RU 7004 / Walcott
Arizona Grand Canyon
Field Notes 1879
found between pp 148-9

Arizona
Grand Cañon
Walcott 1879

Chas. D. Walcott

U. S. Geological Survey.

3 June
1920
with
A. A. Stuyvesant

Music Mountain west of Reed
Springs, Oregon.

The lower portion of the slope
north of the road is granite.

Tepees

Lying on the granite is
about 6 feet of pearly white
saccharoidal, cross-bedded massive,
fossile or fossile stained &
the other hand the massive
Carnivian basal quartzite.

Bright Angel shale

This grades up into a thin
series of typical Bright Angel
shale. & limestone, brightly
colored with perhaps a bit more
arenaceous layers & less calcareous
also lime.

Muav

This shale grades upward into
Muav limestone, which here attains
a thickness of 800-1000'. Compared
with the Grand Canyon the main
difference noted, and general, now
the fact that the fossils are yellow
pearly together,
either in the form of Cruziana
fletchers or worm tubes. Some of
this bed resembles the Intermediate
Elden of E. C. except that the fossils
(megafaw) are yellow and not

Muscia Mt. (cont)

White:
Much Girvanella occurs here. It is a little larger than is usual for the M.C. type, but otherwise quite similar.
Trilobite fragments (unidentifiable) occur in the lower Muav as well as in the sandy layers of the underlying Bright Angel F

Devonian follows.

[Dr Stoyanow has measured section]

June
with
A A Stevens

East of Del Rio, Arizona.

On the edge of the plateau at this place, the granite is capped, plain by a sandstone like the tableats but which is succeeded by Devonian limestone.

a little to the north of this first locality a thick series of metamorphosed quartzites intervenes between the granite and the Devonian sandstone.

Algae in Ohuan region. Nankoweap.

Lowest exposed. Simply grinkly bedding. Up to several feet in thickness.

Vase former. Coarse ~~ll~~ sandstone. Forms layer perhaps 10' thick over whose rounded mamma the overlying shale is laid in sharp folds. In the lower part of the formation the individual colonies are small rather irregular cylinders which sometimes bend rather sharply. These cylinders show the regular Cryptozoön structure and widen a little as they grow. Taken together they form large masses that are described below. In the upper part of the bed the small cylinders give way to large rounded heads. Both the cylinders and large heads combine to form huge vase-shaped masses. Usually the base is narrower than a regular flare would require.

6-8

Walcott makes a good drawing in his 1908 book. Sample of the small tubes taken.

Alga (Chara) Com.

Upper zone. Irregular broken, usually blackened algae. Some appear to have been turned over by the waves.

Above this zone there is an oolite layer that is usually altered to black chert. The oolite

Topmost limestone has very little algae. All are indefinite and broken.

19 June
1930
with E.D McKee

Kaibab Trail.
Above Ponderosa.

Tapeat's typical in character and thickness

24 May
to 1920.
W. Stevenson

Waukomeaka Creek,
Lower Portion. [Box canyon
above Colorado R.]

Beds tilted toward river at about the same angle as the stream appears in consequence the creek flows in the Muav almost all the way.

Just above the box canyon on the west side the Muav is faulted against the Tapeats — at x in a thin

sandy layer I got fossils - Dorypyge, Dr Stoyanow and I agreed, after considerable search that these are actually in the Muav, which therefor dives considerably but this formation is Middle Cambrian as we had previously deduced on theoretic grounds.

Recent Algal deposits in Mankoreap Canyon.

Gravel and sand along stream either above or below the water level is cemented.

#

Below camp in side canyon a seep is depositing much lime.

#

At camp springs are depositing lime white spongy type with leaves and stems enclosed.

#

Elsewhere where water first issues tufa usually occurs.

Notice data at stamen of
Cantaiflowers, also character
of feeding thy aphid.

Aug 12" 79.

ascended hill directly west of Karadeb at 200 feet (Aneroid) above the level of the stream found small shells in ~~red~~ variegated sandstone and 25 feet above lithyic remains × both species evidently of two species. Spent the afternoon searching for them.

