went with Ashes people as far as the Crossing. Oratorio Hill with three Cart loads Indian presents on the road. Saw four Buffalo close at hand & great herds on the W. side of the river visible with a glass. On arriving at the Crossing found Campbells train of wagons just starting off to join Sul Salma who had gone on four miles to stop for lunch. Got a heavy mail of papers & some letters which had come through from Benton. An American Scout brought them in to one of American Camps. He left Benton with a horse besides his own to carry the mail. Was chased by indians & took refuge in the "Bad lands" for two days. Got back to Benton. Started out again, & the second time got through safely. Some of the papers however nearly worn out.

Went on to where Salma stopped & remained for lunch

Travelled on about 20 miles & till quite dark before reaching water for Camp. The heat intense & dust suffocating. A little water distributed among the horses from the water carts helped them through. One of the Scouts nearly stepped on a rattlesnake which was when

this ground promptly killed. It was rather tropical from repletion & had 5 rattles.
Camped at a pool with very poor water.
Daily meteorological cycle. The air on this upper prairie step is exceedingly dry & rain seldom or never falls in the summer season unless a local thunder storm passes. When these are few as it would appear there is scarcely water enough to cause them. The vegetation appears to depend almost entirely on the saturation of the ground in spring which being exhausted about this season brings the growing season of many plants to a close as effectually as winter would.
On the lower level prairie where water more abundant a very well marked meteorological cycle each day. The morning generally clear but soon small cumulus & cirro-cumulus clouds appear as evaporation begins. These growing continually larger & more numerous drift with the prevailing wind & sooner or later in the afternoon local thunder storms develop many often being in view at once. These may go on & coalesce into larger storms but generally do not. During the night all calms down & equilibrium established again.

Sept. At the crossing of the Milk R. 8 m. south of the line he beds already described are again exposed. The very gentle Eastern dip appears to be persistent as the sandstone zone is now about the ~~middle of~~ top of the lower third of the bank. Had no time to examine the sections here in detail but they appeared to be exactly similar to

those already examined.
About 18 m. west on the trail from Milk R.
A coulé shows exposures of similar beds.

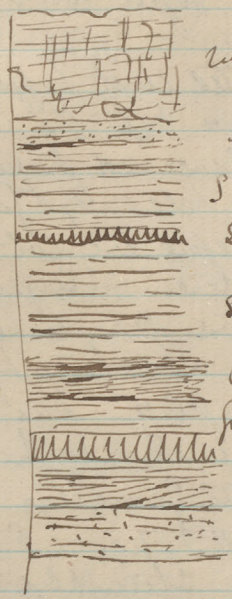
Camp on top of bank w. great dry coulé
6·30 Am.
B. 26·77
T. 68°
4 m. West of Milk R.
1 P.M. B. 26·79
T. 86°.

July 23. Started at 6 AM. & made 12 m. to a coule where water remains in pools. The other watering places on the map appear to have dried up. Saw a good section near the road & got a number of fossil shells from it. Afternoon came on about 10 m. approaching the Eastern butte closely. The Buttes appear very large on approach & have bold & mountainous outlines. A great relief after so much prairie country. Saw a great many buffalo today. The scouts & others had a chase after some yearling but without success.
Camped in a coulé where a beautiful spring of fresh water comes out & supplies a small stream which as usual in this country soon loses itself. Water only travels here safely below the ground or appearing at the surface evaporation & absorbtion quickly cause it to disappear. A picturesque wall

of stones caused by a trap dyke crossing the valley from which the softer rocks wear away & leave it projecting.
The hills around dotted with buffalo. A small herd came nearly down into the Camp in search of water, but observed & retired by another coulé. Ran up on a hill to try & get a shot but they were too far away before we got there. Sat down & watched the men creeping up around three bulls which stood on the hillside about half a mile distant. Shooting began & finally an exciting hunt took place. One soon wounded & fell behind. Shots fired at him in rapid succession from various quarters soon made him bleed at the mouth & nose & then trying to rush down a hill he stumbled & fell dead. The sportsmen then centered on him from all quarters & before long steaks were under preparation for supper. From the hill on which we sat could view the whole through a glass as though at a play.

Jul. Small exposures of beds belonging to the Milk R. Series continue to appear at intervals. Such were observed particularly 1½ m. W of last night's camp. 4½ m. where yellowish sandstones are underlaid by grey sandy clays. At 6 m. W. of the camp many exposures occur in coulés running into a great valley many miles in width with gently sloping edges, which runs about N.N.W.
At 9 m. west a remarkably good exposure occurs

& shows the following arrangement of beds.



About 30 ft.

massive grey sandstone 8'

Sandstone soft with remains of Ostrea 8'

Sandy clays. remains of Ostrea 8'.
Irregular & impure lignite.

stratified sandy clays

Carbonaceous shale

grey sandy clay many shells. mostly small.
Impure lignite with amber.
grey sandy clay
Carbonaceous shales.
grey soft-sandstone.

The remains of Molluscs were specially abundant in parts of this section. The upper beds holding ostreas while in the lower shell bed I am almost sure I can recognise remains of ~~[illegible]~~ paludinas especially of the conical species got last year in the lignite tertiary. If this so goes far to confirm the age of these beds as Tertiary. shows estuarine conditions. See fossils.
16 m. W. of camp exposures belonging to same series & showing purplish carbonaceous shales, yellowish sandstones & grey sandy clays occur.

Camped about 20 m. West of Camp the East Butte bearing almost exactly S. (Mag) & about 9 miles distant. A dyke of soft, green-grey trap with largely crystalline mica here forms a

very prominent object. Standing up like a wall as already described. Its general course is N70°E or radiant from the highest peak of Butte.
The shales &c. on both sides yet are nearly horizontal & contain numerous ostreas in some layers. Immediately in contact with it however they are much bent & contorted & altered. The dark carbonaceous shales especially are hardened & look like those of the true coal measures. The alteration extends but a very short distance from the dyke.

Camp 23. m. W. of Milk R.
6. Am. B. 26.38
T. 63°
Calm Cloudless.

Creek valley 12. m. W. of Camp. Noon
B. 26.17
T. 89° Light variable. Clear.

Camp 9. m. N. of E. Butte. Valley.
8 Pm. B. 25.71
T. 65° Calm Clear.

The whole of the beds seen today probably belong to one formation & that the same as seen on Milk R. Though so extensively distributed, the whole of the sections may not show a great thickness of beds. The dip probably continues gentle to the E. but the general contour of the country rises as fast as the beds do

The country after leaving Milk R is moderately well grassed & cactus only appears in a few places. There are however long stretches along the road without water.

(who started at 6 a.m.)

July 24. Stayed behind Galway's party with Boswell for the purpose of ascending the first Butte to the S. Left camp about 8 a.m. & travelled nearly due S to the Butte. Saw many buffalo & antelope & took random shots at some. The grass in the hollows & coulées is luxuriant on the foot hills, & very sweet there being much scented hay. Very few flowers but but nothing peculiar or new. Many streams rising from copious springs but soon loosing themselves when they issue on the plains. The foot hills cut up by innumerable coulées which radiate from the centre peaks in all directions.

The foot hills look much smaller than they really are. A buffalo standing head on & looking at us from the top of one was at first taken for a lamb. He presently ran down the slope & after several stoppages passed us at about 50 yds. Boswell took a shot at him but without apparent effect.

When we got as far as practicable for horses, at the upper edge of the grassed slopes, left the animals in charge of Dillon & proceeded to ascend on foot over a very steep slope of scree composed of rocky fragments of large size. The steeper slopes & upper parts of the central peaks are well wooded with white spruce, banksian pine, also juniper & ground cedar.

Reached the summit after nearly an hours climbing & were rewarded by a splendid view. Cypress hills to the N. The other buttes westward; milk R stretching

from E. to West, resembling the scarped slopes of its valley. Coules radiating in all directions from us as a centre. Great undulating plains dotted here & there with lakes & ponds, & sprinkled over with buffalo singly & in herds. The spruce & pine form a wood on the very peak. Some of the trees were then a foot through but gnarled. Delicious piney fragrance. Patten mistg in distance & might have seen the Rocky Mts clearly as it was they only appeared very dimly. Though probably the first white to ascend the peak, Indians had evidently been there frequently & had used the place as a watch tower & beacon. Found remains of fires & half burned logs. Also a rude circular shelter composed of logs piled together with some stones for a fireplace in the center. Also a partially destroyed cairn of stones. Took bearings of all principal points in view & after spending about an hour on the top turned to return.

Saw from the top some (3) U.S. soldiers with horses on one of the foot hills. Afterwards spoke to them & found that they came from a camp of cavalry which part of Commission escort & which situated about 15 m. N. we had taken for Flathers Stonehouse's camp from the mountain. They were out hunting.

Got back to camp about 6. The evening turning very cold.

Geol. The Belle obliger surrounding peaks are

composed of hard porphyritic traps. The felspar crystals are grey & very prominent. In some specimens small hornblend crystals occur & nodular looking portions including much hornblend are ~~included~~ surrounded pebble like in a more felspathic matrix in places. The mineralogical character of the rock appears however to be remarkably uniform in all parts of the butte.

The sedimentary rocks rise within about 1000 feet of the top of the Butte in places & are there found dipping very steeply away from it. On descending towards the plain the angle of dip becomes less & less & the beds finally appear horizontal. Near the igneous mass the beds are much hardened & altered & both the trap & altered rocks are traversed by single veins of quartz.

Several trap dykes radiating from the centre like that yesterday & forming the crests of ridges were seen.

The thickness of beds exposed is not very great as the ground rises almost equally with the increasing dip: No very complete sections were seen. Nearest the trap, & lowest were hardened sandstones of no great thickness. Then a considerable breadth of hard blackish fissile shales. Next a rather extensive sandstone formation. Much of it well & regularly bedded, but in some places nodular & giving rise in the valleys where it is cut through to castellated & step like rocks of picturesque appearance. This is overlaid by

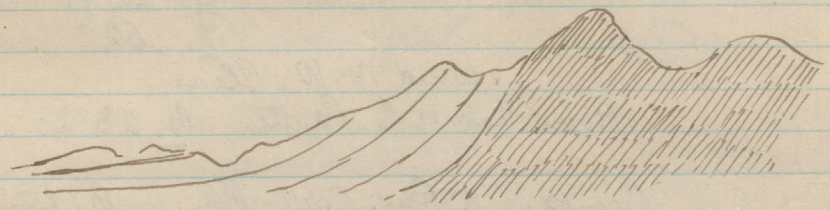
(also apparently many dislocations)

= Sandy clays

= Upper Cret. Sandstones

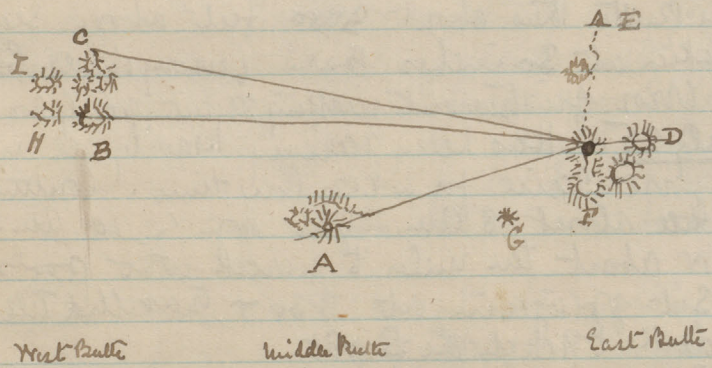
the sandy clays & minor sandstones of the plain with their ostrea remains & other fossils.

The exposed portions of the trap rock are everywhere shattered & fissured & do not offer any chance of detecting glacial striation. The sedimentary rocks have suffered in the same way & are besides too soft for the preservation of such markings.



General Arrangement of rocks.

Bearings from top of E. Butte.




To Butte A 239° To Butte B. 261°

To edge of small butte running N from B. (C) 270°

To U.S. Cavalry Camp. (Capt Weir) About 15 m. Away
& N of the line near two small lakes & a bluff. 9.5°
To our Camp in Trap Dyke Valley 9 miles distant. 4°
To group of small lakes N. of line (distant) 27°
To peak of Subsidiary Butte D. 77.5°

Bearing of Butte from Camp. 194°

Camp Trap dyke valley 9 m. N. of Butte.
8 Am. B. 25.91
T. 62°
Wind N.W. Clear.
Noon Top of S. Butte. B. 23.20. (mean of two obs)

Camp. ~~S.Rm.~~ 5.45 P.M. B. 25.72

Camp. 8 P.M. B.
T. 57° W.N.W. Cloudy inclining to rain.

The Butte thus about ~~5700~~ 6700 feet above sea level taken at 30 inches Bar. (error should ~~about~~ add 0.30 for error of instrument making the Butte nearly 300 feet lower.)

July 25. Has been raining heavily all night. The first rain for a very long time. Continued wet till about 8 Am. Got up & 10 Am. & travelled W about ten miles to a creek with pools of water. Set off again at 3.30 & travelled till nearly dark to reach the Depôt.
Saw immense herds of buffalo scattered over the plain. Boswell ran several & killed two. One an old bull, the other a calf. The latter he wounded & drove across the road just in front

yrs. Had a couple of flying shots at it one of which I believe took effect. The dogs rushed out & headed the calf & it was soon dispatched. The calves run almost quicker than the older animals & are very difficult to pair off. A herd of about 50 buffalo rushed across the track in a solid phalanx about 80 yds in front of the buckboard. Put a few bullets into them, & though we could hear them strike no animals fell out. Near where we lunched a herd of more than 200 were feeding quietly.

The East Butte consists of four main peaks arranged somewhat in square. The N. Western is the most conical & the highest. The S. Western is connected with the last by a ridge, is blunt topped & not far below the last in height. The N.E. & S.E. are considerably lower & about equal in height.

The Centre Butte consists of one prominent pyramidal hill, which preserves its regular outline when viewed from almost any side. It is surrounded by foot hills covered with grass especially towards the N. It falls S of a line joining the East & West Buttes, & is not so high as either.

The West Butte has at its Eastern extremity its highest peak a blunt-topped & large mountain the Eastern end of which is formed in many places by perpendicular rocky cliffs. West & N. of it several good sized peaks & ridges rise, & enclose a rugged pine clad & rocky area of some extent. The foot hills are also on a large scale. This

Butte may be the highest, but cannot be much higher than the E. Butte.

The whole of the Buttes in good view during the day. The country passed over around their base is well grassed & beautifully green in the hollows & coulé's.

Found the Depot in a valley beside a beautiful running stream coming down from the mountains. Capt A. East. Crompton & Scouts at depot ready to start W. tomorrow morning.
Capt Cameron turned up about 11.30 with a mail, part from Benton & part from Dufferin. He had camped near us last night.

Cactus scarcely appears at all in the neighbourhood of the Buttes & the indications are that an increased rainfall takes place from the mountainous nature of the country.

Camp Trap Dyke valley 9 m. W. of Butte
8.45 Atm. B. 26.09 W.N.W.
T. 56° Cloudy.

Camp. Depot at West Butte.
9.30 P.m. B. 26.07
T. 56°

July 26. Drew rations & got various arrangements made packed up & moved about 1½ m. to Galway's Station Camp on the foot hills of the Butte & near the same stream on which the depot situated. Spent remainder of day about Camp, writing up notes, reading papers &c.

Camp. W. Butte Depot. 8 Am.
B. 25.98
T. 66° Wind S.E. Clear.

Camp. 1 Pm. Great Butte Extension. Station.
B. 25.58 S.W. Clear.
T. 72°
8 Pm. B. 25.74 Calm partly Cloudy.
T. 60°

Comparison of Barometer with Mr Fosher's two standard aneroids gives a correction applicable to my small aneroid of +0.30

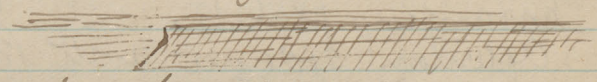
July 27. Morning writing up notes & arranging plants.
Afternoon rode out with Boswell about 4 or 5 miles S of Camp & ascended on horseback up a steep grassy slope the highest Butte on the western edge of the W. Butte region.
Saw a deer. (? pronghorn or black tailed deer both of which said to inhabit here) & had a splendid view over the plain.
The Rocky mts are clearly visible from even the higher foot hills standing as it would appear immeasurably far off in the west in a great

serrated & partly Snow-clad range. Clear cut along the horizon & seperated by a great stretch of plain which but for lakes & coulis would be as level as the Sea seen from the height. The Rockys only about 113. m. distant in a straight line.

Camp W. Butte action. Station.

8 Am. B. 25.75
T. 66°
Calm cloudless
12.30 Pm. B. 25.76
T. 72°
Calm clear.
9 Pm. B. 25.74
T. 64°
Wind E. Clear.

From peak about 4. m. S of Camp took bearing of Southern point of a very well marked plateau looking almost like a basaltic outflow, S. 38° W. Mag.



Had this appearance.

July 28. Engaged about Camp most of day writing up notes &c. Took a walk up the brook in the afternoon in search of sections. Panned out a lot of gravel in bed of brook but could not get even a colour of gold. Found a small quantity of magnetic oxide & some garnet dust in the residuum.

Found an interesting section with hard beds containing fossils undoubtedly Cretaceous.

The animals inhabiting these mountains are numerous in kind, have seen or heard of. Buffalo. Antelope. Rocky Mt. Sheep & Goats. Grizzly & black bears. Beaver. Black tailed deer (? sp) Porcupine. Skunk. & various smaller animals.
The flora is not so much different from that of the plains as one might expect & few new or strange forms appear. Many plants which do not find moisture enough on the general level of the high prairie about here however reappear & creep out of the coulé bottoms & higher ground.

Camp. W. Butte astron. Stn. 8 Am. B. 25-51
T. 76°
Light. W. partly Cloudy.
2. Pm. B. 25-46
T. 84°
Calm Clearing
10. Pm. B. 25.55
T. 67°
heavy thunder storm from the S.

July 29. Made arrangements for a trip up the highest Butte at the S. end of this volcanic group, with Capt. C. & Boswell. The latter detained & could not go. Got off at 11. Am. Party

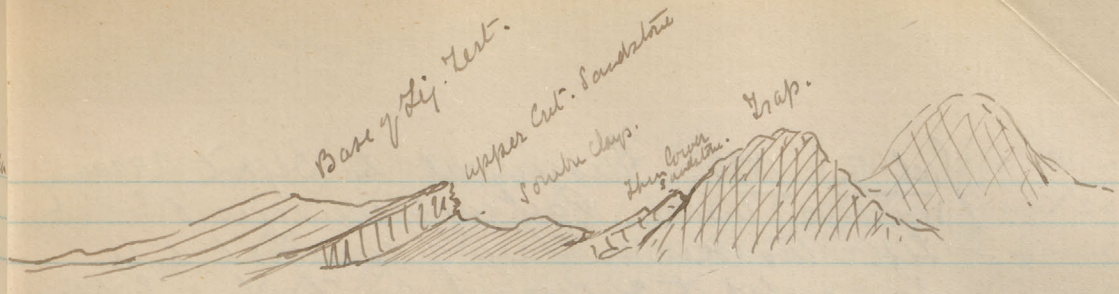
consisting of 3. Scep. Capt C. & Scout name Gandelbois. Followed brook which runs near camp up into heart of mountains, then along the edges of ridges where timber wanting. Repulsed at several points, the hills being impassable for horses. Worked round to South western slope of Great Butte where found a more practicable ridge. Found here however that we had to traverse a great hillside composed of loose broken trap. Owl aided by the mountain sheep's paths. Horses had of course to be lead & stumbled & scrambled along as best they could. Then got into windfall of Bankscan pine the prostrate logs masked by a young growth of the same tree. Scrambled along & at last got close to the foot of the central peak & found a little open grassy space. Lunched but without water, & then began the climb on foot. Toiled up through scrub & windfall. Very fortunately not hot. At last attained summit. A blunt peak sloping away at first quite gradually on every side. Back & bare being composed of trap nearly in place but shattered into innumerable fragments by the frost. A little soil accumulated between the stones supported a scanty growth of grass & moss. The pines near the actual summit almost prostrate.

Splendid view but rather hazy in the extreme distance. Rocky Mts however could be seen in outline. Found a shelter built of stones & roots similar to that observed on E. Butte. Also a

little cairn of stones. Found also a bot of matches, left by one of the men. A portion of the top of a flint-arrow-head, & below a stone a kind of mouse, of the short-tailed variety. Scared the Coltes up in one side of Field glass.
Took bearing on prominent points, & Barometer observations & then discended again to horses. Found it 6 P.M. & little time left to get back. Struggled through windfall & scrub & then getting on the grassy slopes got along pretty fast to Camp stopping several times for water at the various cold springs. Beautiful sunset & purple light on hills!

Geology. An examination of rocks in this vicinity explains much previously in doubt. The rocks retain their former position (as seen at E. Butte) eg. dipping away from central igneous masses. Here on the Western flank of Butte they dip W. & on its northern flank Northward. A large mass & probably some smaller portions are however included among the igneous peaks of this West Butte. This detached portion is much more altered than the rest & the greater part of it appears to dip S.E. acting at ~~right~~ high angles.
The rocks surrounding the Buttes are not all Eocene tertiary as previously supposed. The lowest beds seen are sandstones either immediately underlying the Sombre clays or intercallated in them. The Sombre clays next appear, somewhat hardened & more shaly than before. They also

do not show the same number of Septarian nodules formerly seen in them in some localities. The hardening appears to have taken place in a somewhat different way. There being somewhat continuous hard layers & thin intercallated sandstones. Some places however still show large nodules.
Found in some broad lenticular bands many fossils though not very well preserved, still undoubtedly marine & Cretaceous. Inoceramus. oshea? Ostrea? Ammonites. & several gasteropods. (? yet one contains there could be called a limestone)
The beds overlying those representatives of the Sonora clays are sandstones, which appears to be much more hardened than where seen further east, & may be taken to stand for the higher division of the Cretaceous. They generally form a prominent ridge round the mountain & like the other beds dip away from it. These do not appear to contain fossils.
The formation traced from E of Milk R & here is thus above Cretaceous & as supposed represents the lower beds of the Tertiary. The transition between the Cret. & Tertiary becoming more complete westward. The passage from Salt to Fresh water conditions going on very gradually as the many oyster beds show.
The sandstone zone of Milk R. valley may not improbably represent the Rocky Cerce Sandstone.




Camp. W. Butte. Astrin Stn. 8 Am. B. 25.51 S. Cloudless.
T. 70°
11. Am. B. 25.58.

Bar. on Summit Lifhet-Butte. 4.30 Pm. 22.87

Camp 8 Pm. B. 25.50 W.S.W. Light Clear.
T. 60.°

The Barometer readings are of course subject to a correction of + 0.30

Mr Fish's readings at Depôt Camp lower down the stream. Mean of 2 Standard Aneroids.

8. Am. 26.09
Noon 26.09
9. Pm. 26.16

Making a difference of very nearly 3 inches. (2.99) between Depot Camp & Summit.

By Mr Fish's observations the height of Depôt camp will be well ascertained.

Compass bearings (referring to plan of July 24). Peak of E. Butte, 83° Rear peak of E. Butte (F) 87.5° Small cone (G) 114.5°. To W.S. Camp on line. 59° To middle Butte (A) 109.5°. To Butte (H) 303° To Butte (I) 325°. To Peaks of N. edge of hills round Pyramid Butte. (= A) 98°.

July 30. 1894. Morning at the Depôt arranging various matters. Packing specimens &c. Left two boxes in charge of Mr Fish to be forwarded to Ottawa. One chiefly of geological specimens the other containing birds.
Spoke to Commissioner about prospect of going back to Red R. by some other road as far Fort Ellice or Edmonston. He is quite agreable to the proposition if any arrangement can be effected for travelling over the Mounted Police or otherwise.
No oats at depôt & so cannot move on tomorrow with Galway. Hope to get off next day & catch him at twelve miles W. of here. Mr Conrad in charge of oats from Fort Benton arrived this evening & reports them at hand.
Ashe coming in from his survey Eastward reported finding the remains of 21 dead Indians on the prairie.
Conrad says they are no doubt Crows a party of about that strength having left Benton last Autumn on a horse stealing expedition to the Blackfoot country to the North. They never returned.
Photographers going out to same of battle tomorrow, made arrangements to go with them.
Conrad tells me that the Battle & country along Milk R. forms neutral ground for 4 or 5 tribes. The indians do not enter, or cross it except

in war parties. The Crows he says are connected with the Lower Gros ventres & speak a similar language. The Cutes are connected in the same way with the Mandans. The crows are not a large tribe. The Peagans get the credit of having perpetrated the massacre. They speak Blackfoot & are a tribe of that nation.
The Peagans Gros ventres (proper) & Crows are said to be the richest tribes on the Missouri.
The indians he says now complain that they are the most helpless of people, much more so than they were a few years ago. Now that they have kept pace with the times & getting breech-loaders & repeaters the Government can stop their supplies of ammunition in the moment any trouble arises. They have lost to a great extent the aptitude of using the bow & when deprived of ammunition have no substitute.

Camp W. Butte Action. Station
8. Am. B. 25.71 E. Cloudy.
T. 54°
Noon. B. 25.66 Wind light
T. 65° N. Clear.

July 31. Salway broke camp & moved west.
Moved up camp at same time down to the depôt. Started at 8.30 with Boswell & the photographers for scene of massacre. Situated about ten m. East on the line.

The bodies were much shrunken & quite mummified. The arm & leg bones projecting & heads nearly all broken in. They were scattered irregularly over a little area on the slope of a gentle hill. They had been on foot. If mounted originally their horses must have first been stolen from them. They had evidently been surrounded by a greatly superior number of Indians & made preparations for a desperate resistence. They had dug shallow rifle pits, probably choosing badger holes to begin on, & piled stones & earth up round the edges. There were about 7 of these altogether some larger & some smaller but offering very poor shelter at best. Their ammunition had evidently lasted round & round them in indian style firing as they ran. One horse had been killed. The crows must have inflicted heavy loss on their adversaries from their position but had been eventually themselves all killed. The bodies lay nearly all round the edges of the pits. They had been cut & slashed in all directions after death. Some had as many as three bullet holes through the skull. One body on being turned over showed 5 bullets variously flattened & bent which had dropped out during decay. Nearly all lay on their faces for convenience of scalping. The scalps had been removed from the forehead to the back of the neck. All had a belt-gash just below the ribs made by a knife for some purpose. Found a number of bullets

Some heads. A couple of iron arrow heads & many portions of shafts. The chamber of a revolver with two empty cartridges. A knife &c.

Saw Capt. Heathcote & his party coming along the road & joined them to go back to Depot. Very buffalo. Several bands ~~xx~~ ran across the road & received shots. Found a small band in a hollow. Crept up with Nelson & fired at a couple of bulls who remained when the rest ran. I luckily struck him in the hip & shattered the femur. Nelson struck him in the foot. His companion did not desert him & both went off at a slow pace, the wounded fellow on three legs. Followed in the buckboard & at last got pretty close. The sound bull then made off leaving the wounded one. I had only been afraid before of his charging down on us & so now went in on foot & a few bullets caused the beast to fall on his knees & shortly expire. A very big bull ~~xxx~~ & fat & in good condition. One of scouts fortunately coming up. We managed to dissect him with our blunt knives. Cut out the tongue. Cut off the fleshy part of a hind quarter. Extracted the liver & the suet from round the intestines. Loaded them on the Buckboard & returned to Camp.

Got a mail from Benton.

Wrote letters for forwarding via Benton when Conrad returns.

August 1. 1874. Detained waiting for oats. Wrote home. Wrote letter to Col. French. Reading writing up Diary &c. Oats arrived at about 4 P.M. A fine day but a heavy thunder storm in the afternoon & heavy clouds hanging about since. Sergt Armstrong returned from Milk R today & reports that Campbell the Ass. Commissary had been met 3 days E. of here by a party of Sioux numbering about 800 lodges. He upset & fire threw everything & his escort being small (15 men) the indians quietly cut the traces of his mules & took all the provisions they could find, leaving him scarcely enough to get into Camp on. The report may however be exaggerated.

Camp at Depôt W. Butte. 8 AM. B. 25.95 Calm.
" T. 64° Clear.
" Noon B. 25.87
" T. 76° Calm Clear.
" 8.30 P.M. B. 25.98 Calm
" T. 56° Clear.

Aug 2. Breakfasted early & started my teams before 8. Stayed behind with Buckboard & Boswell mounted to see oat train come in. Train came in just before 12. Maj. Turning & party turned up at same time. The oat train a most extraordinary sight. Huge "Missouri freighting waggons" like Roach's with canvas covers. Two & in some cases 3 yokes fastened together like the cars in a

team & furnished with powerful lever brakes.
8 or 9 yoke of oxen attached to each set of wagons.
Stretch out to enormous length & all hitched to
a strong iron chain. Only leading oxen & wheelers
require to be broken cattle, the rest & file
filled up with young animals.
Started W. with Boswell at 12.20 & reached
the place where the teams had made their
noon halt before 2. Lunched & came on
13¼ miles making 21¼ miles for the days
march. Boswell finding 21 head of stray oxen
some west turned back with them to depot &
has evidently stayed there all night.

Geol. About 6. m. W. of Butte exposures of
sandstones belonging to lower portion of
Ly. Tert. with gentle dip westward. They
overlie the upper cretaceous sandstones
seen near the W. Butte astronomical station
8. m. W of Butte the same sandstones
reappear with a gentle eastern dip.
15. m. W of Butte the valley of milk R. seen
a few miles to the N. shows dark looking
banks. probably drift.
16. m. Hills about 2. m. south composed of
drift underlain by sandstone rock probably
belonging to tertiary.
Nature of Country. Many coulés on road.
Country covered with close but short growth
of grass, not now very green but nutritious.
Hills none of bad character of land over sombre
clays, but may be too dry for cultivation.

W. Battle Depôt. 8 Am. B. 25.83 T. 64°
Calm: partly cloudy.

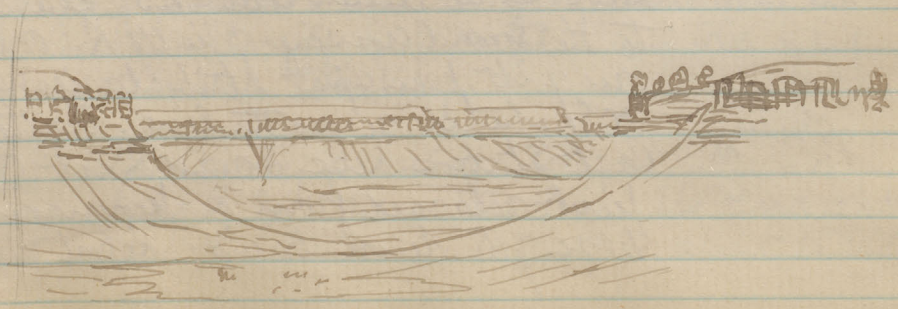
Camp 20¼ m. W. of Depôt
9.30 Pm. B. ~~25.05~~ 26.03.
T. ~~68°~~ 51°

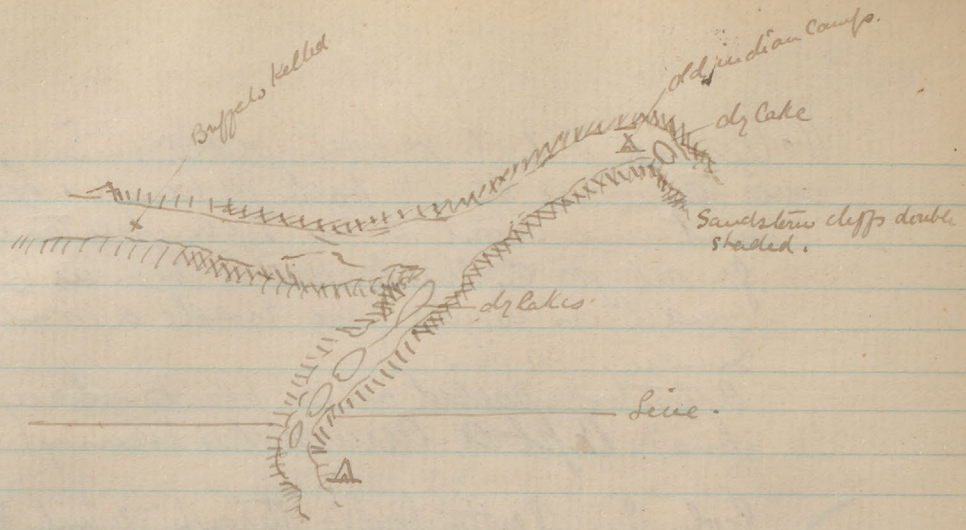
~~Wind light E. partly cloudy. Thunder~~ Calm Clear Clouds Clearing away.

Aug. 3. Bozwell arrived early this morning. Went out with Nillson & rode S. Westward down a coulé about 6 m. Saw recent traces of Indians. A party of. Blanket which had not got burnt the grass down under it. Also horse tracks. The valley very picturesque from rounded sandstones. Much of the bottom occupied by flats yellow-grey mud in the form of lakes & having all the appearance of water from a little distance. Saw several jackass rabbits & many antelope. Met Mr Bain who said he had seen a buffalo in one of the branch coulés. Sorry found him. An old bull alone drinking. Left horses with Nillson under a hill & crept up to the bull. Got within about 50 yards & both fired. Bull appeared almost unhurt. Fired again as he ran up the hill. This time Bain hit him in the leg breaking it & my bullet went into his hind quarter. Got on Jerry & followed the bull which could not now run fast. Dye also followed him & while the bull ran at him got close on horseback & gave him another shot. He soon fell over & seeing rather hard to die, walked up & gave him a coup de grace through the heart.

He turned out to be both old & thin. Cut out his tongue & started back for Camp. Found the distance about 6 m. & everyone too lazy to go out for the meat. Had it been in better condition would have made a point of sending for it.
Afternoon packed all dry plants. Changed damp ones. Capt A. Arrived this evening!

Geol. In all the Coulées through which passed today about this point. Same rocks observed. Sandstones no doubt of lower portion of Lig. Cret. & probably same zone as seen in Milk R. & possibly same as Roche Percée. Very similar to those of latter place in character. Perhaps about 30 feet thick in all. Upper layers weathering into all sorts of fantastic & castellated shapes along the edges of the bank. This upper portion rather massive in bedding. Lower parts very regularly stratified, sometimes in very thin layers, & showing worm tracks & other obscure markings! They appear to be perfectly horizontal.
Below them were impervious beds of sandy clays or clays turning out springs of water, but moisture clearly visible.






Camp 20¼ m. W. of W. Butte astron. Stn.

8 Am. B. 26.05 Light E. Partly cloudy
T. 68°

9 Am. B. 26.04 Calm Clear.
T. 55°

Heavy Thunder storm about 3 Am.

Aug 4. Left Camp Start after 7 Am. with Capt Anderson & parties, & travelled on about 13 m. to a small lake. Passed the Hoop (or whoop!) up road 5½ miles W. of ~~[illegible]~~ morning camp. Running across the line trail nearly at right angles. Saw Astor's people surveying near where we lunched & soon Astor himself appeared & had some lunch with us. Travelled on again to the second crossing of Milk R. or at least of one of its principal tributaries which flows N. Eastward across the line. Patterson has his last station here. Found East & Crompton just returned from a reconnaissance to the base of the mountains. Report much rough

25¾ m.

ground, windfall & timber before the actual peaks reached.

The Whoopup road is the main avenue of approach of the Smugglers & Whisky traders. By it they come N. & W. from Benton to their forts & posts on the Bow Belly & other rivers. The road where we crossed it is deeply worn & wide & shows evidence of recent & very heavy teaming being done over it. I also saw yesterday a party of traders going N. They had several freighting wagons drawn by mules & horses & heavily laden. There were about 6 men & two women. They stated that they had been "cleaned out" by indians last season & one of their party killed. They evidently hoped for better luck this time. This illicit trade is quite organized & many of the most prominent Benton people have a hand in it. That is to say they supply the traders with whiskey &c & take from them their robes. They even accomodate them so far as to team the liquor out to various points on the Marias R, where the traders, many of whom are afraid to appear even at Benton, meet them. Besides injury inflicted on the indians the result of the trade is that a great proportion of the buffalo robes of the N.W. find their way out of Benton instead of by Manitoba. In fact Benton is largely supported & was told by indian trade in British territory.

Sept 4. The country passed over today is hilly, becoming more abrupt so near this river. The road which nearly follows the line ascends gently for about 15 miles

& then drops again towards the river. The hills which begin to develop themselves prominently about 20 miles E. of here have quite a Coteau character. They are not very stony but appear consist of glacial drift & enclose many little swamps & some small ponds. There lie in basin like depressions without outlet. Coulées drain away Northward & Southward but both systems probably eventually reach the Milk R.

The surface covered by fair but short growth of grass & some bottoms arid fair. The hills & uplands are nearly yellow, but not so much dried up as further E. appearances are that we are getting into a much more rainy region.

Buffalo have been killed about here last season but few if any buffalo can have passed through the country from W. Butte to this point, this summer No fresh droppings or trail.

Glorious view of the rocky Mts from various parts of the route - Chief Mountain standing out like truncated pillar.

Camp 20 1/4 m. W. of W. Butte. Ashen Sky.
7.20 Am. B. 26.16 Light
T. 64° clouds

13 m. W. of Camp. Noon B. 25.53 N.W. clear
T. 73°

Summit of highlands between Buttes & Second crossing of Milk R. 15 1/2 m. W. of Morning Camp. 3 Pm. B. 25.31
25.31

Camp valley of Second crossing milk R. 8 Am.

B. 25.71
T. 60° Calm. partly cloudy.

Odometer at Whoopup. Rd. 2250.
" Noon halt at lake. 5300.
" Camp at Second crossing milk R. 10480.

Bearings on Buttes from morning Camp 20 1/4 m. west of W. Butte Astron. Obs. & m. N of line.
N. Peak of W. Butte. 74.5°
Base of highest or Southern peak of W. Butte 85.5°
Pyramid or Central Butte 91°

Aug 5. Morning examined banks of milk R at the Second crossing. Picked up a few plants & found a large ant hill inhabited by the common red headed ant, from which a regular path marked by a throng of insects going in each direction lead away. Followed the path, which was quite beaten in places, for 35 yards when it was found to terminate at a small willow bush on which were some aphides. The ants were busily running over these.
Salway's & Ochs parties got in about 11 Am. & we all started out together between 2 & 3 Pm. & made 7 2 m. to a small lake where camped. Saw an apparently good section at some distance & went out with Boswell on the buckboard to examine it. Got back just in time upon a very heavy thunder storm. Found

traces of a very large Indian Camp which could not have been abandoned more than a day or two. It was on the bank of the Milk R. a band of which we unexpectedly struck on our way to the Section.

Glorious view of the Rocky Mt. peaks in the evening.

In rectification of yesterday's statement as to want of buffalo. It would appear that many of these animals must have been through here in the spring.

Sect. 34. The Milk R at the second crossing flows in a moderately wide valley with banks 40 to 50 feet high. The actual valley of the river is of course in the bottom of a long gentle depression especially marked on the Eastern bank. The scarped parts of the bank show nothing but drift & that here seem almost exactly resembles that seen on the E. fork of the Milk R. It is of anything rather more yellowish in tint however. It includes glaciated stones. Shows signs of stratification here & there but tends on weathering to break up into upright columnar fragments, giving the clifs a peculiar appearance.

Section visited about 2½ m. ~~[illegible]~~ about E.S.E. of camp, & on a bend of the Milk R.

50 or 60 feet thick of beds were exposed in the hill which formed a miniature patch with the character of the bad lands. The lower part consists chiefly of pale greenish-grey clays or mudstones. In the upper part the greenish

colour is not so marked & there are somewhat massive sandstones. The latter are almost conglomerates in some layers, holding small pebbles chiefly greenish shale fragments of bones, & shells like unio. The greenish beds have many nodules of the same colour in some places (See specimens). The upper clays & sandy clays also hold nodules but these are reddish brown in colour. With them vertebrate remains are associated chiefly, though, as already mentioned they also occur in the sandstones, & are found in the greenish clays below. The bones when in the bank are purplish black but where weathered are whitish or dust coloured. They have belonged to very large animals, but unfortunately are so traversed by cracks & crushed by the pressure of the clay that it is very difficult to get any out in recognisable state. The resemble exactly in preservation & form those already found in the "bed cacti" S. of Woody Pt. & on the Milk R at its first crossing. The shells also appear to be similar to those at latter place. They are therefore in all probability Upper Tertiary.

So the beds have somewhat changed their lithological character, especially when compared with the Woody Pt. locality. Sandstones are more important & coarser & the sandy clays have somewhat changed their colour by the introduction of some green mineral or rock. It seems very likely that the green tint is due in the clays to comminuted fragments of shales

(slates) pinkish pebbles are included in the sandstones. These may very well be derived from the same source as the green pebbles now occurring abundantly in the drift (see below) & in that case the interesting ~~fact~~ conclusion would be that the Tertiary beds not only increase in coarseness in approaching the Laramie but differ by the introduction of certain altered rocks in the same way as the more modern drift is found to do.

(Unhorizontal) The section examined is in an isolated hill which stands out like an island of Tertiary among the drift which laps it round. It is an outlier of a plateau with irregular edge which runs approximately northward & begins on the line about 8 m. W of the second Milk R. If this is therefore the very base of the Tertiary the drift in the Milk R. valley may be undulating & cretaceous rock.

N with a little easting.

Superficial drift. Quartzite pebbles preponderate but very many of pale greenish slate. These first noticed W. of Second Milk R.

Valley of Milk R. Second crossing.

| | | | |
|---|---|---|---|
| | 8 Am. | B. 25.76 | Calm. clear. |
| " | | T. 67° | |
| | Noon | B. 25.66 | N.N.E. light |
| | | T. 73° | partly cloudy. |
| Camp 7½ m. W. of River | 8 Pm. | B. 25.53 | |
| | | T. 60° | |

Calm. clear. Two thunder storms this p.m.

Temperature of Milk R. 8 Am. 62°. water greenish-white probably giving rise to name.

Aug 6. Left camp at 6 Am. & continued ascending almost uninterruptedly till we reached the E. bank of the valley of the third branch of Milk R. From this point a splendid view of the mountains obtained & in the middle distance a succession of wave like ridges one behind another, running parallel with the base of the mountains. The valley of the river is here double. A very wide gently sloping one & in its bottom another ditch-like & deep in which the river serpentines, doubling on itself & touching the base of the bank at every bend. The water of similar milky hue to that seen in the river before, but not so much so.
Examined section in bank while lunch preparing collected a few plants.
Shortly after leaving the river passed numerous fine springs coming out along the sides of a branch valley. Temperature of water 46°.
Camped at a small lake. Rudy & met many ducks - traces of a very recent indian camp.
~~Wide mountain valley~~
Crossed a road heavily marked leading to "Fort Standoff" a whisky-traders post at the forks of the Bow & Belly Rivers. Road running nearly N & S where seen.
Chief mountains standing up always ahead. A very prominent landmark about 5 m.

South Olive. Resembles huge broken pillar & stands out from the other mountains, with which it is connected by a ridge. Horizontal lines of stratification clearly visible in its front.

Told that trail from Benton to Edmonton is identical with past "Stoop up Rd" seen W. of Battles. The trips can be made with teams in 17 days.

Gol. Sections in banks of 3rd fork branch of Milk R. show similar beds to those described yesterday. Green-grey sandy clays & well stratified sandstones some layers rather soft, others hard. Beds almost perfectly horizontal. Probably anything a little lower than yesterdays section in series as beds seen in a lateral valley two or three miles W. & still horizontal resemble yesterdays section more closely by the presence of reddish nodules, & are at a higher level.
Fossils found in section on banks of R. in a layer of nodular limestone? or impure ironstone which weathers red-brown. Shells apparently fresh water paludinas &c some looking identical with those found on the Souris &c.

White limestone boulders still appear in superficial drift.

Gold. issued by Stuart & Campbell Hdq. Edmonton have prospected in this part of country that

traces of gold in all the streams coming down from the mountains. Campbell specially mentions Kenney found gold in streams running down W. of Chief Mt.

Camp 7½ m. W. of Second crossing Milk R.
6 Am. B. 25.68
T. 51° N.W. clear.

Height of land between Second & third crossing of Milk River, nearly on the edge of latter stream. Alt. 9.15 Am. B. 25.05
Bottom of valley 3rd crossing 25.49

Bottom of Valley 3rd crossing Noon 25.49 calm part cloudy.
T. 78°

Camp at lake 8 m. W of 3rd crossing
9 Am. B. 25.55 cloudy
T. 57° thunderstorms.

Water of river. 3rd crossing 65°
Water of spring W of river 46°

Odometer 3rd crossing 5175
" at springs 5625
" Road to stand off " 8200
Camp at lake 8600

Aug 7. Start 6 Am. & came on 6½ m. to so called St Mary's R. a tributary of the Belly R. which runs into Saskatchewan. Cross watershed between Gulf of Mexico & Arctic Sea. The river a splendid stream rushing rapidly N. ward over a pebbly bottom. The banks high & steep. The water transparent & blue. Fine trout in the stream, of which some caught by the men. Current so swift that though water rose up to horses belly some nearly carried away. A very steep bank led down to cross short after crossing the river. All teams doubled up.

Necessary to do some cutting at river brink.

Stopped on a small tributary stream for lunch. On through a beautiful country with the mountains in full view. Thunder storms in all directions & distant spots grain.

Site selected for astronomical station & camp pitched about 4 P.M.

Geol. In valley St Mary R. section showing hard sandstones of considerable thickness, well horizontally bedded, showing worm tracks & ripple marks. dipping at about 20° S. Westerly. About 4 m. W. of the river valley a ridge of sandstone cropping out along the edge of a hill, yellowish in colour, some layers soft & others hard. Strike N 41° W with a very steep S. Westerly dip. Found enclosed in these rocks a log of silicified wood the first found in situ.

(not metamorphosed)

?

The first flexure seen occurs on the St Marys R. The ridges may be said to begin at the 3rd crossing

?

of Milk R. They are at first flat topped plateaus rather than ridges, though they appear as such from a distance. They do not depend on the geological structure of the country but on water erosion acting on horizontal beds. Often crossing the St Mary's bottom the ridges are steeper & frequently seem to depend on sandstone beds which stick out along their tops.
The folding due to the mountains elevation therefore appears to begin abruptly.

Cannot tell to what formation sandstones seen belong.

The country has been of better character since leaving the Buttes than E. of them, but has now a very fertile appearance. This may be said to begin about the 3rd crossing of Milk R & the line. The plants which have been sheltering in damp coulées now creep out again & cover the hills. The grass is long & luxuriant especially in the bottoms where splendid hay. The soil black & rich. Altogether a splendid country of early & late frosts do not occur which from elevation seems probable.
Part of fertile belt.

Camp at lake 8 m. W. of 3rd Crossing.
6 Aug. B. 25.53 wind S.
T. 60° light. Clear.

Camp at Astor. Station. 8 Aug. B. 25.04
T. 49° Calm cloudy.

Water St Marys R. 62°. Odom. at St M. River 2600.

Aug 8. Left camp at 8 AM. with Capt A. Burpee East & a party of scouts to make a reconnaissance to Moulton or Chief Lake & ascertain the practicability of a waggon trail to that point. Morning cloudy & windy but fine. Followed the so called Kootanie trail which resembles a buffalo path more than anything else. By it the Kootanie indians & company with the Flatheads & Pend oreilles come over to hunt buffalo in the autumn when these animals fall back among the foot hills. The Western indians associate themselves thus for protection against the Blackfoot & allied tribes.

The country passed over beautiful in appearance. Luxuriant growth of grass & flowering plants. Poplar & black thickets & in some places spruce, but woods have been very generally burned & where they have been much windfall & brulé. Many beautiful little lakes & ponds, perhaps the majority often formed originally by beavers which are still at work. Hay grass in damp hollows often nearly up to horse's backs. Wonderfully refreshing after the monotony of the dry prairie.

Found some of Capt Cameron's people camped in a valley about 5 miles N of our camp. They have been waiting 5 days for his return from the mountains.

Travelled on about fifteen miles at as rapid a pace as the nature of the ground would

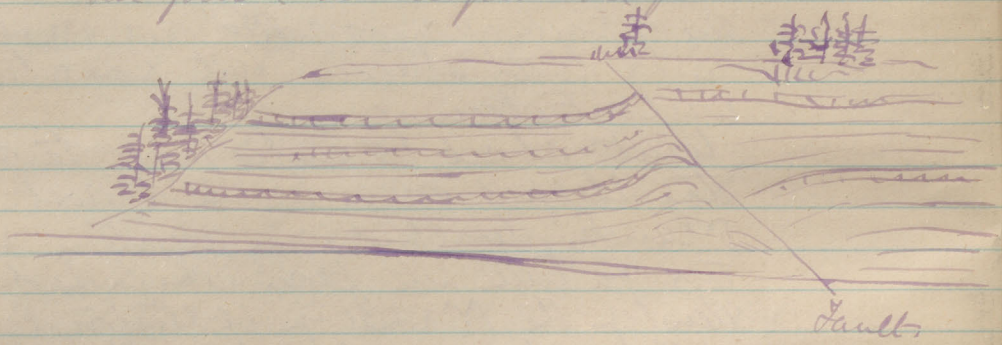
allow, the pack ponies giving some trouble from the constant loosening of the tying of their packs. At about 15 miles came on a large river running northward & like the St Marys R full of beautiful clear blue water & very rapid. After some trouble found a place to ford & crossed. Lost the trail for some time but presently picked it up again. One of pack ponies rolled over on its back in a little stream but was extricated without damage.

Went about 5 miles past the river & then stopped on a brook to rest the horses & lunch, walked on about a mile to the top of a little hill from which had a good view of the N end of Waterton Lake & its valley & the river to which it gives rise, running northward. Returned to place where horses left, lunched, & Capt A. Burpee & I started back for camp leaving Rest with pack animals to finish the Reconnaissance. Rode back in four & a half hours without accident though I got one spill in a swampy hole.

Chief Mountain visible from almost every point & constantly presenting new aspects.