Aug 13,

Hill ½ mile S of Karadeb.

(1) Base of shale, crumble gypsiferous, resting on Lower coal ~~shales~~ 90 feet

3 massive layers, dark hyaline shale, + an ~~ca~~ thin massive limestone ~~shales~~ Upper coal 50 feet

3 Massive

Radish Brown shale 30 feet.

light colored sandstone
[illegible] 50 feet
thick which [illegible] a ledge
[illegible] similar to the
[illegible] bands of sandstone having
thickness — 20 feet to almost 60
[illegible] (Section Continued on page 6)

From [illegible] to the 2nd
[illegible] Coffee with
[illegible] Section, Township 9
west from the East Bible of
the Black Hills. A mile
of the Section Line Light
Nee one above the other
to the east & west
by Chimney.
The Chimney Canyon
above is made by
a creek (Chimney) which
on the hills [illegible]
heads [illegible]
to the west in [illegible]
[illegible]

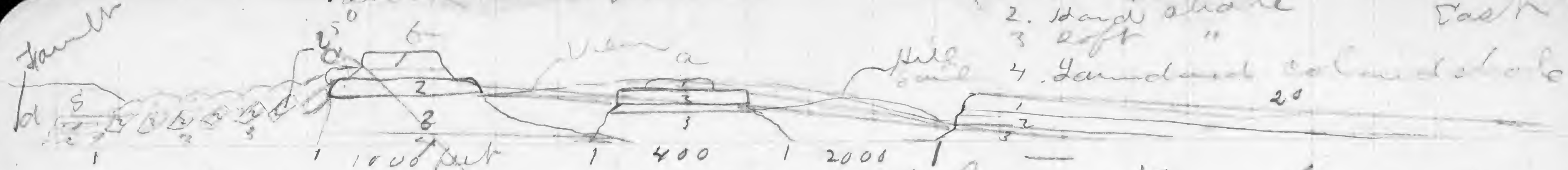
Remarks. (3) The Complete
Combustion Longely of a coal
fire under, moreover, the
steam pressure, further evidence
that part of the oxygen
with an atmosphere [illegible]
[illegible] thickness. The principal
of the steam pressure
and boiler pressure in the
in the Board. Pressure
one pulled [illegible] (and
other [illegible]
[illegible] and
are mixed [illegible] 6 x 5
when which the [illegible] are
file of relief valve [illegible]
in the [illegible] boiler
long unit in [illegible] pipe
boiler [illegible] [illegible]
all water [illegible].

2% of Carbonate Rock N. 750
" Limestone " "

1 Boat = 1=50 feet

1. Conq
2. Hard shale
3 Soft "
4. Laundad conglomerate

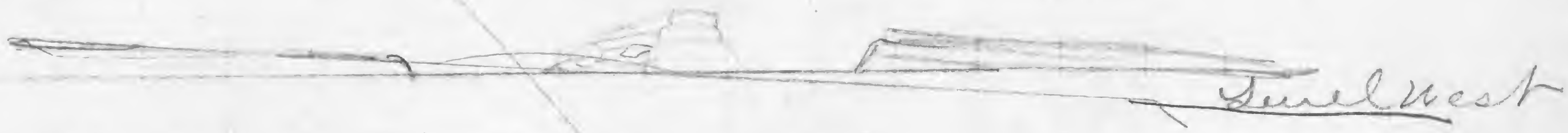
Fault



East

Section across Conq & Miles below Kanab

5



Line of fault 25° W of N.

Section 1.

the Conglomerate (5) gradually rises
toward the East until a hearse
is met with on the east side of
the valley. This separates from the
strata are nearly horizontal
(a) + [illegible] to
at (b). at (c) there is an abrupt
descent of about 125 feet to
(b)(c). The line of the fault could
not be accurately determined
but it is not far from
of N.