Saw several new plants, among others the red flowering raspberry, the berries of which are trying to ripen. Also huckleberries & common raspberries. The Elaeagnus of the plains growing now to a large bush in the thickets. Found a species of Castilleja new to the collection

? Not many exposures & had little time for their examination. Saw some curiously contorted beds where stopped for lunch. Consisted of thin bedded sandstones, interbedded with clays & sandy clays & not much metamorphosed. The sandstones had fragments of charcoal on some surfaces but proved no recognisable fossils.




Foot Hills Astronomical station 8 Rm.
B. 25.50 S.W. clear
J. 52.

Aug 9. Changed plants, & then started with Boswell Galway & others to fish in the St Mary's R. about 6 miles S of here. Drove down in the buckboard. Had very good fishing getting a number of fine trout & some suckers. On starting to return missed the buckboard & waited alone some time on the bank of the river, opposite some whisky traders shanties. The traders have a herd of 130 ponies got from the Indians. One of the traders came across the river to drive the

horses. Had a long talk with him. They are afraid of the US. troops soon coming up with the astronomical parties & intend moving off N of the line tomorrow or next day & burning their shanties. They have never traded two years on the same spot, always burning their shanties on leaving for fear of opposition. They buy horses from the Indians for whisky &c in Summer & then sell them back during the winter for robes when the buffalo come up into the hills, making enormous profit in both transactions. Said had traded N 14000 robes in these shanties last winter. Said that last winter was a terrible one. 3 feet of snow on the level & stayed there months Jan. Feb. & March. Some left in April. Says however that snows sometimes in August. Evidently a set of desparadoes & having no regard whatever for life. Told me that 8 indians had been killed & 5 wounded "round these shanties" during the last 18 days. Not long ago some indians made a plan to shoot him but were discovered & three of them shot on the spot. Blood indians stole away 17 horses from them a few days ago, they were taken from the bloods however by Blackfeet & the latter brought 14 of them back & got some "blankets" &c for their trouble. The indians get drunk & then those of different tribes quarrel & kill each other constantly, the women very often raising the row by boasting about their relations' losses. My informant, known I believe as Castillian Joe, says the US. authorities have a "dead due" against him for something

he "does not know what" though I dare say he could tell very well if he pleased. Had two indian boys herding & they are generally armed with 16 shooting rifles for fear of indian war parties. Undressed when I saw them, for saying that they had frightened him in the morning into dashing across the River with his rifle. They were going away but at a corner of prairie chickens only. – Laments the good old times when a robe worth only a ~~glass~~ pint of whisky now have to give a gallon & a half of tea. Says it is not safe for a few men to travel alone in this country, though he does not mind travelling anywhere by himself for if a party of indians appear he only allows them to approach & if they make signs of hostility he can put a bullet through their chicken than he can draw his pistol.

Buckboard at last came up & ended conversation. Drove back to camp arriving about 7.30. Found Capt Cameron just in & asked him to dine with me. He has had rather a hard trip in the mountains & did not succeed in reaching the mound built by the old commission on the watershed.

No sections along the immediate banks of the St Mary's R except on gravel banks. Solid strata not evidently fractured.

Found that Clarke had been to Camp, from his present station on the crossing of the line of St Mary R, & had brought some fossils & a sample of Coal.

Foot-Hills astron Stn. 9 Am.
B. 24·84 W SW Clear.
T. 68°
9·30 Pm. B. 24·80 Calm. Clear.
T. 52°

Aug 10. Capt A. & Road making party went on this morning to the next river West. Had intended accompanying them but stayed behind to go back to Ashes Camp on St Mary's R to see his coal bed. Rain however came on early in the morning & continued heavy all day. Thought best to put off excursion till tomorrow & then start back early in time to catch him before leaving camp. Very cold, miserable & misty. Got a stove in one of ~~[illegible]~~ tents & read 52.

Foot-Hills astron Stn 12·30 Pm.
B. 24·90 NW. Rain since morning.
T. 56°
9 Pm. B. 25·03
T. 46°

Aug 11. Called at 4·30 by Sentry but heavy rain still coming down with unabated violence, knew it would be no use to get up. Rain & mist continued all day.

Foot-Hills Astron. Stn. 8 Am. B. 25·09
T. 49° Calm. raining.
Noon B. 25·10
T. 57° Calm. raining.
9 Pm. B. 25·12 E. light raining.
T. 47.

Aug 12. Morning still wet & raining almost constantly but showing some signs of clearing up. Left camp at 10 A.M. with Capt Featherstone's party following the newly made wagon trail. Road very hilly & several breakdowns occurred. About noon came on camping place where Capt A. & the road making party had weathered out the storm. Had left not long before & fires still burning. Lunched & then pushed on to Belly R, meeting Compton & Scouts just in time as they had only finished exploring a new road to the camping place, much shorter & better than their own trail. Camped on the W. bank of River.

Weather cleared about noon & mountains began to show themselves after having been concealed for more than two days. Clouds still however clinging round the peaks. The rain must have been represented by snow on the mountain tops as they are far more extensively whitened now than before the bad weather.

Armstrong saw & tried at a real panther today near our present camping place.

The river filled with splendid trout some of the men have had large strings of fish.

Fort Hills Astron. Obs. 8 Am.
B. 25.00
T. 46° Calm raining.

Camp on Belly R 8.30 P.M.
B. 25.31 S. light. Clear.
T. 44°

Aug 13. Capt L. moved his camp about two miles up the valley. Southward to the farthest point practicable for wagons! The line about 4 miles still further S. Rode up past his camp. Found several new plants. Vegetation of valley very luxuriant & gay with Asters Solidagoes, Epilobiums, Gerdenuums ?? (See specimens from wood, but) Sunflowers of various kinds &c. &c.

Castilleias.

Geol. The river cuts into high banks in places especially S. where the valley becomes contracted & gorge like. These appear to be composed chiefly of drift though in one place a section showing thin layers of sandstone seperated by soft clayey beds, was seen. The whole dipping north at about 15°.

?

Gold. Campbell who has prospected this river several years ago says there is gold but not in paying quantity. "Two or three colours to the pan" This to be found by grubbing in the banks when the drift comes down on the bed rock.

One of men brought samples of lignite which he says occurs in the bank of the R. Have not had time to visit it but intend doing so on return.

Rem. Getting packing up & other preparations made for start up the mountains. Pack animals in readyness &c.

Camp. Bell R. 8 Am.

B. 25.24 N.E. light. Clear.
T. 58°

3

3 P.M. B. 25.08 N.E. light
T. 74° Clear.
8 P.M. B. 25.16 Calm Clear.
T. 54°

Beautiful effects of light & shade on the mountains.

Aug 14. Set out for the mountains with Capt. Crompton & a small party of axemen. The latter in case trail has to be cut out to the monument. Have with me Duckworth Stuart, two pack animals & a riding horse. Much ado at start getting packs arranged, both horses & men being unused to the business. Great art required in offering load so that it does not work loose & come up after a time. During the day frequent stops to repack (on packing form of saddles &c see Lord's "At home in the wilderness")
Follow the Kootanie trail towards the pass. It skirts the northern end of Waterton Lake & crosses it by a ford fourth deep just where it merges into the river. The lake is magnificent sheet of water long & river-like & running South a long way bordered by almost precipitous mountains. Those on the East side belong to the outlying spur called on Blackiston's map Mt Wilson. Those on W. belong to chief range of rocky mts. only the northern end of the lake is open, & that is bordered by undulating green prairie of the foot hills. The arrangement of material being evidently that of moraine matter stopped for check in the jaws of the Kootanie Pass

& even here on the threshold of the mountains began to find many new plants.

Started again in the afternoon & travelled about 5½ miles W. along the pass. The trail is rough but not very bad. It follows sometimes along the bank of the stream, but often climbs far up the slopes of the mountains. So far the bottom of the valley is generally flat, sometimes forming little meadows & sometimes clad with poplar & pine. Camp on a little meadow patch surrounded by thick pine woods just where the valley branches. One arm running S. Westward, the other a little N of West. The trail also branches, but that going up the SW. valley is evidently the most travelled.

Bones of buffalo are frequent as far as the Camping place, but beyond this point were not seen, & this probable marks the limit to which these animals penetrate the hills in winter.

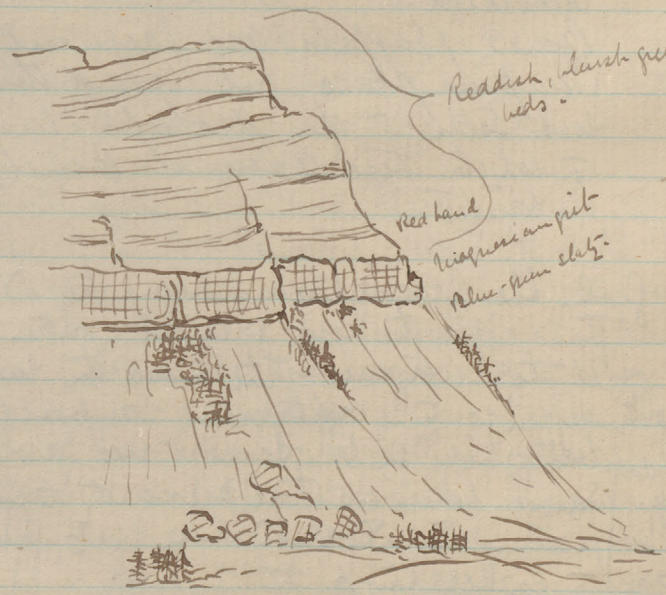
Sept

Sept. The mountains along the Northern side of the pass offer the best & most continuous section. At the entrance of the pass the rock on the S. side appears to be ~~[illegible]~~ composed of ~~[illegible]~~ disturbed slates & sandstones, probably belonging to same series as those presently to be mentioned as forming the N. entrance rock, but difficult exactly to correlate.

The lower part of the N. mountain composed of reddish, greenish & bluish-grey coloured slates & sandstones considerably altered. These form a broken

The E. end of rock pretty regular, shows the crimson sandstone about half way up. The hog-back being below the base of section exposed. Dip W. SW., at low angles.

& are not very well exposed. About half way up the mountain a yellowish massive bed of Calcareous & probably magnesian grit occurs. It may be about 50 feet in thickness. On fresh fracture it is white, being composed of clear particles of quartz & a white magnesio-calcareous cement. It forms a bold shelf on the mountain side & great blocks of it have fallen down & encumber the pass. The upper part of the mountain is formed of a succession of red, greenish, bluish, & grey sandstones & slates which alternate curiously & have quite a ribbed aspect from a distance. The whole mass dips S. westerly.




Greenish quartzite.
Greenish slate } exp in brook about here.

In following up the N. side of the valley to the camping place the following beds are met with, coming down on the trail at the distances given.

1¼ m. Green slates & variegated sandstones &c of upper part of mountain section continue with similar dips.
Then next base of a band of 200' or more of crimson or purple red sandy shales which forms a very marked horizon.

¼ m. further trough of synclinal. Top of a peak in synclinal formed of brownish columnar beds of limestone. Some other beds not well seen intervene between the crimson zone & the limestone. After passing synclinal beds dip. N. Easterly.

2/3. m. further. Gentle anticlinal

½ m further ~~[illegible]~~ the base of the red beds have come down again on the trail

½ m. further Beds nearly flat. hills low. Red bed at the base & about half way up.

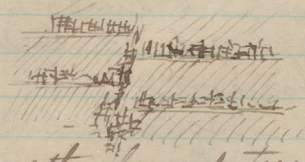
1½ m. Valley follows anticlinal. Top of red beds not yet down to level of trail

Camp. Total distance into pass estimated at 5¼ m.

The hills N of waterton lake are evidently composed of moraine matter, & show rocky fragments of all shapes & sizes piled together but generally concealed under luxuriant vegetation & close sod of foot hills. The glacier forming the moraine has evidently pushed N along Waterton Lake valley & scooped out the numerous ravines & valleys opening into it on both sides.

The entrance to the pass is beautifully terraced

on the S. side for some way up the mountain. The terraces however do not exactly correspond in level. The top zone sometimes being on the level of the middle of another equally well marked. Is it possible that faulting has taken place since the formation of terraces. [See recent disturbance of terraces in Hutton acct.]



One of the lowest terraces, cut into by the brook shows a great thickness of clean pebbles very uniform in size & of a general pale purple tint.

Camp Belly R. 6. Atm.
B. 25.18
T. 54°
Calm. Partly cloudy.

Waterton Lake at efluc of R. 11. Atm. B. 25.31
Tops of foot-hills at mouth of Pass. noon. 25.03
Mouth of Pass 1 Pm. Thermometer 72°. Wind SW
Water of brook 54°.

Camp not. 5½ m. into pass. 8.20 Pm.
B. 24.71
T. 58°

Aug 15. The chief object of the expedition being to attain & the monument built on the Watershed by the former Boundary Commission in 1861; & by doing so tie in the work of the two surveys;

I now became expedient to choose the most practicable route. Where we camped about ten miles from Monument & most impracticable peaks intervening. Capt Cameron with a few men attempted to get to it some days ago. He tried the Kootanie pass but this going too much west he climbed a peak about two miles from its entrance but could see no practicable route. He then went down to Waterton Lake, one of the streams flowing into which rises near the Monument. He could not reach the mouth of this stream except by raft & was beaten in attempting to ascend the valley by woods windfall & brule. Capt A. decided to attempt passage by a brook joining the main one about 2½ miles up the pass & which was also supposed to rise near the Monument.
The old boundary trail to the Monument branched from the Kootanie trail at a place called "The forks" about 5 miles on the British Columbian side of the watershed, & from there ran S.E. down a branch valley. Thinking I would see as much of the country in that as any other way I volunteered to go over & see what condition the old trail was in.
Started with Duckworth, both mounted at 7.45 & followed the Kootanie trail S. westward. The trail for about half a mile follows the axis of a gentle anticlinal which runs into the point seperating the S.W. & W. vallies already mentioned. It then turns to the left & follows the N.W. side of the valley, sometimes near the stream & sometimes climbing high up the mountain side

to avoid ravines, windfall, rocks &c. The track much encumbered with windfall, through some of which heavy fires have passed this spring. The Indians appear never to think of cutting a log or fallen tree if they can help it. The trail from year to year assumes new courses to avoid these obstructions & becomes very devious in consequence. As it was the horses did nothing but step over & scramble through logs & fallen trees for miles. Crossed the brook twice & then left the main stream running out of a ~~si~~ valley to the left & began the ascent of the watershed ridge. This very steep, encumbered with trees & rocks & exceedingly trying to the horses. The steep part overcomes an ascent of about 1000 feet. The summit attained was found to be a long rounded ridge of broken rock (Summit approx. 7½ S.E.) with stunted trees & alpine plants. A most magnificent view in both directions. The scenery which has been splendid all through the pass here culminating. Looking westward the valley of the pass is seen to run S.W. between two splendid mountain masses, of which the tops are covered with snow, & which were at once recognisable as Mts Kerby & Spence, & Mt Farrel of Blackiston's maps. Saw also the valley up which boundary trail must run but at a long distance & found it impossible to reach it in time to loose. Started & again to descend into the valley of the western flowing stream, a tributary of the Flathead. The descent

even worse & more trying than the ascent. The brook where first struck on the W. side, at the base of the step ridge being nearly 300' lower than that last seen on the E. side. Again involved in windfall & an exceedingly narrow & treacherous path along an almost precipitous side hill rendering progress provokingly slow & toilsome. Got down to the forks of the stream at 1.30, & found the place marked by the widening of the valley into a little meadow studded with young Banksian pines. Found the old boundary trail branching off, & followed it several hundred yards. It appeared to have been recently used & was well beaten. Rested the horses half an hour or so & ate what lunch we had brought. Could not stay longer for fear of being benighted. Worked way back again over the old obstacles & arrived at Camp No. 1. at 7.15 just before dark. Having been nearly 12 hours in the saddle or walking & leading the horse, & accomplished a distance of about 30 miles by the worst possible kind of trail. Saw hardly a living creature all day the woods & hills being remarkably silent & lifeless. Chickadees in the woods & a rather garrulous & harsh voiced species of jay? Loudly in the tops of the pines. Also a few small black grouse. Found that Capt. A. had failed in his exploration not having been able to find a practicable track. Windfall & forest fills the lower parts of the valleys & the only way to get along is to keep above the timber. The side hills are then exceedingly steep & generally impassable for pack animals. Decided

to try & reach the Monument by the Kootanie pass & old Boundary trail routes.

Geol. Noted in a general way the rocks appearing in the valley.

About 4 m. up the valley a thick bed of contemporaneous amygdaloidal trap is seen overlying the limestone. Large fragments of it have fallen into the valley. The capping of the mountain on the right hand is here of fawn coloured beds which overlie the trap. Dips of the whole westward at low angles.
A little beyond this point a brook runs into the main valley & appears to come in a general direction of S 7° E. mag.
About 9 miles from Camp cross the watershed. Mt Farrel appears to be formed of similar beds to those already seen. A great mass which including red beds & limestone are there tilted up to the N.E. at an angle of about 45°

Camp No. 1. 7 Aln.
B. 24.78 Wind light. W. Clear.
T. 55°
Water in brook 44°

Height of land on watershed 11.25 Aln. B. 22.82
Brook at foot of watershed ridge W. side. B. 24.125
"The Forks" 1.30 B. 24.66
Camp No. 1. 10 Pm. B. 24.71.

Aug 16. Whole party left Camp No. 1. at 7.45 & travelled W. by Kootanie trail. Passed the same trail as yesterday & through the same magnificent scenery. Here the men ahead forever cutting impeding logs & making the passage much better. Nevertheless hard work driving & leading the pack animals with their cumbrous loads over & through the woods & windfall. All sorts of trouble with the packs. Lashings constantly coming undone packs catching on logs & tearing off. Much heavy swearing indulged in among the men.
Many berries of various kinds. Berry of the white flowering, & common raspberries. Blueberries, Amalanchear berries.
Arrived at "Forks" Camp at 2 P.M. & after lunch went on foot to explore the old Boundary trail. After following it some time found that the main track, & one used by the indians turned off to the left up the shoulder of the hill & did not keep the proper direction. Then discovered the Boundary trail by the old cut logs & blazes. No one had apparently used it for the last thirteen years & the aspect of the woods had no doubt in that time much changed. Areas then covered with windfall through which had been much heavy chopping then now coming up in sturdy young growth. Much of the old windfall had been burned away. Where however heavy standing timber had been 13 years ago now heavy recent windfall all across the track & very difficult

to follow. It had been well blazed, but the marks now mostly nearly grown up. Cut into several & could distinctly the 13 yearly increments. The wood turning in towards the wounded part & eventually forming a new union. Rather a curious research altogether. Accurately blazed the track as far as we traced it & all then returned to Camp & make ready for tomorrow.

Sketched out Jarrel from the Camp. Pressed the many new plants collected.

Saw large tracks of grizzly bear near Camp.

Ther crazy from Camp No.1. to Forks Camp.

Left camp. 7.45 Twin peak bearing S.52°W.

9.45 Just below out point of Twin peak. Cross the brook.

10.30 Cross last branch of brook before beginning steep ascent of watershed

11.20 Summit

12.35. Reach the first West brook at W. foot of the watershed ridge.

2. Pm. Arrive at Forks Camp.

Rate of travel say 2¾ miles an hour, reduced to 2 while crossing watershed ridge.

Camp No.1. 7.15 Am. B. 24.83 T. 53° Clear calm.

Brook at E. side watershed ridge 10.30. B. 23.97

Summit 11.20 B. 22.94

First W. brook on W. side ridge 12.35 B. 24.29

Forks Camp 8.30 Pm. B. 24.90 T. 52° Calm Clear.

Jul. The contrast between the abruptness of the break in the country on the two sides of the mountains is very marked. On some of the ridges one can see through the gaps the sea like prairie to the East, the undulations of the foot hills being hardly discernable from the height. To the West nothing but an ocean of abrupt & pine clad mountains which may be said to reach from there to the Pacific coast. The rocks where seen 5 or 6 miles E. of the base of the mountains are Cretacious or Tertiary & though disturbed not metamorphosed but comparatively soft & earthy. A sharp line seems to seperate these from the mountains proper & West of this the whole country is corrugated & folded.

Aug 17. Left Camp 7 A.M. & Travelled S.E ward up branch valley towards Boundary mound, following as nearly as possible the old trail. Axemen ahead hard at work making way through windfall. When we got into the heavy wood progress very tedious never pass more than a few yards when brought up by another windfall which must go round or cut through. Sometimes much difficulty in finding the trail at all. Axemen disperse through the wood & look for old chopping or half grown up blazes. Many of the logs cut 13 years ago still sound. Some old trees which had been dead & partly burned 13 years ago & had then been marked with a blaze still standing. When nearing the old camping place nearest the monument, missed the trail for some time among heavy woods, but at last picked it up again

Splendid spruce trees just round the camp growing scatteringly & with green sward between them. The dampness of the climate here also causes all sorts of vegetation to be exceedingly luxuriant. Rocks clad with moss as well as trunks of trees. Dead branches full of bright yellow & black lichen (see specimens) A pretty noisy brook running over clean pebbles of red slate formed excellent place for washing & toilet. Its banks gay with flowers of all sorts & green with moss. Large patches of snow in the hollow at foot of steep hill & only a few hundred yards from the camp. Camp called by old Survey "Camp Akamina" a name obtained from the indians.

Jul. Four miles up the valley from the forks camp the valley is blocked by a series of very evident & perfect moraine mounds. Traces extend for nearly a mile. Those lowest down the valley have been much modified by water & are merely steep rounded knolls. Those last left by the glacier still retain their abrupt ridge like form & are concave toward the glacier side. These no doubt at one time dammed up a lake, but the stream has now cut completely through them. Where a lateral valley joins in a straight edged ridge has been produced by the interference of the lateral glacier subsequent to retreat of main one.

About 5 miles up the valley observed reddish & bluish-grey sandstones & slates dipping

N Ward at angle of say 80° & forming the hills on the N.E. side of the valley. Rather thin bedded red sandstones however preponderate the whole way up the valley. They lie very regularly & uniformly & almost preclude the possibility of extensive reversals of strata.

The general sequence of the whole of the beds seen disregarding possible overturns appears to be as follows.

1 Grey reddish & greenish slates sandstones & quartzites frequently alternating considerable thickness. (Seen at entrance to pass)

2. Yellow weathering calcareo-magnesian grit. massive. Seen at entrance to pass. Say 40 or 50 feet thick.

3. Dull reddish, bluish greenish, & grey, beds sandstones & slaty rocks & quartzites? Say 200 or 300 feet or more.

4. Crimson beds. Shales & sandy shales of deep red colour, some fine thin pale green layers in marked contrast. Colour deepest red in lower layers. Say about 200'.
Forming lower parts of pass on N. side 4 or 5 miles in

The upper layers of this stratum apparently turn again into variegated beds like those below. At least in places.

5. Limestone, generally bluish grey on fracture but weathering brown or fawn colour & forming when on the tops of mountains crags or peaks quite columnar in aspect. Say at least 300'. occurs in all the hills along the pass at various levels for 8 or ten miles. When half way down a mountain or near the base does not generally become columnar or craggy but forms sloping ledges. Lightly seperated by many stratification planes.

6. Amygdaloidal trap. No doubt contemporaneous, but variable in thickness where seen between Camp No. 1 & the watershed probably 50' thick at least. Dark coloured, & forming cliffs in the mountain sides.

7. Fawn coloured flaggy beds overlying the last & apparently an upward continuation of the limestone series which has only been intercepted by the trap overflow. Thickness not great.

8. Great upper series of red sandstones. not so bright as the Crimson beds but distinctly red. Includes however some grey or pied beds. Many of the sandstones massive, but often as frequently the case forming top of hills & ridges weathering to a steep rubbly talus. Seen in many places.
200' or 300'.

9. Upper series of pawn coloured beds probably calcareous. Form crumbling hill tops. More than 50 or 60 feet seen.

Forks Camp. 6 A.M.
B. 24.83 E. Light. Clear.
T. 40°

Camp at Kamnia 8.30 P.M.
B. 23.21 Calm Clear.
T. 50°

Aug 18. Left camp early with Capt A. Crompton Duckworth & some of men to go to Monument, which situated about a mile nearly S. of Camp. Passed out of the woods & clambered up a very steep grassy slope, every few feet gained or which opened some new valley or feature of landscape to view. Got on the crest of a steep hog back ridge seperating two immensely deep valleys in each of which a little lake formed by expiring energy of glacier. The valleys formed

like amphitheatres with cliffs behind & open in front. Climbed up along the knife edge towards the central peaks. The only path exceedingly rocky & treacherous. In one place obliged to climb down a steep rocky face only a foot or two from the edge of a precipice hundreds of feet deep, & appears to overhang the lake. Got at last on a round topped summit & found that must go down again some distance & climb round the flank of another mountain to get to the monument. The hillside however so steep & rocky that could not pass along it safely so got on top of ridge again & clambered on over rocks. Came at last to a very bad cliff overlooking the monument by 100 or 200 feet. Down this it was very difficult to go & to round it one must travel a long way. Felt quite contented with proximity & sat down to enjoy view while one or two adventurous men went on to the monument itself. Stop on a beautiful little meadow among the rocks evidently much frequented by mountain sheep, three of which were seen making their way up a distant ridge. Many alpine plants growing near the snow which still lies here in large drifts & fills some of the valleys on the higher peaks.