Con of section (b) from page 12)
for a distance of two miles directly
north across the valley the strata are
buried beneath sand + decomposed
rock (shaly sandstone typ) for two miles.
Began measurements with Locke level
at first appearance of banded marls
(decomposed), in long low foothill
running south from 3rd Cliff (Headland)
w of Kanab Canon. In the face of
the cliff the strata is composed
of shale, dark purplish brown, greenish
+ blue-gray banded argillaceous
marls much decomposed
+ formed low rounded foothills
at the cliffs or else sheet out
as a level plain to the
canyon. The marls are
variegated in color and contain
both nodules + layers of nearly
pure gypsum.
Thickness of measured
section 350 feet.
The base I have taken as the
normal cliff. It is a band
of sandstone, the lowest

5850
5525
325

light colored (~~soft~~) (chert) overlaid by ~~the~~ red shale formation, the layers are from 2 to 7 feet in thickness, total thickness of stratum. B-5975 20 feet

Succeeding this there is a mixed mass of pebbles and shales and layers of soft ~~shale~~ red shale-like sandstone (total) 70 feet. This is succeeded by a mass of R. R. Rock, which is soft & easily disintegrated. Numerous thin partings of shale & marl break it into layers of from 1 to 6 feet in thickness. Total 120 feet

~~(600)~~ 120

Total to Base of Fish Creek
Locks Lime 210
Average 200+

An 5975

The upper portion of these rocks are massive & thick in. The the lower 150 feet of the above 210 are nothing but passage beds to the semilunar cliffs from the Shinarump Gh.

At the base there are 3 light
sandy layers with shale (?)
partings & then 6 feet of fine
argillaceous sandy shales
they vary in color from dark
through brown to red with
fillets of greenish color, as
yet this section has not
but a few fish scales.
This bed is separated from a
somewhat similar one above
by a narrow band of fine
light colored sandstone
varying from 2 to 4 feet
thickness. The entire band
varying from 20 to 25 feet
in thickness. This band is
strongly defined on all the
prominent headlands cutting
out from the main cliff &
appearing as a white
ribbon on the face of the red
sandstone wall. As the massive
strata above the ledge present

Fucoid a fold reaches V.
It is also of unusual interest
as the present time it
has afforded more fossil
than any other stratum to
the fossil above the Arenaceous
Conglomerate. (25 feet.
Massive light (colored) brown
layers. 50-feet)

The cliff is again denuded
by bands of argillaceous shale
and thin beds of sandstone.
This bed varies in thickness
at the point it is (visited) 25 feet
This is succeed by bedded
sandstones varying in shades
of red + light colored standed
externally by the red carbon-
aceous shale, the
layers are regular in
thickness + contain in
places of oolitic rock

(10) (50+

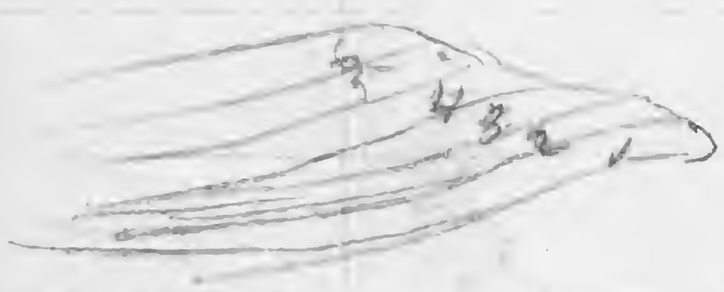
etc. Solutions formed by the
penetrate the rock in many
places, where exposed by
abundant the rock is of
a yellowish cast. Thin
beds of conglomerate occur
but not often. Further
to the south of the first
white capped cliff above
the second fish camp
beds 230+
This level is the one on which
the capitol town in
headland Each of these
is built. It marks a radial
recognized horizontal
the plane pattern of the
group of the more undu-
lated beds above.