The view wonderfull. In valley to S. of monument a large lake, & another smaller in sight. The water evidently deep (see diagram) & from our birdseye view intense opalescent indigo colour. Other

valleys opening in all directions. That running West holding another large & beautiful lake & flanked by two of the highest peaks in sight, both to a great extent snow clad & almost perpendicular towards the top. (See sketch) The prairie country visible through gaps in the Eastern ranges. Also a glimpse of water on Lake nearly due E. Westward range behind range as far as the eye could reach. The silence only relieved by the sharp clear whistle of the rock marmot which answer each other from hill to hill. Returned to camp slowly collecting plants & rock specimens by the way

Many plants seen in seed at lower levels on the peaks still in flower. They gradually become stunted & depauperated on ascending. Besides plants collected in flower the following were noticed blooming very high up: Castilleja same as found on foot hills (see specimens) white variety preponderating. Campanula rotundifolia, the common Epilobium. also the shrubby yellow flowering genus? This very common not on the mountains & foot hills.

Boundary Mt. section. Geol. Examined a section embracing say about 700' of beds on the way down. The whole dipping at a gentle angle E. ~~Westerly~~. The section was seen to be overlain on neighbouring mountains by at least 200' of red sandstones &c forming the upper red series. (No 8) The Barometric difference of elevation between top & base of section examined = 0.90 or over 800 feet. The section may be taken as embracing some lower beds of No 8. The whole of

No 7. & No 6. The upper beds examined consisted almost entirely of flaggy dull red sandstones frequently ripple marked. In descending these began to alternate with beds of grey & fawn coloured sandstone, the latter calcareous & white on fresh fracture. Lower in the section whole red & red-purple sandstones still continue, whitish & fawn coloured limestones frequently concretionary are intercalated & become thicker & more frequent towards the base. These are then followed by No 6. the Amygdaloidal trap, which has here a thickness of at least 50 feet. The thick flaggy limestones seen underlying the trap in cliffs in neighbouring mountains.

Many of the sedimentary beds are ripple marked. Impressions of sun cracks & rain pittings are not infrequent & at several different levels the surfaces show curious impressions of salt-crystals which have since disappeared. The whole indicating a land locked shallow salt-lagoon or basin not in communication with the open sea. No fossils or traces of fossils could be found.

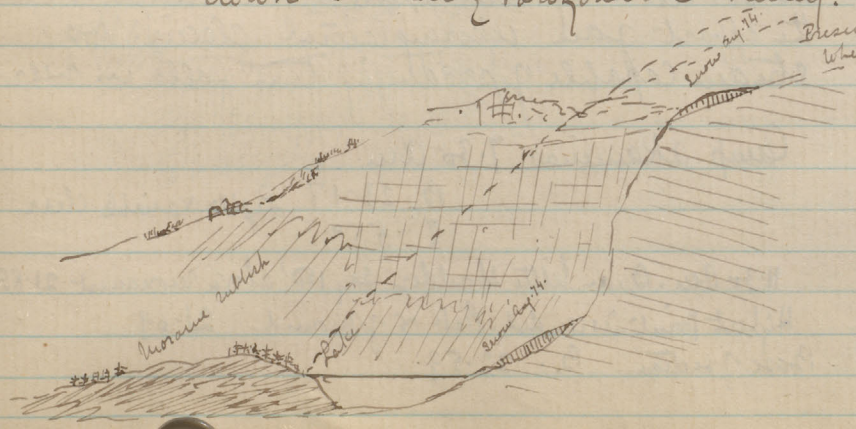
(See series of rock specimens marked Boundary Mt. Section & numbered from above downwards.)

At Camp Akamina the rock seen red sandstone somewhat irregular in position.

The dips of beds forming the mountains at any rate in this part of the range do not appear

to be steep. The beds lie generally pretty regularly & at comparatively low angles. Many of the mountains & ridges have a form resembling that of waves ready to break; depending on the near parallelism of one slope (generally the western) with the planes of the beds. The opposite side showing abrupt cliffs where the strata have been broken across.

Effects of glacial period very clearly & beautifully shown. The larger lakes long & river like & lying in valleys radiating from central peaks appear to be blocked in by ridges of moraine matter. Amphitheatres with almost perpendicular walls are common near the larger peaks, & generally terminate the valleys. They are open in front & almost invariably each holds a little indigo lake in its bottom which has evidently been formed by the descent of the glacier when near its last. The prow ploughing deeply into the rubbish in the bottom of the amphitheatre once holding a great <u>nevée</u>. It is to be noted that the excavating power of ice thus descending almost vertically must be much greater than when moving down a nearly horizontal valley.




diagrammatic section of Coombe Lake

The depth of most of the lakes is very great, as indicated by the intensity colour when viewed from above. Much snow lies at present on the shady sides of the higher peaks & lingers especially in the retired amphitheatrical valleys. It is generally quite hard & may be walked over with ease, but has nothing of the character of true glacier ice. This perennial snow is no doubt keeping up direct succession since glacial period & only waiting another opportunity to advance again down the valleys.

The lake immediately E. of the Boundary monument is very remarkable & the transparency of the water allows the contours of its bed to be clearly seen. No stream of any magnitude enters the lake & no valley communicates with its upper parts. It lies in a hole among the mountains only open to the N. The shores are surrounded with a well marked bench or shelf of shallow water which suddenly falls to the deep water of the centre. The depressions at a. are very well marked & seem to indicate the effort of an expiring lateral glacier. No stream capable of producing these falls in near.

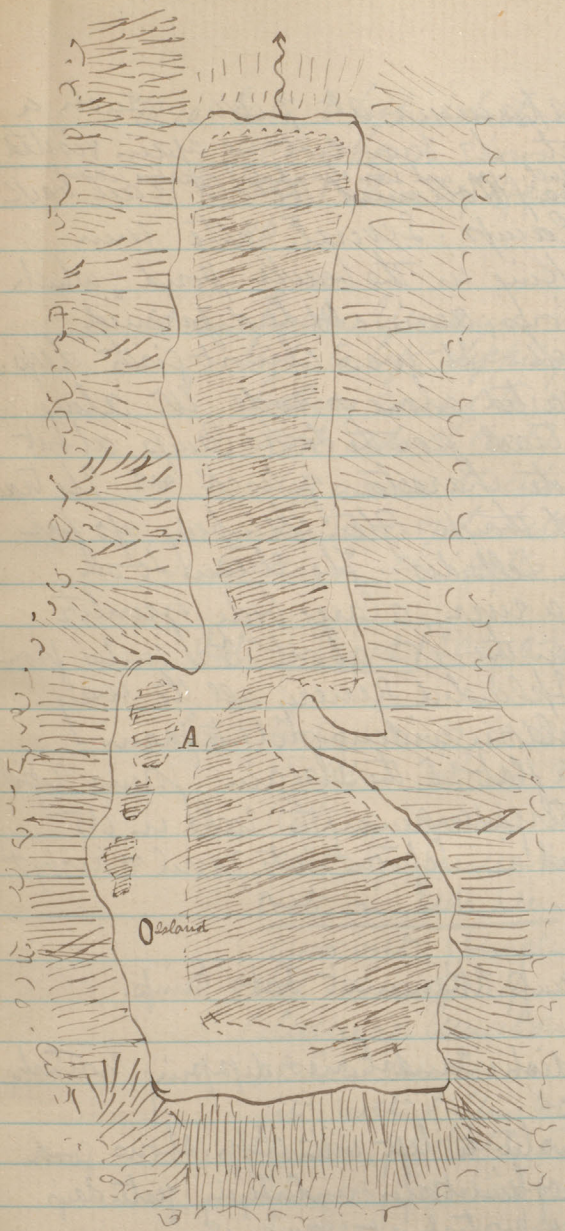
Camp Akamina. 7.30 A.M.

B. 23.17 Light. variable. Clear.
T. 55°

11.30 A.M. B. on little shoulder say 150' above monument 21.85

(Top of section) Highest point ascended. Peak N of mound. 21.69

Base of section B. 22.59




Camp Akamina 3 Rlu.
B. 23·10

Camp Akamina 8 Rlu.
B. 23·20
T. 49°
E. Light. Clear.

Aug 19. Left Camp Akamina at 7 a.m. such a lovely spot that it may not be again visited for fifty years. Followed the old trail back to the Forks Camp. Several of the men getting a ducking in the beaver pond, which these industrious animals had formed across the track. It was almost girth deep. Afternoon started alone & rode W. along the Kootanie trail from the Forks Camp about 4 miles to note character of rock &c. The trail is pretty good though often climbing up far on the northern hillsides. The stream soon becomes quite a river, a large body of water coming in from the N. about 3½ miles from the camp. Splendid scenery all the way. The valley seldom widens out to form anything like a flat & the stream forms rapids & small waterfalls among the rocks in its course. Hemmed in between nuts Larrel & Kirby & Spence.

Sept. Itinerary from Camp Akamina to Forks Camp.

Leave 7 a.m.

7.20 Hard reddish sandstones dipping northerly at high angle

8 a.m. Amphitheatre to left with cliffs. Shows good section with heavy limestones underlying yesterday's trap layer. Dip westerly at low angles.

8.50 Mountain to left topped by thin bedded fawn coloured rocks say 100' seen. They appear to overlie the upper red series. & dip westward at low angles.

10.10 Cuts to left which hitherto of red sandstones not well exposed shows the latter overlaid by paler red beds & then by fawn-grey flaggy beds dipping NW ∠ 25°.

10.30 ~~Rocks~~ Moraine mounds in valley. Rocks in cut to left dipping NEasterly at low angle. Rolling round to this from former position. The red beds (No 8) are at the top & appear to dip across & into the Right side of the valley near the base of the hill.

11.50 Arrive at Forks Camp.

Rate of Travel. Say 2½ miles an hour.

Leave Forks Camp to ride W. along Kootenay trail 3.10 Rm. Pass running from camp S. 34° W.
Rate of Travel nearly 3 m. an hour. (See part of general section through pass.)
Notes on beds seen. Chiefly in the N Side which offers best & simplest exposures.
Hill above Camp capped by whitish weathering columnar limestone. Horizontal or dipping N.ward. at low angles.
At next valley west, through which small stream comes. probably a fault.
Then a great series of red sandstones, rather massive but no doubt answering to upper red series No. 8. These beds are reddest in the upper layers. Below the tint is not so marked & they are interstratified with thin beds of magnesian limestone. Concretionary & weathering to a fawn-

colour. These become more frequent in descending & then
great mass of dark coloured amygdaloidal traps. No doubt contemporaneous (No 6)
Say about 100'. thick.
Below this great thickness of yellowish weathering limestone in flaggy layers, but sometimes rather massive. Estimated at about 300' at least.
Below this a series of variegated Sandstones & slates. Sandstones red & greenish, slates generally grey or green. Many bands of white Quartzite of small thickness.
There is no marked unconformity between the variegated beds below the limestone & that rock but they are beautifully plicated or undulated on a small scale & appear to be more metamorphosed than those above them.

Found a rock surface (green slate) showing very well preserved glacial markings. The first seen in the Mountains. Direction S.40°W or directly down the valley main direction.
Great terraces of gravel remain on some of flanks of Mountains. & streams in some places cut through genuine tough boulder clay of light fawn colour.

| | | | |
|---|---|---|---|
| Camp Akamina | 6 Am. | B. 23.26<br>T. 45° | Calm. foggy. clearing. |
| Forks Camp - noon | | B. 24.57<br>T. 74° | Calm. Clear. |
| Forks Camp - 8 Pm. | | B. 24.69<br>T. 50°. | S.E. Light. Clear. |

On this trip food has consisted of bread & boiled beef cold, well enough as long as it lasts, but now fruit of all kinds becoming scarce. Reduced to bread & tea & barely enough of that. Expect to meet beef tomorrow at noon on arriving at Camp No. 1.

Aug 20. Leave Camp at 7.25 & travel back of Kootenay trail across the watershed, to Camp No 1. Morning showery but cleared up about noon & became quite warm. Noting characters & succession of rocks to form a general section as came along. Just before reaching old Camp was surprised to meet a pack train coming west, & found Mr Fanning, Commissioner Campbell & Mr Bangs on their way west to Monument. Found Lieut-Green Camped at Camping place No. 1. & had lunch with him. Found him luxuriating in fresh butter, ham, various sorts of bread & cakes. Got a small mail consisting of 1 letter & 3 papers.
Every made a couple of sketches. Examined rocks in brook &c.

Geol. The hill which the trail passes below on the N side of the pass seems to be above red sandstones, below of green slaty beds. The highest peaks formed

of limestone as already mentioned. The whole dipping gently Westward. Ascending the W. side of watershed the rocks seen mostly greenish slates but not well exposed. The upper red beds cap the hill on the left-hand S. of the watershed ridge & appear to dip westward into the base of the ridge. The red beds are underlaid by dark coloured beds which are probably chiefly of limestone or calcareous grit. These followed by the amygdaloidal traps beds. Not nearly so thick however as where seen in Mt Jarrel. Then the great limestone series weathering columnar & craggy when on the peaks but flaggy & shelving when cropping out in hillsides.

Beds immediately below limestone not well seen. but probably all variegated sandstones &c. The crimson beds, a lower red series then come in say about 200'

(These red beds were not distinctly observed in Mt Jarrel section)

Below the red beds & forming the point of the hill near Camp No. 1. which seperates the S. western & western branches of the pass. Variegated Sandstones & Quartzites.

A gentle anticlinal runs nearly W. (mag.) into the core of the mountain mentioned, & follows the ridge seperating the two brooks.

In the S.W. Brook a lower greenstone trap is exposed. Very hard but so traversed by joints & slikensided surfaces that hardly possible to obtain a clean faced specimen.

This trap underlies the beds last mentioned. About 20 feet are exposed & there may be a greater thickness, though it is impossible to tell whether this trap forms a component part of the series or not.
Below the trap & also in the bed of the brook an extensive series of ribbond red & green sandstone with white quartzite layers. Shale conglomerates also occur. Small irregular pebbles of green or red shale imbedded in quartzite or sandstone of pale green or whitish colours. These beds lie low & regular enough but are somewhat corrugated.

Forks Camp. 6 Am. B. 24.67 S. cloudy.
T. 50°

10.20 Am. Top of wooded ridge B. 22.74
Camp No 1. B. 24.40
Camp No 1. 8 Pm. B. 24.53 wet. light.
T. 57° partly cloudy.

Comparison of Lent Greenes Aneroid with Mercurial & of his Aneroid with mine.

Greenes Aneroid this Am. 26.00
Mercurial 25.833
Attached thermometer 54°

Greenes Aneroid 8 Pm 25.385
My small aneroid " " 24.53.

Aug 21. Leave Camp No 1. 7.50. Valley running S. 70° E. Noting distances & character of rocks by the way for general section. Met Ashe & party going W. at crossing of Waterton R. Get back to camp on Belly R after a rather long & hot ride at 1.25 Pm.
Change plants & find that none have suffered much

Camp No 1. 7 Am. B. 24.54 W.N.W. Clear.
T. 62°

Belly R. Camp 9 Am. B. 24.97 Calm Clear.
T. 52°

Aug 22. Engaged all day writing up notes & journal &c.

Belly R. Camp. 9 Am. B. 24.98 S.W. Clear.
T 68°

1 Pm. B. 24.92 S.S.W. Clear.
T. 74°

8 Pm. B. 25.10 S.S.W. light clear.
T 53°

Aug 23. Writing up notes & arranging specimens. Afternoon went up to Fallestons' Camps in buckboard with Crompton to reclaim plants from Hellman. Found him out fishing & so had journey in vain. Had a flying toss out of the buckboard coming down c. hill. Capt Ward arrived having left Rome much

better & at Woody Int where he is to stay & regain strength for onward journey. Reports buffalo numerous near the Butte but not W. of them. Now beginning to move S. The depôt at White Mud R. Cpt in charge of Kennedy has been raided on by Sioux. A great number of them came round & by holding revolvers to his head &c induced him to give them half of the stores amounting to 500 rations. They then lit a number of candles & danced all night in a tent. Two of the mounted police had turned up at Woody Int while he was there. Hear indirectly of police. One of whisky traders here told one of our men that the Indians had told him that the Union Jack was flying on one of their forts to the E.

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|---|---|---|---|
| Belly R. Camp. | 8 Am. | B. 25.09 | E.N.E. Light. Clear. |
| | | T. 68° | |
| | Noon | B. 24.92 | Calm Clear. |
| | | T. 75° | |
| | 8. Pm. | B. 24.975 | S. Gusty. |
| | | T. 66° | Partly Cloudy. |

The prevalence of light winds & calms here near the mountains is very remarkable, especially when contrasted with the almost daily strong winds experienced on the prairie to the E.

Aug 24. Broke camp this morning & started for the N End of Waterton Lake with Capt A. Cust. & scouts. Arrived about 1 Pm. The distance must be about 14 miles. Found ashes & there US. Camps on a beautiful undulating grassy slope crowded in between the N End of the Lake & the foot of

the mountains. Mr Fury of U.S. Commissioner at our Camp. Also found 2 cones. Mr Fyon has his observing station some miles down the lake on the line. To attain the point he has had to construct a raft & ferry his apparatus down. The mountain sides being impassable.
Afternoon Boswell & Barper arrived. Went with them to see a beautiful little waterfall. Found it falling over quite a new series of rocks which hope to examine more fully tomorrow.
One of U.S. people caught a Salmon trout in the lake today weighing 18 pounds.
Scenery wonderful the lake running away S among magnificent mountains.

Camp Belly R. 8 Am.
B. 25.01 Colm. partly cloudy.
T. 63

Camp Waterton Lake. 1.30 Pm.
B. 25.10
T. 74° N.N.E. partly cloudy.

" " " 8. Pm. B. 25.15
T 57° Colm cloudy.

Geol. Drift Lignite is found in the banks of the Belly R. near our Camp left this morning (see specimens) It quite resembles tertiary lignite & as all the drift material appears to be from the mountains indicates presence of lignite beds not far off. Probably in the valley of the R. itself.
A little fold of tertiary included.
The bank of the R. shows genuine light brown coloured, stiff boulder clay with glaciated stones

from the mountains, overlain by a considerable thickness of clean pebble deposit - formed no doubt partly by rearrangement of last & partly from surrounding rocks; by, rivers itself when at higher level.

Aug 25. Thinking that E. side of lake S. of Camp best place to see the lower series of rocks seen yesterday at the cascade N.E., & East - also wanting to go over there for survey purposes accompanied him. Attempted to go round to a narrow place N. of this & cross on horseback. Found the way so tangled & boggy that came back determined to build a raft. Got a raft built - after a good deal of trouble, the wood not being suitable. Embarked, 5 in all after lunch & tried to paddle over. Got on slowly till about 1/3 over when light breeze sprung up ahead & soon reduced progress to nil. The water washed nearly all over the raft - its power of flotation so small. The traverse about a mile. Obliged at last to turn back & give up attempt with so clumsy a craft. Water of lake from colour & clearness must be immensely deep.
Got horse saddled & went down to look at rocks near the fall. Also tried for a trail going along W. side of lake but could find none passable.

Found a Cyprinea of species not very common. Also found a small fish like a cottus lurking among stones along the margin. Managed to catch 4 or 5 of them & put them in spirits.

Shores & bottom of the lake of clean round gravel. Water blue & very clear though perceptably opalescent. Much drift wood at high water levels, & evidence that lake varies very considerably with the season.

Geol. The beds examined are brought up by an irregular anticlinal which crosses the lake at the narrows. They underlie the beds designated Series 1. in former section. The highest & that immediately underlying the latter is a limestone of some thickness (say at least between 50 & 100 feet) which weathers white. Where exposed near the falls it has cherty concretions in places. It also holds at least one thick band of magnesian grit exactly like that called No. 2. in the general section. This however is probably a merely local development

Below the limestone & well shown on both sides of the lake S. of the narrows is a great series of hard beds which on weathered surfaces are coloured very remarkably in shades of bright browns & orange due possibly to ~~magnesian~~ dolomitic matter. They do not however effervesce with cold HCl. & are exceedingly hard, breaking even with a semi-conchoidal fracture. Internally they exhibit shades of purple & grey. They evidently represent metamorphosed mud rock; & are very evenly stratified layers several feet in thickness alternating with several thin flaggy beds very frequently. The whole substance of the rocks shows regular stratification planes by variation in the tint. Rather low down in this series a limestone

of considerable thickness occurs bluish gray internally & weathering whitish externally. (See specimens)

The lower limestone underlying series 1. of former section may be designated as Z & the tinted rocks below it by X. These two series Z & X may be called for convenience the Walter on Lake series.

There is to all appearance a want of conformity between the thick limestone designated by No 5. & the beds below it. The latter including 4, 3 2 & 1 being in all probability reducible to a single great series.
On the E side of the N end of Walter on lake the limestone No 5. is seen to rest directly upon the crimson beds of No 4. in an apparently unconformable manner (See section). On the N side of Kootanie Pass near its E. end No 5 is again seen to rest above No 4 but with the probable intermediation of a small thickness of other beds. 5½ miles up the pass a very considerable thickness of greenish & reddish sandstones & slates intervene between 4 & 5.
Underlying No 5 in Nut Gorge no thick belt of red beds was seen though a great thickness of green & red sandstones & slates with white quartzites &c was exposed.
In the cuts S of the E. end of Kootanie pass (See Sect) the red beds (No 4) are much less important than in the N & does not appear to be persistent.

It would therefore appear (1) that the limestone No 5 is underlain by a great thickness of variegated sandstones & slaty rocks, with quartzites &c none

of these beds have great individual thickness & the whole alternating in colour from red, to green & purple-brown & various shades of reddish & greenish grey. In this series occurs a band of beds characterized & peculiar bright red colour of uniform thickness. Also probably several zones of magnesian grit & possibly even limestone.

(2) That there is an unconformable junction between the limestone (No 5) & the lower series (Nos 4.3.2.&1.)

There is also an appearance of unconformity between the last mentioned grit series & the limestone next below Z, but this does not appear so clearly from present sections.

Limestone Z weathers in a peculiar manner giving rise to roughened surfaces (see specimen)

The mountains appear to be the source of the so called Quartzite drift of the plains so often mentioned. Much grit may be derived from the lowest series X. The pale green pebbles mentioned as occurring frequently far out towards the Buttes are probably from the grit series 4.3.2.&1.

No Fossils or traces of life found anywhere though carefully looked for. Ripple marks very frequent in grit series 4.3.2.&1.

Camp Waterton Lake. 1 Rm. B. 24.89 I 89° Calm. clear.

8 Rm. B. 24.98 I 63° S. Partly cloudy

Aug 26. Started after breakfast to examine the mountain on the S. side of the Lake opposite here. (N.W. Corner of Mt Wilson) Rode round to the wagon trail ford, about 4 miles, & then down the S. bank of the Lake, following deer & buffalo paths as far as possible but sometimes being obliged to push rather roughly through tangled thickets. Trail at last very rough. Steep slope between cliffs of mountain & Lake much encumbered with windfall & broken rock. Got down opposite the camp after a 3 hours ride.

Sept. Got a good general geological sketch of the opposite mountain. Examined rocks of the cliffs from fallen fragments & find them quite similar in every respect to those of same series near camp & elsewhere.

Rode back by a shorter way crossing the lake at a narrow place by a ford not much more than fifty deep. Collected a few plants. different varieties of Solidagos &c

Saw some Sand-hill & one white Crane. These birds are common again after having been invisible ever since the first meeting with the Coteau.

Got back to Camp 2.30. Lunched & went out with Gun to try & shoot a Lagomys or rock rabbit, having seen a pair at a certain place yesterday. Got a shot at one & hit him but he tumbled off the rock & crept in below it & was lost. Shot a dusky grouse, got several specimens of rocks &c & got back to camp at dusk. Found Boswell & Ward just returned from trip up Kootanie Pass. Found Guide unwell having a pain which caught his breath. Got a mustard plaster &c

Camp Waterton Lake 8 Am.

B. 24·91
T. 73° S. Clear.

8.30 Pm. B. 24·90
T. 63° S. partly Clouded.

Occasional showers during Pm.

Aug 27. Gregory & party including Dr Cowes went off early bound S. for the Buttes. Boswell a good deal better. Left off for depot 30 m. S of this with word.

Worry changed plants & arranged specimens & rocks &c. Afternoon walked down the lake about 1½ m. to a point chosen beforehand to get a good sketch of the yellow mountains. Also took a couple of water-colour sketches of the lake.

Ashe & party return having completed traverse line up Pass to watershed.

A very perfect double lunar rainbow visible about 8.45 Pm. The colour of the inner very distinct. The whole placed in exact symmetry over one of ranges of mountains & looking like a gigantic frame.

Lake under the influence of the strong S. continuous S. wind making a noise like the Sea.

Camp Waterton Lake. 8.30 Am. B. 24·875
T. 73° S. partly Clouded.

Noon B. 24·89
T. 73° Strong S. partly clouded.

9 Pm. B. 25·07
T. 57° S. partly Clouded.

Occasional showers during Pm.