Am 6/15

(1)

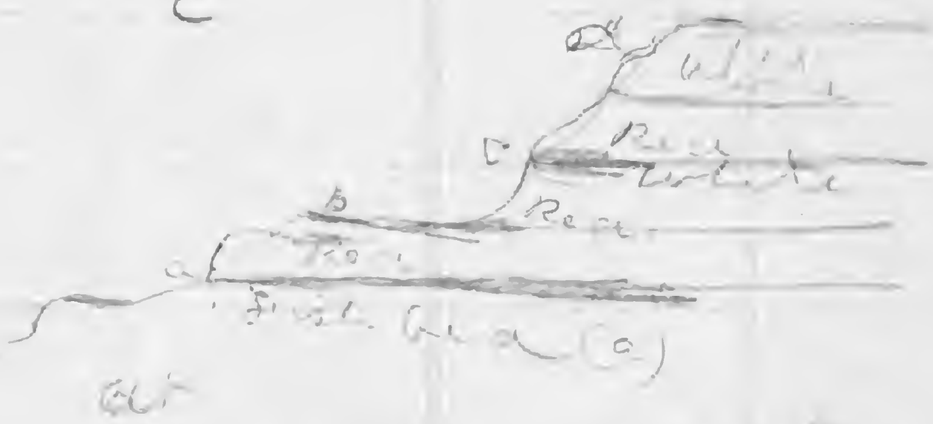
Am 9/15

Section of the Carboniferous
Series of Kansas. Did not make
section here as the rocks are
as good or better elsewhere
take E of Kansas. 2 mi N.W. of Kansas
a fault takes the line of cliffs.
The western cliff terminates in
a gentle fold syncline.
The intervale between the cliffs
would be filled in out in a
shallow valley running
to the north.



W

E



East

The cliffs are 5 to 6 miles apart
little further to the west. The fish
the same only not quite so high
distant. On the south side of the
a dip of about 5 to 6°.

12

Day 23 d) Continuation of article from Page 10.

The light grey Carboniferous ledge of sandstone about 20 feet thick. It is a prominent feature in all the cliffs around Kanab & may be seen up the valley for two miles where it disappears owing to the dip & the rise in the bed of the valley. The section is taken up, two miles above Kanab, just above the point hill.

The strike of the beds is often a little S of west (20°) The dip 1.5° N.

Above this rests 180 feet of dark red sandstone with thick layers alternating with thin shales & readily disintegrating to a reddish mass which makes muddy water during freshets.

The highest bed is a conglomerate

above the ~~+~~ framing the same
rule as at the end of the 4th
yd. when the character of the
succeeding stratum commences
to predominate the line of
separation between the ~~upper~~ upper
~~and~~ & white cliff ~~and~~ consists
of the ——— ? 9 inch 12
shaded line. 5 ft 6 inch
bedded sandstone light chocolate
forming by a ~~mass~~ mass of
of light ~~grey~~ sandstone
which is slightly ~~stained~~ ——
bedded, but is chiefly composed
with a thin band of white clay
about the middle of the
yd. ~~The~~ ——

White Cliff Sh.