Aug 28. Capt A. left early for Depot Camp 30 m. S of here. Delay until ashe the tomorrow morning then all move S.
Left camp at 9 am. with Nelson & Rode Northwards along the base of the mountains about 13 miles. The country hilly but not abruptly so. Many of hill slopes clad with brushes & small poplar, especially the northern exposures. Many small lakes, pools & swamps. Saw a good many prairie chickens, some ducks, & several coveys of Canada grouse (Tetrao Canadensis). Found a nuts vesicaria. Ascended one of foot hills & got a magnificent view northward & westward along the range. The farthest peaks which must be at least 80 miles away stand up very boldly & are probably higher than any about here. The highest peak ascended by Greene near the Boundary monument only 8000 & some odd feet. Cheap but according to Galway somewhat over 9000.
Saw close to farthest point pride what I take to be the opening of the N. Kootanie pass.
Got a geological sketch of range looking N. the morning sun shining on the S. faces of mts. making many beds recognisable with aid of field scope.
Got back to Camp 4.30.
Every sketching mount of Kootanie Pass. Went with Ashe to visit Greene who has just returned & starts S day after tomorrow.

Sept. From a hill about 6 m. N. of Kootanie pass got a good general view of mts to N. Also was able to notice many points of structure as rode along. Got general idea of range for at least 20 m. N of line.

The whole mass of strata dipping W. or W.N.W. towards the axis of the Chain, broken off abruptly to the E. The rocks chiefly composing the Eastern slopes belong to the great Limestone series (5) & the slaty & Sandstone beds underlying it (4.3.2.1.) where gaps in the Eastern wall allow the inner lists to be seen the Traps & fawn beds & the upper Red series are extensively developed forming summits of lists. These appear to be nearly flat & have very gentle dips. The general structure of the range about here would therefore appear to be well represented by the Section drawn out for the Kootanie Pass, & to be very regular. The red band No 4. persists northward as far as the structure of the lists could be seen, generally cropping out from 1/3 to 1/2 way up the Eastern slope. The trap horizon (No 6) also appears to be very constant. It is seen in many of the hills & fragments referable to it are found in great abundance everywhere round the foot of the lists.

The rocks of the lists do not end abruptly where they appear to do, & where the vegetation of the foot hills slopes up to & covers the base of the lists. In sections given by streams they can be seen at some distance from the list. Slopes.

Softer sandstones &c. belonging to the Cretaceous series probably occur in some places quite close to the lists bases. Did not however see any fossils in them by which their age might be recognised.

| | | | |
|---|---|---|---|
| camp waterton L. | 8 Am. | B. 25·11 | S. Strong. Clear |
| | | T. 59° | |
| | 9 Am. | B. 25·175 | S.S.W. Clear. |
| | | T. 55° | |

Aug. 29. Left Camp with Ashe & part of the party & turned finally Eastward. Morning quite chilly & hoar frost on the grass in shady places. Crossed the Waterton & Belly Rivers & stopped for lunch at a Creek 4 m. beyond the latter. Got a Geological sketch of Mt. Wilson from the N.
Came on again & got back to Depôt at position of Galways Foot-Hill astron. Station about 7 P.M. Heavy load some difficulty & delay in crossing brooks &c.
The traders now camped N. of the line near our trail.
Sept. Harvey heard that they brought a sample of coal down to the Depôt, enquired particulars as to locality &c. It comes from a point at Junction of Waterton & St Mary rivers. It occurs in the banks of both streams, lies nearly flat. On the Waterton R. the seam about 5 feet in thickness. 6 feet on the St Marys. The point of junction of these rivers is said to be about 50 miles N. of here & perhaps also a little E. The traders at Hoop Up use the coal for fires & in a smithy forge. It is said to be of very good quality. A trail crossing the Boundary about 5 m. E. of here leads to Hoop up. The trail past west of the Buttes also leads to the same place.

Camp Waterton Lake. 6 Am. B. 25.23 S.W. Clear.
T. 48°

Foot-Hills astron Stn. 10 P.M. B. 24.70 S. light. Clear.
T. 54°

Temperature Waterton R. 7.20 Am. 52°
" Belly R. 10.30 Am. 54°

Aug 30. Coyotes howling all night round a dead horse not far from camp.
up early this morning & as soon as all could be packed up & prepared whole party set off Eastward. Rode on with Ashe to see some fossiliferous rocks he had found & also the seam of coal on the St Mary R. Party stopped for lunch at St Mary R. Afternoon went on to small lake & camped. Rode W. with Crompton a couple of miles to see some exposures further down the St Mary R.
Two of the teamsters Neil Campbell & Armstrong leave here having got their discharge to go prospecting in the mountains with "Barney Hughes" an old miner. It appears he got some good indications near the W. Kootenie Pass on the W. side of the mountains & now wishes to go back & investigate more fully. Barney is famous as a prospector having been told discovered the "Virginia City diggings in Montana. He was with a party of 13 when the indians came down on them & took all their horses except two. They then set out to return to some settlement but when halted one day at noon Barney "took a pan & began washing in a little brook & soon struck $24.50c per pan".

The traders now camped a mile or two W of the line. One of them told me that they had got over 8000 robes last season. They have plenty good horses & lend them to "young fancy

bucks" among the indians who for the mere pleasure of riding a good horse & excitement of the chase hunt buffalo & bring the robes back to the traders. One of the traders said that the other winter he made up his mind to get a "clean thousand" robes himself, & did so, shooting most often near their kraal. He said he was an outlaw in the eyes of the U.S. having with 12 men "faced up" against two deputy marshals & 25 U.S. troops. The traders stood with rifles pointed behind their wagons & the marshals & troops thought best to leave without attempting conflict. Last year when the indians came in to trade he mentioned as a very clever business, that they had managed to "clean them out" of all they had in a day. The last indians shot were killed in this way — one having had an altercation with the trader in question (called O'Neil I believe) ~~[illegible]~~ struck him across the face, the latter then immediately shot him through (some accounts have heard say not fatally). Then the indians friends then planned to shoot O'Neil but some other indians finding it out shot them before they could effect their purpose.
Near where we stopped for lunch on the St Mary R. a dead indian was found. The body was in a little gully partly covered by earth. The wolves however had dragged his bones about & also various things which were with him. He must have been left there not more than a few months ago. He had not been properly buried according to indian fashion, neither had he been scalped or robbed as though killed by enemies. It appeared that he had been thrown into the hole just as

he was of what he possessed at the time of his death. The skull was broken in & appeared to have been gashed by an axe or some similar instrument. A large quantity of tobacco in a bag was found near a handkerchief full of red paint powder. A bag made of a fragment of carpet held a pair of Childs moccasins & a little dressed skin pouch containing a charm? Various blankets &c were also to be seen partly protruding from the soil.

We now travel in one party, the waggons & carts in a certain order. At night they are all drawn up so as to form a corral for the protection of the horses. Two men on watch the first half of each night, relieved at 12 by two more who stay on guard till 4 Am. The Camp is then called & the wrangler whose turn is to herd the horses takes charge of them till it is time to drive them up for their outs. Leave camp at 6 Am.

Sept. 7. The fossiliferous locality first visited on the crest of a little ridge about 4 miles W. of St Mary R. & parallel to the Stony creek ridge visited Aug 7. & in which silicified wood found. The fossiliferous bed belongs to the same series no doubt, overlying the silicified wood sandstone a few hundred feet. & having the same strike & dip of about 20° W.S.W. ward. The bed where seen is almost a solid mass of fossil shells, chiefly ostreas & might be

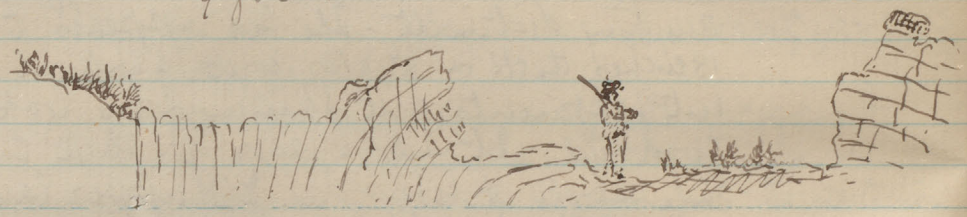
called a limestone. Most of the valves crushed by pressure except the thick part near the hinge. Found tomorrow one a two nearly perfect.

7. The coal in the St Mary R valley, occurs about 1/2 m S of the trail crossing & about 2 m. N of the line. It is seen just at the river level & is partly covered by water. Axes party have dug out all that occurred above water level & it is now difficult to see anything distinctly. The bed appears to be about 18 inches thick & breaks with a cubical fracture into fragments with shining faces looking like very good fuel. It has a layer of black carbonaceous shale above & below it. The upper layer of shale is a few inches thick & is followed by a hard shell bed of 18" or 2' thick. Of blackish colour but weathering whitish. The shells here again are principally oysters & the bed must come near the same horizon as that last seen. It may even be the recurrence of the same bed as the rocks hereabouts are very sharply folded & even perhaps partly overturned.
Above the oyster bed a considerable thickness of flaggy & ripple marked sandstones occur greyish & brownish grey in colour. These dip where examined S. 28° W ∠ 35°. The sandstones mentioned as occurring along the river (Aug. 7.) underlie the coal. The ripples indicate a current in a direction S. 14° W.

About 1/4 mile S.E. of the coal exposure similar sandstones associated with greenish grey clay beds occur. The fossiliferous bed also recurs but is not

well exposed. Much carbonate of lime apparently filling fissures & peculiarly fastened down on the weathered banks. The same substance identically developed was noticed where some sandstones occurred close in to mountains & about 8. m. N of Kootanie Pass entrance.

The sandstones in this locality are very abruptly folded.



A mile or two further N on the river similar beds are again seen. Had not time to examine them closely but did not see any coal or fossiliferous bands. Sandstones & greenish fire clays on E. side not far from horizontal. beds on W. side much disturbed. At or near here begins disturbance due to mountains.

Foot Hills Astron Sta. 8 Am.

B. 24.69
T. 56°

N.N.E. Clear.

St Mary R. 2 Pm.

B. 25.06 N. Thunder Storm near.
T. 71°

8 Pm. Small Lake nearly on Light plane between Saskatchewan & Missouri waters.

B. 25.[illegible] T. 52°. S. light Clear.

St Mary R. water 55°.

Drift. About the St. Mary R. Stones of Laurentian origin begin to appear among the drift which however still remains chiefly of Rocky Mt. rocks.

Aug 31. Leave camp 6 Am. Ride down to Cin & follow it Eastward with Ashe. Strike 2nd branch Milk R & follow it up to trail about 3 miles. examining sections. Afternoon made about 12 miles. Left trail & went about a mile S. to camp on a bend of the first Branch where good feed. Examine sections which near there formerly examined which contained vertebrate bones. The river much smaller than when last seen.

Geol. On the second branch. Sections show bluish-grey clays & clay rocks interstratified with sandstones & impure iron stones from the line to the trail. About 3 miles. (Sections near the trail formerly examined & fossils procured from them) Seen nearly horizontal & no marked contrast but disturbed state of beds W. of St. Mary R.

Exposures on first Branch at Camp examined for fossils. A good many fragments of large bones but but none perfect. Sandstones & bluish & greenish grey clay rocks clays & sandy clays. These colours appear characteristic of the lowest tertiary? beds.

Drift on Second Branch mostly of Rocky but
rocks but some Laurentian.

The fertile belt may be said to extend to the St
Mary R. E. of that R. to the 2nd Branch the
Country is only moderately good & the swamps
not good hay few. On leaving the 2nd branch
ascend out to flat-topped plateau which
extends to within about 6 m. of the first
Branch. It is dry & gravelly so covered with
a short scanty growth of grass only.

Camp at small lake 6 Am.
B. 25.10 W.SW. clear
T. 57°

2nd Branch 11. Am. B. 25.075 W. Strong. clear.
T. 62°

water of stream 59°

watershed between 1st & 2nd Branches 24.62

1st Branch 6 m. W. of crossing of trail. 8 Am.
B. 25.57 SW. clear
T. 48°

Sept. 1. Start 6 Am. Cross 1st branch on
trail. much diminished in size. Travel till
noon & then 4 hours in the afternoon making
over 30 miles. Camped at Creek 24 m. W
of the Buttes, which look beautiful in the
evening light.

Country dry rolling hills with ~~scanty~~ short grass

& not many good swamps. See first buffalo

Sept 2. Left camp 6 a.m. & travelled on to pools about 8 m. W. of Buttes. Some of scouts killed a Buffalo bull near the track just before lunch halt! Sent back for some meat.

Drift on Second Branch, North Rocky Cut

9 Census of Drift from 6 m. W. of Crossing of Trail & first branch Milk R.

| | | |
|---|---|---|
| (Lam.) | Granite & Gneiss, pinkish & blackish. | 45 |
| | Quartz | 2 |
| | Iron stone (local) | 3 |
| | Soft Sandstone & claystone (local) | 9 |
| | Ostrea fragments (local) | 2 |
| | Diorite | 5 |
| | Limestone (some from Mts but majority resembling that of Red R) | 13 |
| Quartzite pebble. | Quartzite & hard altered Sandstones, greyish, reddish, & brownish. Coarse grained or cherty looking & compact | 86 |
| | Graduating into Hard altered slates & clay rocks, greyish & greenish. | 37 |

The altered slates &c are more common here than in any sample yet examined from further E.

[illegible] Over 30 miles. Camped at Creek 24 m. W of the Buttes, which look beautiful in the evening light.

Country dry rolling hills with ~~Scanty~~ short grass

& not many good swamps. See first buffalo today. Two bulls a cow & a calf.

Geol. note the remarkable absence of limestone among the drift. Most of drift rocks seem to have been derived from Lower Series (#4.3.2.1.) Near the lute limestone finds common in gravel of creeks &c scarcely a fragment on the plains. As the limestone is mostly confined to the central & highest parts of the range, & the lower beds above mentioned seem generally to form the outer lower tier of mountains. It would seem that no glaciers of any consequence could have been descending at time of greatest & last submergence that gravel probably distributed by coast ice & that water at deepest did not rise high up on the mountains proper though overtopping the foot hills.

Camp. 1st Branch 6 m. W. of Crossing of trail. 6 A.M.
B. 25.69
T. 46° N.W. partly cloudy.

noon Smell Lake B. 25.69 N.N.W. partly cloudy.
T. 56°

Camp 24 m. W. of Butte station 8 P.M.
B. 26.30
T. 52° Calm. Clear.

Sept 2. Left camp 6 A.M. & travelled on to pools about 8 m. W. of Buttes. Some of scouts killed a Buffalo bull near the track just before lunch halt. Sent back for some of meat.

Arrived at Butte Depot in good time & found my Pony. Sugar, &c. &c. there found a large Camp. Selway & Featherstone left E. this morning.

Fish who left in charge of Depôt has been bothered by indians. almost alone & obliged to let them do pretty much as they pleased. Praying to the number of 400 camped near depot with 800 horses. Got all sugar, tea &c & left not much at depot. Did not actually take by force but said they must have so & so. Many buffalo round at time. Indians killed several hundred, made pemmican & then moved off. Fish says could have got a moderately good pony for 40 rounds of Spencer Ammunition which being worth only $1.20, could not be considered dear.

S.W. of Butte 4 m. Noon.
B. 26.34
T. 74° W. Clear.

W. Butte Depot 8 Pm. (ft above former camp at Depot)
B. 25.95
T. 56° W. Clear.

Sept 3. Remained at W. Butte all day to get blacksmith work done, pick up the remnant of depôt &c.
Engaged changing papers of plants, writing up journal &c all day. Wrote home (a) & left letters with U.S. party who move out tomorrow morning to Benton & then proceed down the Missouri in mackinaw boats to Bismarck. Visited U.S. Camp & said good-bye to friends there.

Camp 9 Am. B. 25.70 S.E. Clear
T. 77°

Noon B. 25.64 SS.W. Strong. Clear.
T. 77°

8 Pm. B. 25.575 WSW. Partly Cloudy.
T. 67°

Comparison of aneroid with Gregory's Mercurial
At U.S. Camp.
Mercurial 26.278
Attached thermometer 74°

Aneroid 25.60

Fish-tills on several mineral springs 115° Hot from which samples taken. Every now & then much of bubbles of $SH_2$ which can be lighted & burn for few seconds with blue flame. Water must be nearly saturated with this gas. The brook here presents curious phenomenon. Nearly dries up every afternoon opposite depot & water proceeding from several large springs is much diminished in volume for whole course. Target in morning. Same phenom. observed at crossing of Milk R. Most perceptible on warm bright day but observable even on cold day. No doubt due to evaporation.

Indians mentioned in yesterday's notes killed about 600 buffalo in 3 days. Generally killed with steel pointed arrows. The arrow sticking in the flesh stops the animal very effectually. Also a great saving of ammunition. Even those pressing good rifles armed also with bow & arrow for buffalo hunting

Sept 4. Travelled E. about 17 miles. The U.S. parties also broke camp & were travelling along the road at the same time. Day fine but oppressively warm. See many buffalo. Some of U.S. Indian scouts drove a large herd down across the track. The U.S. infantry opened fire on them as well as all the travellers &c of both parties. The band scattered in all directions & a great many killed. I suppose

Altogether about 30 but scattered over a wide area & difficult to determine exactly. A great number more or less wounded many of which will die. Most bulls, but some cows & a calf or two in very good condition. Got as much meat as could carry from one or two fresh animals. Only the tongues & boilers taken. Bullets flying in all directions during the chase but fortunately no one hurt.
Got a heavy mail from Benton, chiefly of papers & magazines - affording welcome reading matter.

Camp W. Butte 6 Am. B. 25.67 J. 59° Sw. Clear.

Camp 17 m. E. of W. Butte 8 Pm. B. 25.29 J. 58° Calm. clear.

Sept 5. Left camp at 6 Am. & came on to 620 m. pt for lunch. Day very warm with a strong southerly wind & hazy atmosphere. Found a good many pools of water in coulés but all stirred up & fouled by buffalo. Camped without water for horses, though enough for making tea in barrels. Innumerable buffalo in small herds in view all day. Towards evening came in sight of a vast body stretching over the prairie for miles & numbering thousands of individuals. A few horsemen running in a part of the herd quickly collected into a dense black mass & went tearing across the prairie throwing up volumes of dust in their rear. Looked specially fine when coming towards one, reminding of a body of

troops advancing in line. Whole prairie dotted with buffalo as far as eye can reach. Every dry swamp & hole containing water poached up by them & well worn paths in every direction. Poor feed for horses as the buffalo have cropped all the good grass off so short. Several calves killed today & some old animals. One herd drove down past parallel to waggons & stood a regular fusilade from all hands without much apparent damage.

Country passed over dry & parched compared with that round the Buttes, but covered by a fairly close growth of short grass, Slipa & [illegible] (see specimens) Cactus begins to appear as soon as get E. of E. Butte & becomes more common eastward. Have not seen any since leaving Rocky Nts to this place.
The soil is rather light coloured & does not seem to contain much vegetable matter. It is also quite gravelly & very hard. Altogether of little consequence agricultural, though the grass is sweet & nutritious & would afford good grazing, as everywhere in this country.

Geol. Reexamined various sections by the road. A few miles N of E of the trap dyke (previously mentioned) found a rich shell bed (see specimens) overlying a considerable thickness of soft sandstones & arenaceous clays.

In another coulé. Irregular layers, & large partly connected, roughly lenticular masses of ironstone developed, overlying pale grey-green sandy clay & overlain by sandstone, yellowish brownish, & yellowish sandy clay.

Camp 17. m. E of W. Butte. 6 Am.
B. 25.31
T. 59° Nearly Calm. Clear

Noon. Creek 620 m. pt. B. 25.74 S.W. fresh. Clear.
T. 86°

Camp 23. m. W. of Milk R. B. 25.84
T. 55° Calm. Hazy.

Sept. near the Buttes. Many "silicious pebbles" also much Laurentian & a great quantity of felspathic rock from the buttes thereabouts.

Sept 6. 74. Remained Camped at same place about 23. m. W. of Milk R near the 610 m. pt. Sappers Maul & Mc Nichol of ash's party, on a scout, Tracey. who left together to do some "tying in" on the line not having turned up. They left in the morning at the same time the train started & had to go a short distance N. to the line, work along it & strike due South to meet us again at lunch time. He did not appear at that time, but no anxiety felt till evening. Thinking they might be benighted large fore of "chips" kept going. Indians having been seen about watch doubled & two relays of four men each put on. The Sappers knows the country having surveyed it before, also furnished with maps & compasses & have the Milk R. to the N & the road to the S. all along. Also the Buttes in sight forming an excellent landmark. Can thus scarcely have missed their way.
Camp called at 2 Am. & all got ready for start at 4 to march on to Milk R, the stretch being

without water. As Sappers however did not turn up did not move. Aske & 4 Scouts sent out W. along the line where they were to have worked. East & Scout go E. on trail to Milk R in case they might have gone on there. Crompton & Scout go back on trail to landing place yesterday. All returned without having found the least trace or clue to the missing men. East saw altogether 13 indians near Milk R. in two bands. Crompton caught sight of one. Fear that the men may have met with foul play from some prowling band.

A large fire of chips going again tonight to lead them in if wandering about.

Occupied reading &c all day about Camp –

Immense numbers of buffalo scattered over the plains in all directions, generally in small parties of four to twelve or twenty. In the forenoon three bulls came to within 100 yds of the camp, but turned & fled quickly away when some of men went out towards them. Other parties came very close during the afternoon. Two bulls in particular slowly advanced, stopping a long time & carefully eying us between every few steps, – the nearest within about 50 yds. Then several guns opened fire. Lodged one bullet or more but without any apparent effect except accelerating the retreat. The buffalo really a very grotesque-looking animal. The head dressed matted with black hair among which the short horns stand up. A long beard dangling from the chin. The neck & fore quarters also covered with a good coat & looking immensely thick & strong. The hinder quarters & hind legs dwindling rapidly away. When first got into

buffalo country all the body & hinder parts nearly bare black skin, now begining to show a short thick growth of fur. The coat preparing for the winter. The robes will soon be in prime order.
The appearance of the animal altogether high marsh & weird, looking like a survivor of a bygone age, or a reversed tertiary monster. They stalk slowly along in lines one after another, or feed in little herds. Often they drive in groups in precisely the attitude assumed by a cow. When disturbed they break into a strange lumbering run, but without make good time, & twirling their little pig like tails give a horse a good chase to get ahead of them. Their bellow has a hoarse hollow metallic sound & has a peculiarly eerie effect when heard coming across the prairie after dark. As I write a great herd are lowing & bellowing within earshot.
The buffalo are very fond of rolling over & over in the dust & the whole plain is dotted with their wallow places. The sod in a circular patch is broken & the area filled with dry powdery dust from constant use. A buffalo wallowing in one of these raises such a cloud as to altogether obscure himself, & it has a most singular effect when he suddenly stands up & becomes revealed.

Geol. Census of drift (superficial drift) near 610 m. point.

Granite gneiss 42 of prevalent reddish tints. A good deal of black hornblende 50.

| | |
|---|---|
| Hornblende schist | 1. |
| Diorite | 4. |
| Quartz (crystalline) | 7. |
| White limestone (one at least in all probability from the Rocky Mts) | 11. |
| Orange weathering iron stone (local) | 1. |
| Hard altered clay rocks. yellowish, greenish-grey, blackish | 6. |
| Quartzites & hard sandstones (Siliceous pebble drift) | 100. |

Analysis by colour of components of siliceous pebble drift.

| | |
|---|---|
| Grey & greyish | 17. |
| Greenish | 1. |
| Yellowish. cherty. | 3. |
| Reddish & purplish | 21. |
| Whitish, or only slightly iron stained. | 15. |
| Yellowish & brownish | 40. |

The "Siliceous pebble" or "Quartzite" drift rather a mixed assembly. Some samples so compact that difficult to distinguish them from unmetamorphosed clay rocks which might be highly siliceous. This especially the case with the brownish & yellowish series. Many of the same series are however coarse grained quartzite, still distinctly saccheroidal, though very hard. Some of the whitish have the same saccheroidal appearance. Some of purplish & reddish of same texture though many quite compact. Several of the greyish are quite large grained, the constituent particles being of differently coloured rocks. A few samples. Especially among the greyish are softer than the rest & may be local.

Camp 23. m. W. of Milk R. 610 m. pt. 9 Am.
B. 25.87 Slt. Clouded
T. 73°
Noon B. 25.72 Slt. partly clear
T. 88°
9 Pm. B. 25.84 Calm. partly
T. 63° Cloudy.
Hazy all day. but clearing up in Pm.

Sept. 7. Aste, Crompton, & a number of Scouts off early to renew the Search. Rode N. with Boswell & Fish to see a dead horse which had been found about 5 miles from Camp, but which proved not to have anything to do with the missing men but to have belonged to Leathers town. Rode back by another route making a detour & killing a buffalo bull by the way. Boswell hit him at about 300 yds so badly with a single shot that he did not run more than 100 yds. He then stood & worried the dogs which soon caught up to him. Rode round him on horseback to give him his coup de grace.
Afternoon reading, pinning some sketches &c. Almost suffocated by dust in the tents. A strong S.W. wind blowing all day, having risen in the morning & fallen again at sundown. Searchers returned after dark having found nothing of the lost men. Trailers seem near the Boundary mounds round which their work lay, but not distinct enough to follow. Can hardly suppose that massacred by indians as there so far apparently

friendly escort. On discussing all chances conclusion arrived at that must be ahead, having got in advance of us & gone on; or that having struck S. trail, perhaps in the dark, they may have followed it so far that decided to go to Benton. There being no object to be served by staying here longer move on at 4 tomorrow morning leaving a note & small supply of provisions in provision for possibility that the lost men may get back here by any chance.

Camp near 610. m. point. 8 Pm.

| | | |
|---|---|---|
| | B. 25.86 | SW. push. |
| | T. 71° | Clear. |
| Noon | B. 25.90 | SW. push. |
| | T. 75° | Clear. |
| 8 Pm. | B. 26.125 | ~~Calm~~. W.N.W. |
| | T. 62° | Clouded. |

Sept 8. Camp called at 2 Am. Start about daybreak & travel on towards mouth R. across the arid plain. See a good many buffalo. One herd driven across the line of march by some of Scouts. Many horsemen then rushed out, & after forming much like a small general action. Several killed, among which some calves & cows. Took some beef & tongues off. Shortly afterwards a single buffalo bull was seen making towards the wagons. When a short distance off he seemed to become suddenly suspicious. Wheeled at right angles & ran parallel to the train. He

received several bullets from the number fired at him, & finally becoming angry & desperate, turned & charged down on the train nearly knocking down a cart, but being dispatched before he could do much mischief. A splendid large animal, the robe on which is already getting into good order.

When near Milk R. found a notice on the road saying that Cat men would be at the river having struck the trail. Much delighted, & hurrying on found the three men all right though rather "played out". They had taken the trail to Benton in a mistake. On finding their error started N. & cut the commission trail but being then much in want of water were obliged to go N to Milk R. Then came S. again to road & pushed on towards the crossing of Milk R where they expected to find us. Not finding anyone, they came E. again the next day about 4 miles & put up the notice we had found. Shortly afterwards killed a buffalo calf & so not now suffering from hunger. Had been three days & nights lost.

Soon after our arrival at the river a number of indians appeared on the banks & immediately came down to see us. They turn out to be assiniboins. The chief named Red stone & having several certificates of good character from indian agents &c on the Missouri carefully stowed away in his turban. He & his people moderately well dressed in blankets &c. Armed some with bows, some old muskets, & one or

two with Henry 14-Shooters. Rather good looking men but not so handsome as the Sioux proper seen farther E. & I am assured not to be compared either in physique or dress with the Reagis seen at Battle Depot. Had quite a talk, all sitting in a circle, & passing the peace pipe round. Observed a friend of the chiefs who sat next him fill & light the pipe. Then take a whiff or two & before presenting the stem to the chief turning the mouthpiece for a moment upwards towards the Sky. The pipes used made of black slaty rocks like those of the Chippewas, & furnished with long wooden Stems. Talk ended as usual by demands for something to eat, which could hardly be complied with owing to the state of our rations. Managed to get a bow & some arrows from a "young brave" for a can of powder, some bullets, & a piece of tobacco. The bow very neatly made & held originally together with the arrows in a quiver slung over the back, & made of dog skin with the hair on.

Start again 3 P.M. & go on to the lake about 10 m. N.E. of the Crossing where had camped before on my out. Found a half breed Camp of 37 lodges within two miles of us & soon had visitors from it. Friends of the Scouts we had seen a few days before. Hear that many assiniboins near at hand, also a large party (about 300 lodges) of Crees within 15 miles. These tribes & half-breeds all living in Amity. The Crees have come so far S. in search of buffalo, these not having gone so far N. as usual. The buffalo said to be all W. of this Camp now. An intelligent half breed says the buffalo

being reduced so fast that in 10 years, they will have to give up the Buffalo business as a trade altogether. I think in 12 or 14 years the great Northern band of buffalo will be practically extinct, so far as they render support to the indians.

Milk R. Valley 3 Pm. B. 26.33

Camp S.W. E. of R. 9 Pm. B. 26.18 N. partly
T. 64° Clouded.

Sept 9. Start 6.15 Am. & travel out to W. Fork in one spell, camping at 1.30. The country very poor, a large proportion of the soil bare & hard, or thinly scattered tufts & blades of grass, now quite dry, & large areas of Cactus patched everywhere. Day exceedingly bleak & cold. Spent Pm. reading, making Census of drift pebbles &c.
Redundo in W. Fork Valley still quite green & not showing slightest sign of autumnal tinting. See no buffalo all day. Lin Antelope killed this Pm. & many seen.

Camp S.W. E. of Milk R. 6 Am. B. 26.08 N.W.
T. 33°. Clouded.

Camp W. Fork 1.45 Pm. B. 26.18 W. N.W. Fresh
T. 56° Clouded

9 P.M. B. 26.26 W. N.W.
T. 48° Cloudy

Wind rose with Sun. Blew all day & stopped at Sundown.

Geol. Census of Pebbles of Superficial drift.
W. Fork of Milk R.

7

| | |
|---|---|
| Granite Gneiss &c. prevalent colours pinkish & greyish. | 68 |
| Whitish limestone (one or two like Rocky Mt. lime) | 19 |
| Quartz | 10 |
| Chert | 7 |
| Porphyrite resembling that of Buttes | 3. |
| Soft Sandstone, claystone, &c (local) | 15. |
| Ironstone (local) | 5. |
| Ostrea shell. (local) | 1 |
| Quartzite or siliceous pebble drift | 138. |

The latter includes a few undoubted fragments of slaty rocks (greenish or blackish) & many samples apparently intermediate between this & quartzite &c but not clearly separable into either group. Have therefore enumerated the whole collection under one name as having probably come from the mountains. General colours of Quartzite drift here, yellowish, brownish, whitish, not so much red as in last sample, but otherwise very similar.

Though the Quartzite drift probably from the Mts. presents some peculiarities. Much greater preponderance of yellowish & brownish quartzites & hard sandstones than observed in parts I have seen. Also absence or rarity of slaty rocks &c & of red & green colours.
At bases of Mts greenish prevalent colour of pebbles & many reddish slate pebbles (associated with blackish &c) as far out as First Crossing of Milk R. (see samples there examined) May not these softer rocks have been ground out before getting to

far as this, leaving only the most refractory kinds? Siliceous pebble drift & true shingle, & just such as would be expected to arise from the denudation of a portion of the underlying boulder clay towards the close of the subsidence. The semi-angular & striated stones found below worn into good pebbles by the action of the sea on beaches & banks.
Boulders of Laurentian origin generally run much larger than those belonging to siliceous series. May arise only from greater homogeneity rock & may show that originally larger ice coming from that direction.

Sept 10. Travelled from W. Fork to E. Fork in a single spell seeing no water by the way. Arrived at E. Fork between 10 & 11. Found depôt all right & plenty of everything required. Stayed till about 3 P.M. Getting rations weighed out & distributed & depot broken up. Then travelled on to a lake about a mile N of the road & 5 m. E. of the depot.
Shortly after our arrival at the depôt a few indians appeared. They turned out to be Crees & to have come from their large camps near that of the half-breeds. They were rather poorly dressed & provided & look a fine bodabe people compared with the Assiniboins & Sioux. They picked up a number of little things left behind.
Shortly after the appearance of the indians a great train of Half-breeds began arriving, many on their way to join their friends at

Milk R. A very singular sight. Each family seemed to keep pretty much together on the road & there was often quite an interval between one party & the next. Men mostly riding. Women & children driving country carts. Mostly open, but some covered with hoods. Often paterfamilias & some other old masculine member of the family, then 5 or 6 carts. No 1. driven by Paterfamilias. No 2. by sons wife, or eldest daughter. The rest very generally by children which frequently almost babies. Lodge poles tied alongside carts & projecting behind. A cloud of skirmishers consisting of dogs & loose ponies, the former not unfrequently hauling travailles & cooking ~~[illegible]~~ hideously helpless & humorous when rushed out upon by a pack of dogs from our camp. Men mostly ugly. Long haired & rough looking, dressed in blue cloth with brass buttons, or skin suits. Women hard looking & soon wrinkled, wearing calico dresses of dark colours & with a turban of similar material wound round the head.

Camp. W. Fork 6 am.
B. 26.24
T. 41° WSW. clear.

Camp at Lake 5 m. E of E. Fork 8 pm
B. 26.21
T. 42° N.W. light clear.

Wind rose with sun blew strong westerly all day & fell at sundown.

| | |
|---|---|
| Wood End to Woody Mt by Chief's odometer | 183 m. |
| Woody Mt. to White R. by odometer | 71 |
| White R. to East Fork by Chief's odometer | 85½ |
| East Fork to Milk R by Chief's odometer | 44 |
| Milk R. to West Butte by estimate | 72 |

July 27 1874.

1874 was not a year of great flood but the early breaking up of the ice & influx of water to the South was well marked. At Georgetown Minnesota the ice was gone on April 20. At the Boundary the break up commenced on April 23. The ice was known down the river rapidly on the 24, 25, 26 & part of the 27th. ~~The river was entirely clear~~ on which day the first flat-boat arrived. On the 28th the river was perfectly clear, & the first steamboat arrived. On the same day the ice at Crookston began to move & it had cleared out on April 30, the steamer closely following it.

Odometer from Woody Mt
to White Mud Ri.
Oct 18th 1874

4 Good water in springs &
wood 4 m.

8 3320 Creek nearly dry
12½ 5090 Pools with water
13½ 5470 Creek water in pools.
15 6020 " " " "
6870 Creek. no water.
A 9400 Water in pools not good.

9400
600
10000 = 600 Creek Good water.
9100 1840 Capt Fitt road from S.
4527
4573 4527 Creek water in pools.
25
A 9100 Swamp. Water bad.
33
25
8 Good water in pools in Creek.
200 yds S. or 14 m. W. on road.

6½ 2700 Ravine yellowish banks.
Exposures of grey & yellowish
sands 9 m. W of camp.
9
13½ 5535 Large valley. Creek.
Water in pools. Worn
hill. Fossils.
10345 White Mud depot

71 miles in all.

Papers relative to the
Exploration by Capt Palliser
of that portion of B.N.A. &c
June 1859.

Further papers relative &c
to the expedition under Capt
Palliser of that portion of B.N.A. &c.
1860. price 3d.

Sunday, Oct 18, 1874.

Got all things packed up & made preparations to go to Sarry with boat expected this evening. When evening mail came in got no letter from Russel & concluded that he could not be at Sarry, & decided not to go down.

Monday, Oct 19. Reading &c. Afternoon walked down to Summerson Ferry with Burgess & took a sketch of the place. Saw an amusing scene. A man, considerably the worse, got his horse & waggon into the river while attempting to get on the scow. Prairie fire burning out west of the Sarry Road.

Oct 20. Reading &c. Waiting for boat

Oct 21. Got boxes weighed & marked. Took sketch of Dufferin, reading &c. Telegraphed to Sarry for news of boat but cannot learn that she has started.

| | |
|---|---|
| * Revolv. Sp. box. | 110 lbs. |
| Smaller " " " | 49 " |
| * " " " | 110 " |
| * Blue box. No. 10. | 100 " |
| * " " " 37. | 97 " |
| * Large sp. case } | 115 " |
| * Brass box } | 83 " |
| * Spirit lamp. | 84 " |
| * Tent. | 50 " |
| | 798 |

Pelican box
* Black tin trunk.
+ Yellow leather valise.
* Black " ".
* Dispatch case
* Kit bag.

Hand parcels
Gun, Rod, &c
Hand bag.
Overcoat.

Oct 22. Waiting for boat. Capt Cameron communicated this evening a dispatch of congratulation from Gov. Gen. to members of Commission on completion of work. Fine warm Summerlike day.

Oct 23. Hear that boat left Gaspe this am. & may expect her early tomorrow. Warm day with Southerly wind.

Oct 24. All Dufferin moving about 8 Am in expectation of arrival of boat. Did not appear however till about 3 pm. Got away about 4 PM. with Thos. & about 32 Sappers who now start for Halifax. Day cloudy & threatening at first but cleared up in PM. Fine warm evening. Men Singing & playing on Concertina & Banjo. Capt Mark Hendricks accompanies the Sapper party to make arrangements. Ticket agent for W. Wisconsin Ry. Heard when Sorrento are E of Morehead that a large party going down. Started at once & came to Crookston. Found no conveyance & so to get legal

a rival Ticket-agent walked 23 miles t Grand Forks. Here got the Stage & came on t Fisherton. Has now been several days intercepting Tos & Fros arranging about through rates. Offers t accompany party all way t Halifax & make all arrangements.

Short but violent thunderstorm with much lightning & hail about 10 P.M.

Oct 25 Strong head wind in morning dying away in afternoon. Working slowly on all day. Prairie fire burning on the banks this evening.

Oct 26 Steaming up the river all day. Stopped between Turtle R. & Grand Forks for several hours t take on a lot of immense oak logs which are going t the latter place for construction of a steamer t ply on Lake Winnipeg arrived. ~~Thursday~~ Day cold & raw. A few flakes of snow at one time. Arrived at Grand Forks about 8 P.M. & again delayed taking off the logs.

Oct 27 Struggling up the Red Lake River all day. Stream swift, very tortuous & full of timber snags & jams. Also shoal in places. Bends so sharp that almost impossible sometimes to get steamer & barges round them stopping & backing constant, & boat no sooner disengaged from one bank before it bounds over onto the next. Hendrick says river must have been "laid out by a rattlesnake & excavated by a gopher." Day rather cold & bleak though fine & promising in the morning. Distance from Grand Forks to Crookston by road 22 miles by river no one knows how far. Hear that Keiton steamers have taken about 10,000 tons freight into Manitoba this year. 300 or 400 tons still remain at Crookston & may not get up this autumn.

Told that Police of East Lynne says has inspected this year 280 flat boats passing

Northward. ? where money to pay for all these supplies comes from.

Oct. 28. Had hoped to get in this morning but have made hardly any progress though working all night. River now becoming still shoaler & very frequently necessary to take out lines ahead & warp the vessel up by a steam winch. Sometimes not over a foot of water & can hardly get her along on any terms. Told that about 7 m. from Crookston by land last night. Provisions running short. Capt told Capt Sh. that not enough left for Sappers even for supper. Capt S in consequence landed with men about 3.30 & started to walk to

Crookston. Have said to have a

Crookston, then said to be only a mile distant by land. Snowing hard all day, decks covered with slush & work very hard on the deck hands. Poling the head round continually & dragging out wet ropes. Ran out of wood before dark but fortunately found some cut on the bank & appropriated it for steamers use. Met steamer Alpha on way down about 6 P.M.

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The lower part of Red Lake R. much resembles same portion of Roseau R. having rather high muddy banks & being pretty deep & not very wide, though perhaps somewhat wider than the Roseau). On ascending the river becomes more shoal & widens. Timber heavy the whole way & consists of elm & oak.

Sections of banks of lower part of River Stow horizontal or slightly undulating layers of whitish alluvium like that of other parts of Red R. Valley. Upper parts this is frequently seen to be underlaid by yellow sand & stones & boulders no doubt derived from the same sandy layers are frequent in the stream near Crookston. Banks near Crookston sometimes abrupt & clay like where cut into by the river & from 20 to 30 feet high.

Most of the snags could be cleared out at small expense with a block & tackle.

The erection of a number of wing dams, by which a few

mill dams, &c, which have been put up this year) would render the stream navigable by these steamers without much difficulty.

Oct 29. Stationary nearly all night the river being full of bars & the wind so strong that paraly possible to manage the steamer, or use the boat for taking out lines. Snowing viz hard. Got up steam about daylight & almost immediately broke the head of the injection pumps Selwoy, self & some others decided, as prospects for breakfast very poor & no progress could be effected till repairs made, to walk on to Crookston. Climbed up the bank, scrambled through the bush & then had about 1 3/4 miles to go. Snow falling gently. Got breakfast at "the House" the hotel of Crookston. A barn like edifice. Two rooms down stairs the first a bar, the inner a dining room. Walls covered written

with felt pasteboard. Sleeping accomodation in an attic which undivided & admits light & air through cracks between the boards.
About noon steamer arrived having effected repairs. Train Started about 3.30. Arrived at Glyndon early in the evening & occupied most of time till arrival of other train at 12 P.M. Setting the mass of luggage checked

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Crookston an ambitious little village, the few houses composing which are fronted up on imaginary streets.
The prairie from Crookston to Glyndon appears to preserve the uniform & rich character of the Red R. prairie elsewhere. Several well timbered streams are crossed by the Ry.
Snow falling all day & storming heavily during afternoon & night.

Oct 30. Breakfast at Brainerd
Arrived at St Paul about 5.30
P.M. met byne reaching the town
by agents of W. Wisconsin Ry. to
whom Hendricks had telegraphed.
Very civil & made all arrangements
about passages of men &c. Got
a good Supper at the "Merchants
Hotel" & then got luggage checked
& got on board Pullman.
After leaving Thomson Junction the
snow lying on the ground was
much less. appears to be a
sort of climatical division between
the Red R. valley region & that
S. of the Big woods which cover
the region W of St Paul. Probably
follows watershed between St
Croix & rivers which flow
S. ward & those tributary to
Red R.

Oct. 31. On arriving at Detroit
Junction at 3.15 A.M. found
no train making connection
for Toronto.

Oct 31. Travelled all day arriving in Chicago towards evening. Ground lightly covered with snow most of way.

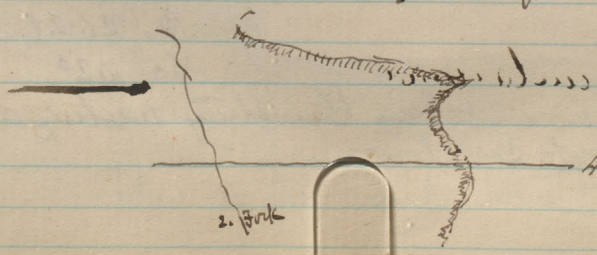
Nov 1. Arrived at Detroit Junction at 3.15 A.M., hoping to make connection with G.T.R. but found that trains changed. Got baggage off transferred & re-checked & shortly after daylight adjourned to a hotel & had breakfast.

Spent all Sunday at Detroit Junction.

Sept 11. Dry chilly & bleak. Small showers in the afternoon. Camped before dark at Goose Lake. Rode on with ashe from lunching place to look at sections in escarpment overlooking the great clay & cactus plain S. of S. Fork. (See notes July 14)

Geol. The lowest beds seen, near the foot of the slope in coules N of line greyish & brownish sandy-clays. Overlying these a very conspicuous red layer which on examination proved to be red sandstones & shales baked by the combustion of a lignite. The latter found in place in one locality but not exposed so as to enable examination of its character or thickness. Some of the baked beds show obscure impressions of plants. Some clays seem to have held no iron & are white or resemble fire-brick, other layers have been completely porcelanized & semi-fusion. Overlying the red beds whitish & yellowish sandy-clays. Section no doubt near base of Lig. Fort. & very probably on same horizon as the part of the section showing red beds in the Bad Lands. S. of Woody Nat Station.

The edge of the Lignite plateau about 15 m. N. of the line comes within about 3 m. of meridian passing through crossing of S. Fork & trail.




Sensible point Edge of plateau bounding Lig. Fort. area.

Camp 5. m. E. of L. Fork 5.30 am.
B. 26.35 Calm.
T. 38° partly clear.

Noon. 16. m. E. of L. Fork. B. 26.41 SW. partly clear
T. 64°

Goose Lake 20 m. E of L. Fork. 8 Pm.
B. 26.325 E. light. clear.
T. 44°

6

| | |
|---|---|
| Granite Gneiss &c. | 63 - |
| Limestone a good deal pounded into. | 41 - |
| Quartz Crystl. | 5 |
| Quartzite drift | 156 |
| Obsidian | 1 |
| Soft Sandstone (local | 3. |
| Chert | 1 |
| Silicified wood | 1 |
| Rocks unclassified | 2 |
| | 273 |

Sept 12. Just at sunrise & as we were preparing to start the mail carrier engaged to bring our last mail up from Benton arrived. He was to have met us at E. Fork Depôt, but not finding him there we left a notice for him to come on. It appears he had met with bad luck having been pursued by a number of Indians after leaving Benton & driven into Bellnap. The indians caught sight of him about noon & kept up the chase till they lost him after dark. Finding that his horse was playing out he was obliged to cut loose one of his bags containing a number of newspapers, his grub, & a "new pair of pants!" He says he "calculated" to keep about a mile ahead of the indians as long as it was light & to elude them after dark. He started out again from Bellnap & was fortunate enough to get through in safety.

The mail carrier had numerous stories of indian horrors recently perpetrated. Three men had been murdered on the Musselshell R. lately, & one of them burned to a stake. Others had been driven back into Benton. The hired train which had brought our oats up on the way back had found on the E. Fork lower down than our depôt, the body of a white man tied up to a tree, but so offensive that they did not care about approaching it.

Made a long march today. Shortly after leaving camp a prairie fire sprang up behind us near the line of march. Probably set by carelessness of some man with his pipe. A number of men

Sent back to put it out, but were not able. It came down on us at lunch halt & we were obliged to beat a very line of it out.
Evening camped in swamps & surrounded the camp by a burned circle in case of the fire which could still be seen away to the north — coming down.
The character of the country on the elevated plateau, the escarpment which visited yesterday, much better than that of arid plains between it & E. Fork & also better than the flat between it & White Mud R. a pretty close growth of short grass, & a good many swamps.

| | | | |
|---|---|---|---|
| Camp goose L. 6 Am. | B. 26·41 | | |
| | T. 39° | W. clear. | |
| Noon 513. m. point | B. 26·37 | | |
| | T. 65° | SSW. Clear. | |
| 8 Pm. 505 m. point | B. 26·38 | | |
| | T. 54° | E. light. Clouded. | |

Sept 13. 74. Left Camp 5·15 Am. & made a march of about 32. m. to Depôt on White R. Calm & warm during night, just at daylight a sudden gust came up from N.N.W. blew hard from that quarter or N.W. all day, & fell calm at sundown. Very bleak & cold.

| | | |
|---|---|---|
| 5 Am. 505 m. point. | B. 26·41 | |
| | T. 47° | NNW. Clear |
| 5 Pm. White R. In coulé on E. bank | B. 27·08 | |
| | T. 34° | Calm. Clear. |

The cold wind an under current, as at one time in morning, upper clouds apparently nearly stationary while lower cumulus & cirro-cumulus tending towards SE.

Sept 14. Spent forenoon in camp fitting repairs done on carts & stores divided up. Started about 1 P.M. an hour in advance of the teams & drove on in buckboard intending to get in to fossil creek before the train & spend the afternoon in collecting. The train supposed to camp in the same creek. Unfortunately took the S. road which crosses the creek at a different place. Could not recognise locality, but walked N. with Crompton & Duckworth to find it. Saw the place from a distance but thinking it too late to go on so far, decided to ride round in morning & catch up train again at lunch time. Got back to buckboard & found that train had passed. Followed them & found they had gone over six miles, completely upsetting all plans.

Sept. The road passes up onto the Tertiary plateau 17 or 18 m. from White R. The edge of the plateau running as in sketch (on Astes plan)
The beds seen at crossing of road on the 12 m. coule from White R. (on the trail taken today) Sombre clays as at the other crossing. A good many vertebrates but mostly in hard crustose & flattened & badly preserved. Large crustose concretions form layers of irregular character. Crustose apparently very pure.

White R. in Coulée on E. bank. 8 Am B. 27.07 S.W. light clear.
T. 41°
noon B. 26.91
T. 61° S. clear.

Camp on edge of Tertiary plateau 18 m. E. of White R.
9 Pm. B. ~~29.94~~ 26.10
T. 48° S. partly clouded.

Sept 15. Started 5.45 & travelled 10 miles. Stopped till noon. Fed heavy food. Travelled on again 11 miles & made camp at Creek with pools of rather alkaline water, surrounded by White Efflorescence. The Country on the Tertiary plateau comparatively fertile & with a thick & close growth of grass, still fairly green wherever moisture. No Cactus on this plateau, or on that W. of White R. Showing better character of soil & less drought conditions.

Geol. The Eastern edge of the Tertiary plateau is descended by the road about 30 or 31 miles from White R.

At Camp 34 m. W. of Woody Mt find exposures of Sombre clays as suspected (see July 9). There must be belong to a bay of Cretaceous extending into Tertiary from the N.

Camp on Edge plateau 18 m. E. of White R. 8 Am. B. 26.11 N.E.
T. 42° light clear.

noon. 28 m. E. of White R. B. 26.44 NNW. light clear.
T. 64°

Height of land between White R. & Creeks running N. 30 m. E. of White R
B. 26.34.

8 Pm. Camp 34. m. W. of woody Int.
B. 2684
T. 40°
Colm clear.

Observed a curious phenomenon at Sunrise this morning. Standing on the brow of a hill looking westward across the prairie with ashe & trees to define the edge of the distant plateau. The Sun just about to rise but not yet shining on us. Observed a bright patch of light on a distant swell of land & on the prairie beyond it, in a line produced through the Sun & ourselves. On seperating the bright spot did not become double. A few seconds afterwards the Sun's rays struck us & the appearance became more distinct. On seperating now saw only one bright spot, that produced by myself, but saw ashe's image as a dark shadow. A saw his image as a bright spot & mine as a shadow.

Have seen a similar effect described somewhere & put down to refraction of dew on grass. The grass in this case perfectly dry.

Saw the same thing last year at sunset, but in this case the image was falling on level prairie only a few yards away. There was a distinct shadow, but surrounded by a corona of brightness. There could have been no dew in this case either.

Probably due to diffraction

Sept 16. Started 6 am. Travelled about 10 miles. Halted from 9 to noon. Travelled on to Creek 13½ m. from Woody Nut.

Geol. Edge of big Tertiary must be on the road about 19 m. W. of Woody Nut. Where it rises into a plateau which however is not so ~~good~~ high as the highest plateau land to the S.
The road then runs on the S. side of the main Creek, crossing many lateral branches of it, & dipping down into Coulies below the plateau land each time.
The main Creek mentioned runs about WNW & meets the Creek which is crossed by the road 34 m. W. of Woody Nut, N of the road.
Then both appear to trend away N. Westward.

Census of drift-pebbles. 25 m. W of Woody Nut.

| | | |
|---|---|---|
| Lau | Granite gneiss &c of prevalent reddish & greyish colours. | 71 |
| Lau? | Quartz | 6 |
| | Hornblend rock & diorite | 4 |
| | Chert | 5 |
| Sil. | Limestone (whitish & yellowish) | 81 |
| | "Siliceous pebbles" Compact & saccharoidal. brownish & yellowish, some whitish & some reddish & purplish. | 59 |
| Lauth Huronian. | Blackish & greyish altered rocks | 17 |

In many localities near here Siliceous pebbles appear to predominate much more, limestone & granite &c to be proportionately reduced. Sudden increase of limestone boulders in this district, however, remarkable.

6 Am. Camp 34 m. W of Woody Mt.
B. 26.79 Atm partly clear.
T. 41°

Noon 25 m. W of Woody Mt. B. 26.89 N. Clouded
T 55° Showery.

8 Am. 13½ m. W of Woody Mt B. 26.71 Sw. light.
T 44° partly Clouded.

A sharp frost last night.

Sept 17. 74. Left Camp about 5.30 & travelled 13½ m. into Depôt at Woody Mt. Found things all safe & in good order. Allen in Charge.

Found that Herchmer had been in communication with the mounted Police, when here, but no reply to my letter to Col French.

A camp of 13 lodges of Sioux Indians now here, as soon as tents pitched they began to come round the Camp, & shortly a deputation of the principal men came to find the Hookemwow or Chief & to have a talk. They presented a document from Lt. Col. French dated Aug. 15. & being a record of an interview with him then held. The Chief speaker on the Indian side being one White Cap. He asked what the police came there for & said he had never seen people like them there before. Said that the bad Americans had killed all their bravest, & that he was not a chief but was only speaking for the rest. That the Bad Americans took their land & killed them. That this was not his own country but that they had been

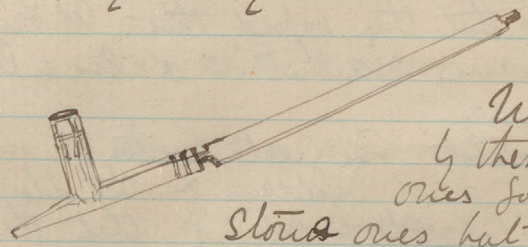
driven here by the Americans & in search of buffalo. That they found themselves here without any powder or bullets & that they hoped that Col French would give them some ammunition, & also a little Tea & flour, & sugar.

Col F. replies that The Great Mother the Queen had black & white & red children & that She loved them all alike. That She had heard that the Bad Americans were coming into her country & ill treating the Indians & that She had sent them out here to drive the whisky traders away & to take care of her red children &c. That they had not much provisions to spare not having got much with. buffalo, but that he would give them some & a little ammunition.

White Cap answered that they were glad to hear all this & that they would be friendly with the English people always.

The Indians wished to know from us about the line, it being explained to them, & the method in which it was marked by piles of stones shown, they appeared satisfied; & approached the main object of the interview by saying that having talked with the chief they expected a little flour, & tea, & sugar. They got about half a bag of flour & some tea & sugar, & then all squatting in a circle proceeded to fill the peace pipe, which the chief man had brought with him & pass it round. The pipe was a very neat one, very ornamented with inlaid lead or solder & made of the genuine "red pipestone" from Dakota.

The matter smoked was chiefly Kinnikinick & very nasty.



Most of the pipes used by these Indians common ones got from the traders. A few stone ones but all except this chiefs pipe of black stone. Got one of the latter kind for two dollars.

All the Indians were more or less painted in various designs. Some had only a general appearance grubbed in vermillion about the face, & a streak of the same down the parting of the hair. One had his face decorated in horizontal stripes of yellow & red. One a single yellow horizontal line on a red background &c

The men are not very good specimens of indians being inferior in physique to those seen at Fort Rae & the Souris! Some of them are tall however & have not bad profiles. The women are all undersized & generally very ugly & decorated with a rouge patch on each cheek & some vermillion in the hair. Two or three of the younger squaws not worse than plain & one was rather good looking.

A good many half breeds here now in the houses & with four large camps the place looking quite busy.

5.30 Aln. Camp 13½ m. W. of Woody Mt. B. 26.62 Colm clear.
T. 28° Hoar frost on grass

8 Rlm. Woody Mt. B: 26.57 Colm. Partly clear.
T. 47°

Sept 18. Morning wet & cold, & raw & chilly all day though clearing towards evening. Reading & getting various little things put to rights. Blacksmiths at work re shoeing horses &c. Compton & two or three men started out to put the few last tablets in the mounds S. of here. Went with Boswell to a half-breeds called Marvin & effected an exchange of one of the Commission horses for a pony, three good carts, & ten dollars, which seemed to please both parties.
Visited ~~a tent~~ the Indians & went into one of their lodges. The tepiz large & made of very well dressed skins, looking from a distance as white as tents, but internally yellow from smoke. That of the chief painted black at the tops & the projecting poles each ornamented with a tuft of buffalo hair in mimic of a scalp. The fire is built in the centre, on the ground, & the beds & seats arranged round it. A few sticks serve for cooking & keeping the lodge warm. Generally pretty clean. Door closed by a piece of skin mounted on a hoop. Skins of tepiz stretched round the poles & meet in front, being fastened together with wooden

pins. The chimney opening at the top has a flap on each side, and which is supported by a pole & can be slewed round to suit the wind & prevent back draught. Behind the camp a couple of poles set up with warriors very like rag dolls. A bundle of coloured rags & the corners an antelope skin &c. &c. up in a bunch & fluttering in the wind.

Boswell while out shooting found a couple of scalps on a small pole which had apparently been lost in the bushes or hidden away there some time ago.

Woody Nut 7 Am. B. 26·66 WSW.
T. 40° Cloudy wet.
Noon. B. 26·67 W. by S. Cloudy
T. 52°
8·30 Pm. B. 26·62 Calm. clear.
T 28°

Sept 19. Engaged packing specimens, writing up notes & getting rations &c arranged for departure. Both astronomical parties arrived from the S. Early in the afternoon.
Got McDonald put on to drive a watercart for supply of the party & Boswells & a new man detailed as cook.
Depot nearly cleared out this evening & all prepared for a start in the morning.

Got a wampum necklace of dentalium shells from an indian woman for four quarter dollars.

| | | | |
|---|---|---|---|
| Woody Net. | 9 Am. | B. | 26·47 SSW. clear |
| | | T. | 57° Sharp frost in the night. |
| | Noon | B. | 26·475 WSW. light. clear |
| | | T. | 58° |
| | 8 Pm. | B. | 26·62 Calm clouded. |
| | | T. | 45° |

Sept. 20. Camps roused at about 4 Am. Teams taken down to Depot when tents struck & the remaining goods there divided out & apportioned for transport amidst much bustle & some confusion. A lot of undrains from the camp, principally Squaws hovering round to pick up what they could. Much amusement caused by their eagerness & struggles for leavings of sugar &c. Two women had almost a fight for an empty sugar barrel. Some surplus remaining at the last, made up of a barrel of flour, do of beans, some sugar & tea; the chief was sent for & presently arrived puffing & panting from haste, but with the best clerical appearance of dignity & repose in his power, & armed with his red stone pipe previously mentioned. Capt. A. spoke to him through the interpreter, saying that from our friendship to the Indians & for a parting gift we left him these things, enumerating them & pointing them out. Between the words the assembled indians utered guttural hauts of satisfaction, & having

shaken hands all round & replied that we had "great hearts", proceeded to a business like examination of the spoils previous to their distribution.

Got away finally about 8 a.m. & made about 10½ m. to lunching place at a creek.
Day beautiful fine, the poplars of woody but as yet showing no sign of autumn, though the undergrowth begining to assume rich shades.

Some flocks of geese passing this afternoon & probably indicating cold weather to the North.

Sept 02. Woody but properly so called is a notch or hollow in the Northern edge of the high level Laguite Tertiary plateau, from which a stream somewhat larger than usual, rises & flows northwards. The wood is in the coulé bottoms & flat ground surrounding the stream & consists almost entirely of poplar. The Northern slopes of coulés & hillsides are also frequently wooded but generally with timber of smaller growth. The stream in the vicinity of centre in a lake a few miles northwards & over ten miles in length, which is slightly saline & appears to be completely landlocked.
The undulating hills & systems of coulés & ridges produced by the degredation of the upland plateau extend I am told about 6 m. N. of the mountain where level dry prairie is reached. Here also the Laguite Tertiary probably ends & the Lowlow clays resume.

The upland plateau S. of Woods Lk. though probably on the same level?? as the plateau of Tertiary further S. & E. along the line, does not seem to show beds of the same age precisely. The beds near Woods Lk & along the Traders Rd. show few & poor lignites, & though composed of similar sands & sandy clays to those along the line are of anything less coherent & softer. Ironstones do not frequently occur. The beds do not appear to resemble closely those at the bottom of the Tertiary seen in the Bad Lands to the S. They therefore probably represent either the impoverished northern edge of the lignite-zeous beds seen last year near the line, or beds higher in the series than those overlying the productive beds of Porcupine Creek district.

? Does the height of the Woods Lk Plateau taken with the horizontality of the beds; agree with the supposition that the strata there seen represent those forming the high watershed plateau seen N. of the line & not visited last year.

Drift. The great abundance of limestone & Laurentian pebbles in some parts of this district & their comparative absence in other places, & replacement by "Quartzite drift" seemes at first perplexing but the general law seems to be as follows.

On the summit of the Upland Plateau already referred to the drift-covering never appears to be thick & consists often of a mere layer of shingle overlying the lignitic Tertiary. It is composed almost entirely of "Quartzite drift" with only a slight admixture of Laurentian or limestone pebbles.

The drift of the Northern more or less degraded edges of the plateau, partakes of the character of that of the lower level plains; & has a large though variable proportion of limestone & Laurentian fragment. Thick beds of undisturbed boulder clay are also seen in several places, especially towards the foot of the slope. This is especially marked where deep bays or systems of coulés penetrate the foot of the plateau, but towards the upper ends of these the Quartzite drift again preponderates.

It would thus appear that the upper plateau drift was derived chiefly from the Rocky Mountains, & that the lower levels, while perhaps obtaining an equal quantity of mountain drift, were so circumstanced as to allow a large admixture of limestone & Laurentian from the N. & E. The conditions not permitting the free distribution of the materials derived from the latter sources over the upper plateau.

These facts thus prove that the Northern edge of the "Coteau" or Tertiary plateau was practically not far from its present shape at the time of the distribution of the drift, & this is confirmed by the absence of Northern debris in the Southern ends of valleys, as these parts have been cut out since & by the removal of softer matter the Quartzite shingle of the higher levels has been let down into them.

(Provisionally further observations & ascertain whether difference of level alone sufficient to account for absence in upper part of valley)

The preceding being taken for granted, & the plateau of Woody Nut being assumed as on the same level as the Watershed Plateau running N. of the Line road N. of Porcupine Creek & Eastwards from it; the comparative absence of limestone along the lower levels near the line would tend to prove that the upper plateau was as effectual a barrier as on other grounds it appears to have been, to the passage of ice drifting southwards with a definite current; or that denudation has gone on much faster on the S. side of the Plateau & cut far into it. (The rapidity of denudation on the southern as compared with the northern sides evident on inspection of nature of country.)

The alkaline lakes & dinders valleys of the northern plateau edge along the Traders Road from Woody Nut probably due to blocking of old stream courses by drift during submergence. The rainfall as compared with evaporation, never being sufficient since to enable them to cut through to the north.

Camp Woody Nut 7 A.M. B. 26·71 Calm. Clear.
T. 44° Frost in night.

Creek Valley about 10 m. E. of Wd. Nut. 1 P.M.
B. 26·95
T. 64° W.S.W. Clear.

Camp 23 m. E. of Woody Nut 6 P.M. B. 26·99 Calm clear.
T. 41°

Sept 21. The large alkaline lake seen on the road out S of the track about 6 m. E. of last night's camp now a dry level plain with sparse growth of grass. The alkaline lakes occurring in the big valley crossed about 39 m. E. of Woody Ck now also for the most part dry, but showing a pure white surface of crusted salts. Long before arriving at the valley its position was made apparent by a great volume of white alkaline dust rising like steam in the air. The breeze on the upland prairie not strong, but appears to ~~blow~~ down the bottom of the valley & form eddies there raising the dust continually from the surface in more or less spiral columns. This must tend to prevent the excessive accumulation of the salts in the lake basins or to redistribute them over the country. The white drying lake surrounded by patches of bright Salicornea &c greenish & yellowish tints of grasses in various stages of growth presents a most remarkable appearance. The crust of salt is only about 1/8 inch thick & rests on blackish fine soft unctuous clay in which a horse easily mires.

Went this morning to visit some indians stayed in tries not far from the track. Found however that some passing parties had pulled the remains down.

A couple of wandering Indians turned up today & begged for something to eat. They followed us to the Cenellion place & had a feed.

Sept 21. The upper level plateau forms the western side of the large alkaline lake & can be seen running S. Eastward from it a very long distance.

Yesterday & during the early part of today we saw more or less perfect sections seen. All appear to consist of yellowish-grey, greyish, & whitish sandy clays & sands &c. No lignites of any importance observed, though specimens of the substance were obtained by some of the men a few miles S. of the road.

Limestone pebbles in drift very abundant.

| | | | |
|---|---|---|---|
| Camp 23. m. E. of Woody Int. | 6 Am. ~~8 Pm~~ | B. 26.96 | Calm. |
| | | T. 39° | Clear. |
| Noon. Bottom big valley 39. m. E. | | B. 27.21 | |
| | | T. 71° | N.W. Clear |
| 8 Pm. Camp 46. m. E. of Woody Int. | | B. 26.99 | Calm. |
| | | T. 47° | Clear. |

Sept 22. Start 6 Am. Course about 17. m. to lunch, & a few miles in the afternoon; reaching the 69. m. point. A fine warm Summerlike day.

Drift. Limestone pebbles & boulders abundant.

6 Am. Camp 46 m. E. B. 26.90 T. 44° Calm. Clear.

8 Am. Camp 69 m. E. B. 26.92 T. 56° N.N.W. light.

Sept 23. Left Camp on horseback with axe to try duck shooting by the way but found swamps nearly all dry & soon returned to teams & kept ~~with~~ sun on backboard. Went up the prominent butte S. of the road about 5 m. E. of camping place of last night. It is raised perhaps 200 feet above general level of country & commands a wide view but a monotonous one. There is however no further escarpment of the high level plateau visible to the north & nothing but an expanse of undulating "Coteau" hills which look from a height & on the grand scale wonderfully monotonous. A very large stone circle on top of the butte resembling the ordinary tepee circles of the indians but evidently having belonged to a great medicine lodge such as that described & figured by Catlin. Diameter 40 paces (horse) Drove a head in the afternoon with axe to shoot on the branch of the Souris on which we camp, but found the pools so small that no ducks were to be seen. Got a badger by the way & skinned him in the evening.

5.30 Aln. Camp 69. m. S. B. 27.03
T. 37° Calm. clear.

Noon. Bey swamp valley 82. m. S. B. 27.00
T. 76° SSW. Lgt. clear.

8 Aln. Camp on first branch of Souris. B. 27.10
T. 60° S. Clear.

Wonderfull weather for the Season. Warm as Summer like.

Sept 24. Started at usual time & travelled on. Lunched where road nears Souris R. Day very fine & warm. After dark in the evening a light seen moving away to the S. & apprehensions of Indians being entertained the guard was doubled, horses ~~[illegible]~~ hobbled as well as tied up & men ordered to have their rifles in readyness. Many ducks & Geese in pools in the stream bed.

Sept. The Coteau proper along the northern edge of which we are now travelling is composed in great part of drift. A belt of which borders the higher land to the S & west & is superposed here on Upper Tertiary rocks just as Hector shows it in one of his Sections resting on Cretaceous. The coteau edge therefore not marks all the border of any particular formation, but forms a curve round the central swell in which both Tertiary & Cretaceous beds are involved.

5.30 Am. Camp on first branch of Souris B. 27.07 SSW.
T. 44° light clear

10 Am. About 70 m. from wood end; on Souris B. 27.08 SW
T. 83° Clear.

8 Pm. Souris 61 m. W. of wood end B. 27.12
T. 62° SW. Clear

Sept 25. Left camp before sunrise. Drove ahead in buckboard with ~~Cadot~~ Boswell about 9 miles to the first crossing of the Souris coming from the west. Shot up & down the river till the teams came up. Got between us three geese & finite of number of ducks. Travelled on several miles further before lunch, & in the afternoon crossed the Souris again, taking hay from the haystack there along, & went several miles further to camp.

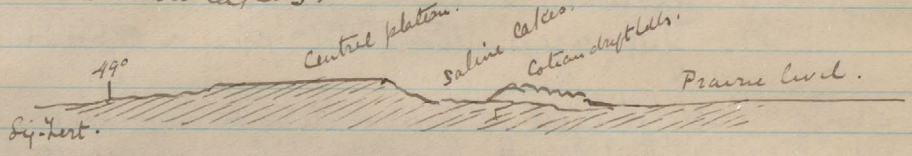
An appearance of gathering for a storm all morning with occasional drops of rain. All cleared up however towards evening. Clouds travelling up from the South though wind WNW.

On coming down on the prairie level the grass found to look remarkably green & fresh & not at all so brown & dry as on the upper levels. much greener than at same season last year. Every appearance of late heavy rains.

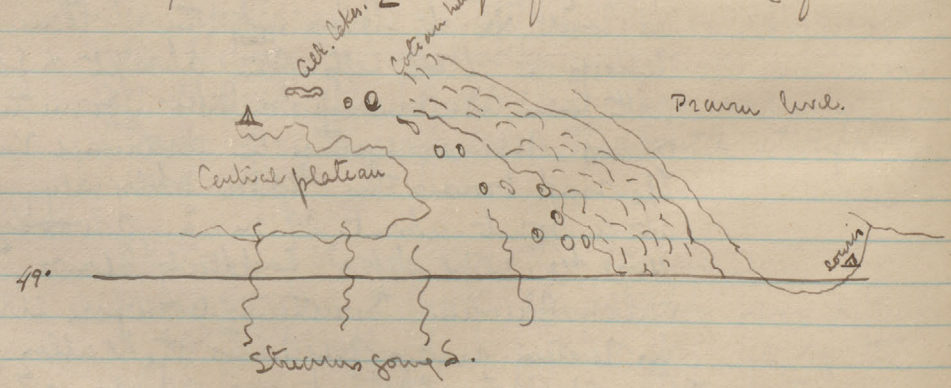
Geol. At the first crossing of the Souris in coming from the west found a small exposure showing a bed of lignite cropping out at the waters edge. About 18" are seen. Overlying it frequent sandy-clay rather hard, a few feet seen. Lignite with amber spots & quite resembling that seen at Wood End & elsewhere. Locality about 52 m. W. of Wood End & fills a gap between that place & exposures beyond Coteau.

The physical features met with in going W. from Wood End along the line are almost exactly repeated further North along the Traders Rd.
The Traders Road in going westward, after leaving the prairie level passes a long time along the gently sloping Northern foot of the "Coteau". The proper Coteau edge is visible to the South (a few miles off) as a gentle but continuous & well marked range of undulating hills. To the N. the sky line is level & sea like.
Shortly after leaving the last branch of the Souris on the road, it strikes into the Coteau proper, a region of drift hills often abrupt & sometimes stony with basin like swamps & lakes, sometimes alkaline; & no regular system of drainage valleys or coulées. The road crosses this region obliquely leaving it at a point about 39 m. E. of Wolsley Post.
Here the road dips suddenly down into a large valley running Southwards where stands, which in many ways resembles the valley called the "Grand Coteau" last year; but is characterized by saline lakes & apparently has no outfall.
It probably represents the region on the western

edge of the Coteau hills or the line characterized & chains of "alkaline" lakes or.
West of this the road follows along the northern edge of the lower or central plateau, following or cutting across valleys characterized & salinity & frequently containing or draining into saline lakes.




The watershed between the Missouri & rivers draining northwards evidently a gentle elevation of Tertiary & Cretaceous strata & has been formed & eroded (in the way mentioned in a previous note) before the deposit of the drift material along its northern & eastern edges. Hector figures overlap of Coteau drift on Cretaceous rocks on S. Saskatchewan exactly similar to overlap observed by myself on Tertiary further S.




The northern slope of Coteau along which the Dreden Rd passes is in general like the prairie about

Wood End. Good fertile land. So are many parts of the Cotian hills & areas along the base of the central plateau & on its summit. The whole underlain by Tertiary rocks making all the difference between fertility & barrenness observed over Sombre clays. To be observed however that fertility not identical with suitability for agriculture, for besides question of wood &c must remember that if there is sufficient summer rainfall for growth of crops there is only a small margin to go & come upon, & a defect of a few inches in any locality might render it useless for anything but grazing.

5.30 Am. Sources R. 61. m. W. of Wood End.
B. 27.13
T. 59° W.N.W. partly clear.

8 Pm. Camp on Sources bank 37. m. W of Wood End.
B. 27.65
T. 50° W.N.W. Clear.

Sept 26. Travelled on as usual. Afternoon rode out along the river with Aske shooting & returned to ~~camp~~ where camp formed about sundown.

5.30 Am. Camp on Sources bank 37. m. W. of Wood End.
B. 27.75
T. 40° N. Clear

1 Pm. Bank of Sources 21 m. W. of Wood End.
B. 27.765
T. 65° N.W. strong. Clear.

8 Pm. Camp. Bank Sources 11. m. from Wood End.
B. 27.925 Calm Clear.
T. 41°

Sept. 27. '74. Rode ahead of teams with Ash & followed the river shooting, arriving at Wood End Depot about an hour & a half after the teams. Shot a few ducks & a Swainsons Buzzard. One of ducks a female canvas back. Found Depôt in good order & got 7 days rations all round.

Smith who with Templeton at depôt has collected quite a quantity of agates, silicified wood &c. Got as much as useful from him. Has a turtle about 15 inches long found here which though decapitated 16 days ago still alive & capable of drawing in its feet when touched. Has kept it in shallow water after first two days.

Notwithstanding the greenness of the grass hereabouts the trees quite faded & some nearly bare of leaves. Poplars all bright yellow, elms yellow to brown. Negundo & thorn brown & most of leaves flattened & fallen. Seems more change than due to difference of time only since leaving Wood Nut where poplars quite green.

5.45 A.M. Sounds hauled 11. m. from Wood End.

B. 27.94
T. 32° S. Cloudless. Hoar frost in night.

Noon. Wood End. River flat.

B. 27.72
T. 72° SW. light. Cloudless.

9 P.M. " " " .

B. 27.80
T. 46° Calm. Clear.

Sept 28. Camped at wood End all day, resting the horses & felling timing & 2 done. Writing Reading & E &c.
Day oppressively hot & sultry. Quite like midsummer.

9.30 Am. B. 27.73
T. 67° Calm Clear.

Noon B. 27.675
T. 81° S.E. light. clear.

Mercurial Bar 28.123
attached Thermometer 84°

8 Pm. B. 27.84
T. 57° E. Clear.

Mercurial Bar . 28.14
Attached Thermometer 58°

Sept 29. Started 5.45 & travelled on to St Peters Spring. After lunch came about 9 miles & Camped at a good grassy Swamp.

A good many specimens of Anemone patens in bloom. Evidently a second crop like that observed last year.

Wood End. River flat. 5.30 Am.
B. 27.93 E. Clear
T. 39°

Noon. St Peters Spring. B. 27.70
T. 70° S. fresh. Clear.

8 Pm. 27 m. E. of wood End
B. 27.76
T. 50° S. light. Clear.

Sept. 30. Drove on with Ashe to River Lake to shoot, but found very few ducks. Lunched at slew a few miles further E. Reached Souris R. early. Crossed at S. ford & camped on river flat. The foliage here seems nearly all fallen & altogether more autumnal appearance than at Wood End.

5.30 Am. 27 m. E. of Wood End B. 27.71 N. light.
T. 64° partly clouded.

Noon about 10 m. W. of Souris. B. 27.70
T. 72° W. partly clouded

8 Pm. Second Crossing Souris River flat B. 27.90
T. 46° Calm clear.

Oct 1. Travelled from Second Souris to Crossing of E. Antler Creek.
Country green & good looking, especially where burned last autumn.

5.30 Am. Second Crossing Souris River flat. B. 28.17 N. light
T. 30° clear.
hard frost in night.

Noon. Swamp 13 m. E. of Souris. B. 28.06 N.N.W. light.
T. 66°

8 Pm. Bank S. Antler at Crossing B. 28.11 Calm clear.
T. 38°

Some Sioux came into Camp this evening. Travelling with a cart along the stream shooting muskrat &c.

Geol. Causes superficial drift at Crossing S. Aulter.

| | | |
|---|---|---|
| Lam | Granite pieces & g. greyish & pinkish. | 82 |
| Lam | Hornblende Schist. | 5 |
| Sil. | White Quartzone | 142 |
| Lam? | Quartz | 10 |
| Tert or Cret | Trap stone | 1 |
| Hur? | Greyish hard altered rocks resembling Quartzite | 18 |
| Sil. pebble cutting | Yellowish quartzite. | 4 |
| Sil pebb.? & Hur &c | Quartzite & hard altered rocks | 11 |
| | Diorite | 2 |

Oct 2. Travelled on to first Crossing of Souris.
Went duck shooting with Ashe before lunch. &
went Capt A & Boswell above on to Souris for
shooting in afternoon.
Morning cold & raw.
Grass remarkably green & fresh everywhere.

5.30 Am. Crossing S. Aulter Bank B. 28.19 Calm.
T. 31° clear.
Moon just in sight.

1 Pm. N. Aulter Cr. Bank 7 m. W. of Souris B. 28.22 S. Clear.
T. 61°

8.30 Pm. First Crossing Souris. (bank.) B. 28.22 N.E.
T. 38° Light. Clear.

Oct. 3. Party moved on as usual. Started with Capt Featherstone Sappers Quint & Wilson Gillot & a scout on a trip through Turtle Mt. Capt F. to put in tablets at mounds. My object to see nature of country & especially to visit a locality where an exposure of limestone reported to exist. Plan to enter the mountain from U.S. Astron. Station at W. end, follow U.S. Cutting & trail to its E. end. Cross or get round Larpian Lake. Strike British line cutting & trail & follow out to Turtle Mt Depot. There to meet the main body again.

Rode about 25 miles across the prairie to the U.S. station. Bond bringing the baggage along on a buckboard. Arrived at station before noon. & halted for lunch & to let the horses feed. Day rather cloudy & doubtful. Wind S. Easterly but clouds coming up from the S.W. Wind strong & chilly. After lunch saddled up, put pack on a pack animal & entered the cutting. Trail only used as a pack trail a few times & very poor. Brush & windfall, stumps & bush rendering progress slow. Found the first mound but in poor condition. One about 2' 6" high diffuse not ditched round & altogether a very shabby piece of work.

Stopped about 5 P.M. at "Summit Lake" a pretty little shell water with high wooded banks. Organized camp by building a couple of good fires & choosing sleeping places. Unstrapped blankets from saddles & after a hearty supper turned in. Night very fine but brilliant Aurora.

Country. In approaching the "mountain" from the west the land of the country gradually rises, & the undulations yet surface become more abrupt & frequent, & swamps are common & contain much good grass, & in many places rising considerably above a horses back. Almost the whole of the prairie between the Souris & Turtle Mt may be considered good & bears fine short grass. The foot of the "mountain" is broken up into rather abrupt hills & lakes are scattered here & there. The features quite similar to those of the "mountain" itself which is merely an elevated tract of broken & undulating land, which from its hilly character & the numerous swamps & lakes has prevented the sweep of prairie fires & enabled a growth of timber. The timber covering renders Turtle Mt prominent from a distance & it is unlikely that it would have been dignified by the name of "mountain" at all but for this fact. The timber passed through along the line today consisted of Poplar & oak chiefly. No trees of great size & much of the wood destroyed by fire.

5.30 Obs. Bank Souris R. B. 28.30 E. partly clouded

2 Pm. U.S. Astron. Stn. W. End Turtle Mt. B. 27.62
S.S.E. fresh. partly clouded.

6.30 Pm. Summit Lake B. 27.28 SSE Clear

Oct. 4. Up at Sunrise & started S. along the cutting again as soon as breakfast over & animal packed. Ascended a ridge immediately S. of Summit Lake which appears to be the highest point passed over by the line & from which has extensive view of the cutting S & West. Travelled on with considerable difficulty to Farquhar Lake, passing round by a very slim path trail, several long lakes which the line cuts across. The Ks. party had crossed Farquhar Lake by means of a raft & cut out a short piece of line on the S. side. No trail however cut out round this lake, & as it was known to extend a good way N. & S. of the line, & to merge into swamps &c. it was a matter of doubt from the first how we would pass it, or whether, with the time & means at our disposal we could pass it at all. Had heard however of a narrow place S. of the line about a mile, which the Indians had reported fordable for horses. On arriving at lake made for this spot & by "worming" along through bush &c managed to reach it. The strait proved to be more than 100 yards across the sides fringed with reeds & rushes & a lane of open water in the middle. Sound the bottom in most places hard, but could not find any place shallow enough to ford. Crossing a point of Rosean grass (Rhegnatus communis) which grew out among the rushes I pushed "Lawson" in till he began to loose his footing, & finding him not at all afraid urged him on till he took to swimming & in a few minutes reached the other side safe & sound, but wet up to the waist &

with a wet blanket & some water in the saddlebags. The rest soon followed & all soon got over without accident. Even the pack-horse swimming over with his pack (which was a light one) without further damage than wetting the oats. Went on again at once & reached by about 5.30 P.M. the 18-m. point measuring from the British station at the E. end of the Mountain. Camped by a small swamp among tall poplar woods, the leaves which quite fallow & falling one by one.

dried clothes &c as well as possible before turning in.

Heard Indians shooting ducks today in several directions & came on two travelling along the trail with a pack pony. They seemed much astonished at seeing us, & pleased to recognise ~~some~~ one of the men who had been up the Mountain last year. Soon after came on two tepés. The dogs barking at us brought out a squaw who on seeing us became for a moment transfixed by astonishment & perhaps also fear. Soon an old man & several other women & some children appeared. We shook hands & passed on leaving them before they had recovered their presence of mind enough to beg. Like all the Sioux of this region the are remarkably light coloured & have good features, & a pleasant expression.

Anderson or Rice Island Lake which the line crosses, must be over three miles in length N.&S. & a mile wide. Its shores are gravelly, & hard. Many beautiful sweeping bays & islands with pine timber.

Night fine & warm. Some owls answering each other from tree to tree, & a partridge drumming possibly to keep himself warm—. Bright & active Aurora.

6.30 Am. Summit Lake B. 27.28
Summit Lake (Second mound) 4½ m. B. 27.14

7.30 Pm. 17 3/4 m. W of Brit. Stn. B. 27.52

Killed several partridges (ruffed grouse) which had been feeding on the catkins buds of hazle. Both grouse & ducks scarce however compared to opportunities for picking up living.

Oct 5. Left camp early & travelled along pretty fast, being now on the Cart trail cut out last year. Visited the supposed limestone exposure. Shot several partridges by the way. Stopped an hour for lunch & then pushed on to the Depôt. Arriving there about 4 Pm. Found the main party camped & ready to start in the morning.

Country passed over much like that before seen but swamps & lakes fewer, & considerable stretches of only slightly undulating & heavily timbered good land. Near the depôt, & on the edge of the mountain the country very beautiful being broken up into natural meadows ~~with~~ by stretches of woods, chiefly oak.

2

Sol. The supposed limestone exposure occurs in a small running brook near the 16¼ mile point on the line coming from the British Stations at the east end of the mountain. It appears to be merely a large stratified boulder of that rock. It shows 3 or 4 square feet at the edge of the water, & has been broken up by the weather since its deposition there, so as to exhibit the stratification planes & make it resemble a portion of a bed in situ with a high dip & ~~strike~~. Many other boulders (chiefly gneiss) occur near it, & the whole of the features of the mountain go against its being really in place.

The "mountain" appears to be merely a more elevated & broken region of the surrounding country & to be composed entirely of drift. Nearly all the abrupt slopes & ridges show boulders in abundance, & these appear to be chiefly of Laurentian rocks. The stones of Anderson Lake are gravelly & white limestone here appears to be more abundant than any other rock. Laurentian pebbles are frequent & greenish & greyish Hermannsburg samples were also observed.

Regarding the hypothesis of any nucleus of limestone or other rock in place, the area now covered by the mountain may have been one in which the set of currents originally tended to accumulate floating berg during the Glacial Submergence. Such an area would have been one of greatest deposition, having once become a bank or shoal

would rapidly assume more material by the grounding of passing ice.
The surface topology of the mountain appears to be that of a comparatively little modified drift area, & resembles that of the Coteau in many ways. The lakes are basin like & drainage valleys are few & unimportant. A portion of the finer material has however been denuded from the slopes & ridges & deposited in the hollows, leaving the former in many cases stony & gravelly.
Lakes are most numerous & largest towards the western end of the mountain & they together with the ridges there appear to have a pretty uniform N.O.S. direction. This is not so apparent towards the East end

The forest-clad area may be estimated roughly at about twenty miles square & of this about two thirds must be N. of the line, for though the mountain extends much further South, much of the Southern portion is bare. The wood is chiefly poplar (Tremuloides, Balsamifera &c) oak occurs abundantly however, especially along the edges of the woods. forming groves on the ridges & often growing interspersed with the poplar & birch. (Quercus Macrocarpus probably almost exclusively) White birch is also abundant though not generally forming large groves. Black birch also occurs. Negundo & elm are also found the latter obtaining considerable dimensions in some of the ravines & valleys.

The largest poplars observed must have been over two feet in diameter at the base & of good height. Average size of many groves about 18". Oak seldom over two feet. Birch about the same as a maximum but generally much less & very tall.
Fires evidently occur very frequently, & sweep over the areas where a sufficient depth of vegetable matter & peaty soil has accumulated. This prevents the average size of the trees from being great, & tends to induce the growth of poplar & such fuel growing trees. Some cases were observed however in which a fire passing through rapidly had been sufficient to kill nearly all the poplars, while the oaks had escaped from the protection of their thick barks. The young growth on burned areas generally appeared to be poplar, forming dense thickets of saplings. In some places however oak scrub prevailed.
Most of the swamps are grassy & would yield excellent hay. They are fringed with willows of various species, of which the rough barked willow attains a considerable size.
Most of the underwood is composed of hazles, choke-cherries & thorns also roses raspberries &c. Peas & vetches are abundant & mingle with Epilobium, & various species of aster & solidago.

The soil is usually deep & rich & based on a whitish marly subsoil of drift. The arable area amounts to a considerable part of the whole, but the chief value of the "mountain" will be as a supply of timber for the forest plains around it.

It may also serve as a refuge for wandering stock, which during the Summer has been herded over the prairie.

The woods are at present about half denuded of leaves. Those remaining on the poplars are mostly quite yellow & falling one by one. The elms, oaks, & maples are almost entirely bare. In some sheltered localities the poplars however still retain their green tinge.

6.30 Am. 17. m. W. of Brit. Stn. B. 27.67
11. Am. 11¼ m. " " " B. 27.62
Noon. 9. m. " " " B. 27.68

8 Pm. Turtle Depot B. 28.04
J. 34° Calm. Clear.

Oct 6. Left the Depot early & travelled on to Badger Creek, stopping at a Coulé for lunch. Rode ahead before reaching Badger Creek to shoot it to the S. & stood up it. Got only a single green winged teal.
A stout from Dufferin arrived this evening with a spring-waggon bearing a mail.

5.30 Am. Turtle Depot B. 27.98 SS.W. fresh. Clear
J. 39°
Noon. Coulé 12. m. E. of Depot B. 28.20
J. 63° S. Clear

8 Pm Badger Creek (Valley bottom) B. 28.40
J. 36° Calm. Clear.

Oct. 7. Made a long march to Long R. for lunch, & then came on about 5 miles in the afternoon, camping beside the haystack, but on a level open prairie with no water nearer than a mile.
Met a large half-breed train today on route for Woody Mountain. The usual array of carts men riding & women driving under calico cart-covers.

| | | | |
|---|---|---|---|
| 5.30 Am. | Badger Cr. (Valley bottom) | B. 28.34<br>T. 37° | S. light. cloudless. |
| Noon. | Long R. (Valley) | B. 28.24<br>T. 73° | S. Clear. |
| 8 P.m. | 5 m. E of Long R. | B. 28.10<br>T. 60° | S.W. partly clouded. |

Oct 8. Came on to Pembina R. for lunch & then to Calf Mountain. Camping on a small coulé with pools of water. Went shooting in the afternoon but with no success. Chickens being few.

Country E. of Pembina R. not nearly so bare as great plains to west. Wood on many coulés, & whole prairie covered with pretty high growth of grass & weeds. Many small willow bushes. Much of prairie beneath must however be swampy in early spring & would require drainage before cultivation.

| | | | |
|---|---|---|---|
| 5.30 Am. | 5 m. E. of Long R. | B. 28.21<br>T. 48° | S.W. clear. |
| Noon. | Pembina R. Valley. | B. 28.475<br>T. — | S. Clear. |

9. Pm. Calf-Mt. B. 28.12
T. 37° Calm. clear.

Oct. 9. 74. From Calf Mt. to Cambria Depôt for lunch. Found haystack Depot 2 miles before reaching depot & took on loads of hay. Pm. came on to Duck Swamp about 9 m. found no water there but camped & sent pioneers to water at a lake 1½ m. west. Lackenbach & Palmer go on to Slew near Grants about 9 m. further.

Geol. In digging a well in Duck Swamp found subsoil below the vegetable mould to consist of very fine & uniform yellowish sand to a depth of 7 or 8 feet. No doubt represents coarser edge deposit of same age as fine sandy clay found at Red R.

5.30 Am. Calf Mt B. 27.96 W. light.
T. 46° partly clouded.

1. Pm. Cambria Depôt B. 28.37 W.NW. fresh.
T. 68° partly clouded.

8 Pm. Duck Swamp 6 m. S. of Cambria Depot B. 28.69 calm.
T. 39° clear.

Oct. 10. Started at usual time & came about 15 miles before lunch passing Grants to prevent disappointing Pm. on to 8 mile point! Boswell Sam on ahead to make arrangements.

Received detail from Capt A. Stating time for party to be at Store to turn over things.

Day cold & blustry throughout. Came off the road to the South & Camped near the woods for shelter.

5.30 Am Duck Swamp. B. 28.81 N.W.
T. 41° partly clouded.

1 P.M. 15 m. point on Pembina R. B. 28.94 N.W.
T. 51° fresh. partly clear

8 P.M. 8 m. point. Pembina R. B. 29.21 N. fresh.
T. 39° partly clear.

Oct. 11. Started at 5.30 & travelled on into Dufferin arriving at 9 Am. Day very cold & blustry with sky clouded. Got all travelling things, teams &c turned over in the afternoon & went into Barracks.

5.30 Am. 8 M. point.
B. 29.44 N. light. Clouded.
T. 32°

Oct. 12. Setting arrangements made. Things unpacked &c.
Drove down to Telegraph office & telegraphed home this Am.
Cold but fine day.

Oct. 13. Morning at work writing, packing &c.
Afternoon drove down to H.B. Post with Rowe to enquire about boats &c. Business appears to be active at the Custom House.
Many flat boats on their way to Garry with lumber & all sorts of goods.
Beautiful Indian Summer day.
Bright Aurora in the evening.

Oct. 14. All day arranging & exchanging plants with Burgess & Millman. Packing fossils &c. Duckworth engaged packing birds & re-catalogueing.
Took a stroll in the evening.
Fine Indian Summer day.

Oct. 15. Engaged packing specimens &c. & returning apparatus &c. into store.
Fine warm day.

Oct. 16. " " "

Fine warm day. Atmosphere now chronically smoky & the sun always setting as a round red ball.
Indian summer, but the hazy appearance due to distant prairie fires.

Sent off horses to Garry to sell.

Compared my small aneroid with the standard Mercurial.

Mercurial 29.096
attached thermometer 70°

Small aneroid 28.95.

General Memo.s.

Sioux at Woods Cut. Much astonished & sear that "King George" dead. When told that a woman now our chief, silent some time. Then one asked. Is she married to the great Spirit.

180
90
170

261

261
170
91

25 box
25 box
25 bn fn
bn bn
on bn

1,51
385
755
1208
453
5.8135
52.9067

2,91

61
34
244
183
2074

29.5
31.5
61.0

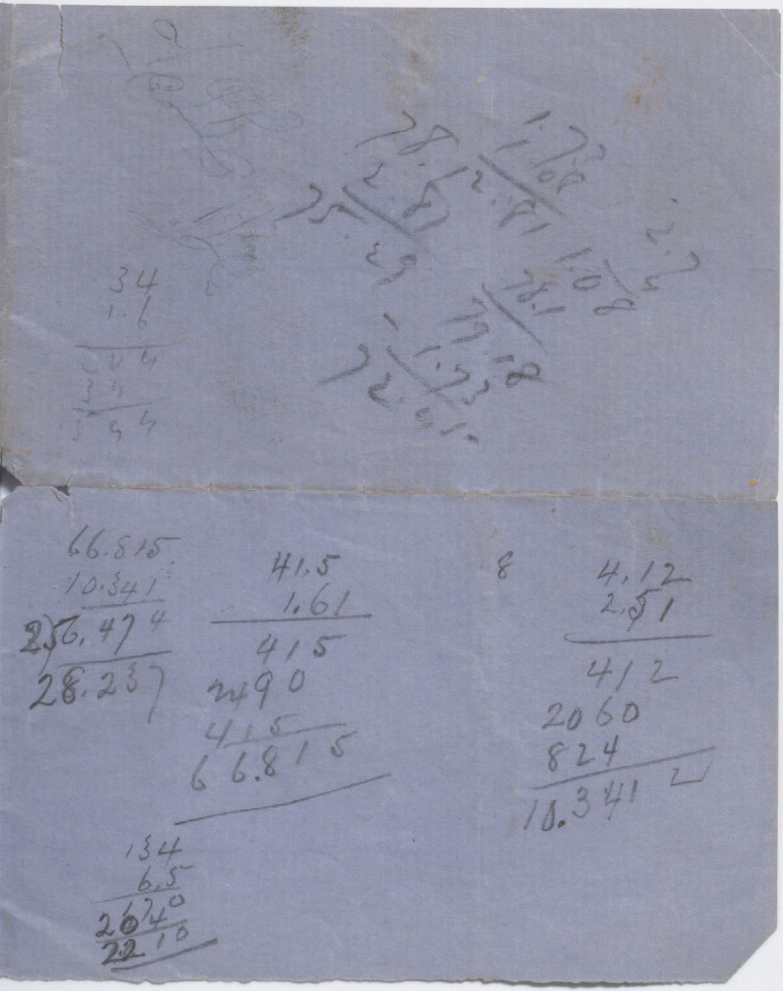
67
67
6.1

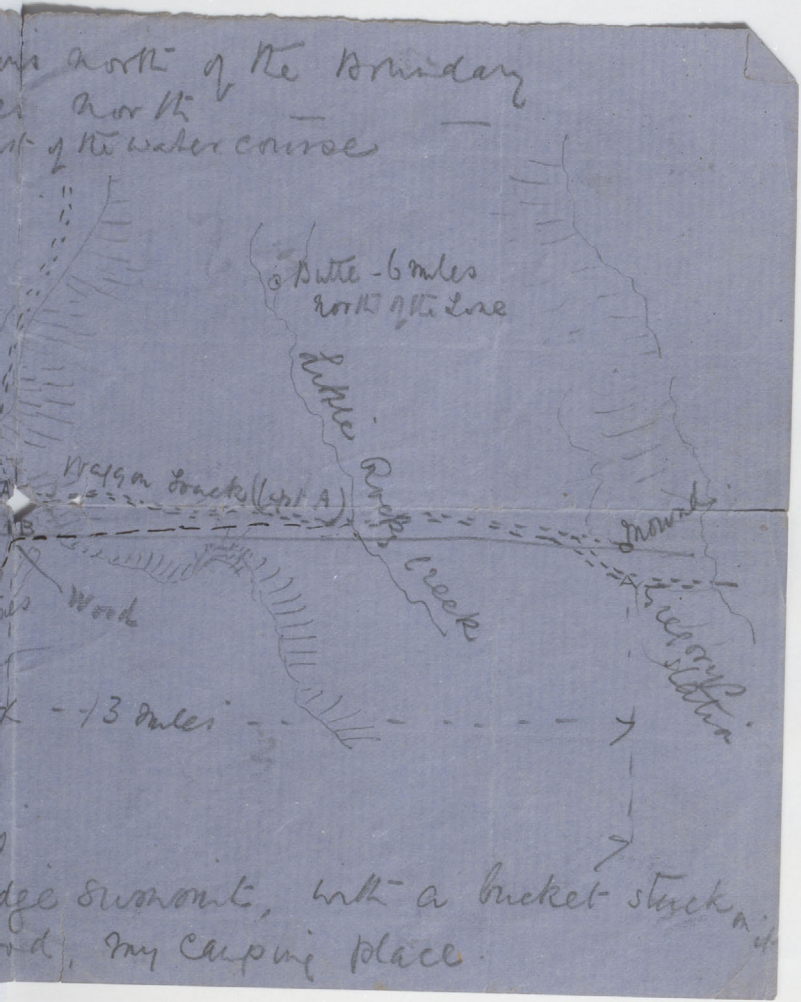
341
33
67

3 42,990
4 95
3 7 95

25.85
2.92

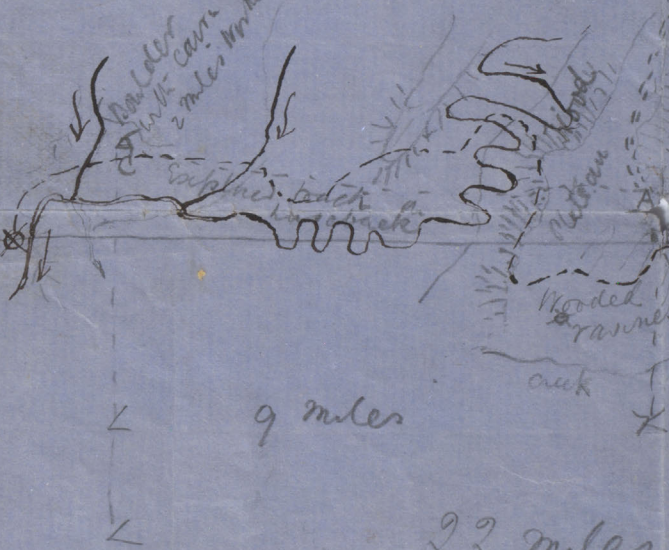
2.40 35.83


34
1.6
204
34
54
66.815
10.341
256.474
28.237
41.5
1.61
415
2490
415
66.815
8
4.12
2.51
412
2060
824
10.341
134
6.5
2010
2210




ge summit, with a bucket stuck
d, my camping place.

Picket A is about 64 chains
Cairn C " 2 miles
and $\frac{1}{4}$ mile east




At (A) is a picket on the ridge
" B is a spring and wood

1 Limestone ~~186~~ 42 – 52.50
Granite 26 – 32.50
Hor 4 – 5.00
Slate 8 10.00
80 100.00

2 Lime 47 – 46.53
Granite 28 – 27.72
Slate 7
Hor 17 – 16.83
Diorite 2
101

3 Limestone 186 – 63.05
Granite 61 – 20.68
Slate 8
Slate dyke 9 – 3.05
Hor 30 – 10.17
Diorite 1
295

4 Limestone ~~80~~ (80) – 21.74
Slate 6
Granite 105 – 28.53
Diorite 3
Hornman? 15 – 4.08
Quartz dyke 159 – 43.21
368

5 Granite 71 – 28.75
Slate 6
Diorite 4
Limestone 90 – 36.39
Quartz 59 – 23.88
Hor? 17 – 6.88
247

6 Granite 63 – 23.68
Limestone, a good deal from lots 42 – 15.79
Quartz dyke 5
Quartz dyke 156 – 58.65
266

7 Granite 68 – 28.94
Limestone some from lots 19 – 8.08
Slate 10
Slate dyke 138 – 58.92
235

8. Granite 51 – 28.49
Diorite 4
Slate 7
White lime some lots 11 – 6.14
? Actinolite slate 6
Siliceous dyke 100 – 55.87
179

Revised nomenclature of Rocky Mt-Rocks -

| | | |
|---|---|---|
| Series X | = | Series a. |
| Series Z. Lower limestone. | = | Series B. |
| Series 1.2.3.4. | = | " C |
| Series 5 Upper limestone | = | " D |
| Series 6 Trap | = | " E |
| Series 7 | = | " F |
| Series 8 | = | " G |
| Series 9 | = | " H. |

9 Granite Dr. 45 - 23.93 × 3½ Granite Dr. 87 - 33.08

Slate 2 Limestone 142 - 53.99

Diorite 5 Slate 10

Limestone Lime from lists. 13 - 6.92 Hess 18 - 6.84

Slate-dr. 4 or +

Diorite 2

263

1.52

Slate 86 } 65.42

Hand altered slates .37

188