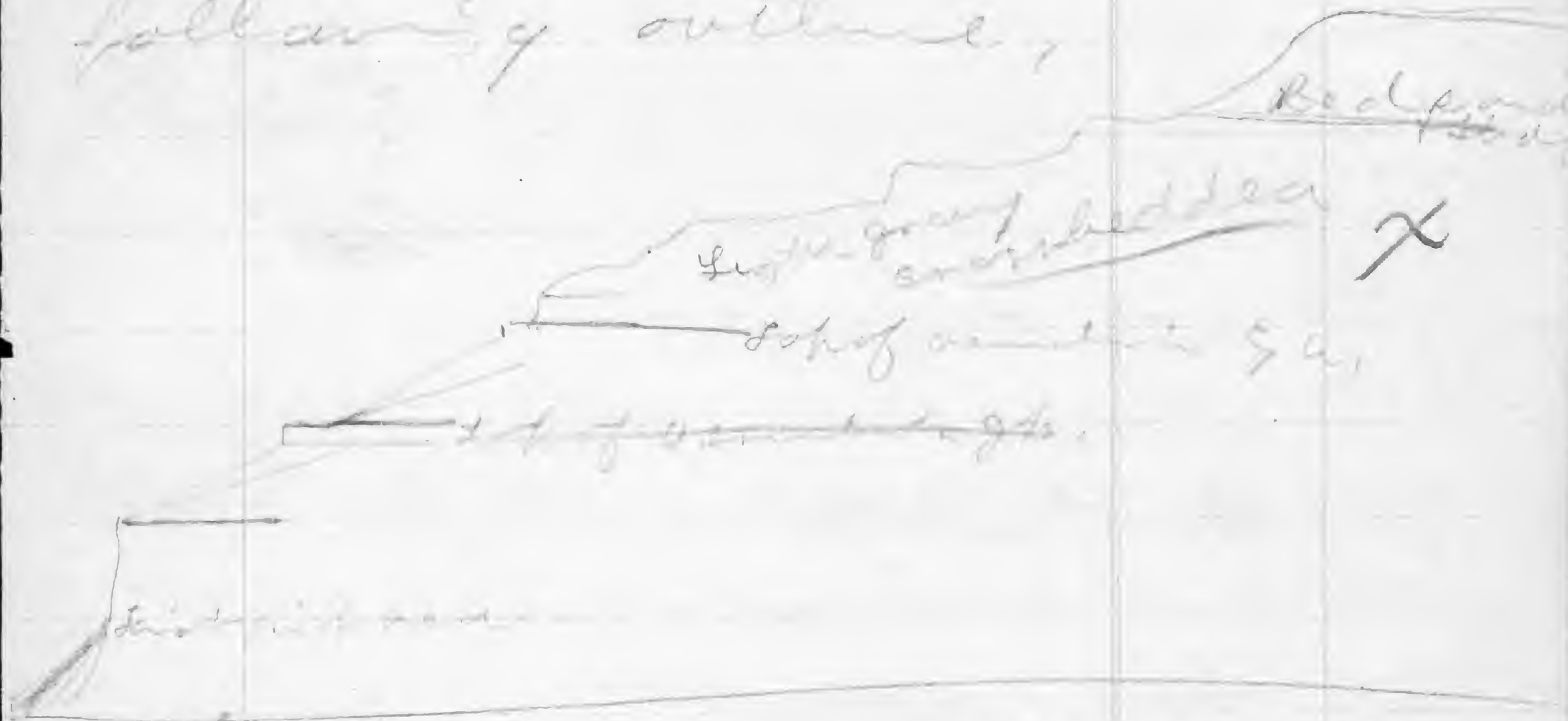
Evenly bedded light ash
reddish ——— 20 feet
thin ~~bedded~~ stratified homogeneous
clay ~~bedded~~ ——— 20 feet
Massive cream-coloured, light grey
with occasional reddish

irregularly interculated 30 feet
the whole length of the room
consists of a light coloured [illegible]
or chute (easily distinguished)
[illegible] one of the beautiful effects
[illegible] of cross-heading in the
upper portion. Sufficiently [illegible]
[illegible] from the [illegible]
[illegible] to show [illegible]
[illegible] the stairs

Saw [illegible] of coarse pebbly
[illegible] Bunter [illegible]
[illegible] the [illegible]
[illegible] the [illegible]
[illegible] the [illegible]
[illegible] for [illegible]
[illegible] [illegible]
[illegible] [illegible]
light [illegible]
[illegible]
[illegible]
[illegible] 120 feet
[illegible] [illegible]

(15)

a view of the west cliff at the mouth of the Kaw of Cow Creek in Cliff Canyon. Locate the following outline.



The white sandstone is divided into six principal beds by thin horizontal partings of more indurated shaly sandstone, which separate the cross-bedded massive layers. The latter are not of uniform thickness at all places, ranging from 3 to 60 feet, but the divisions are readily seen on all normal cliffs.

Aug 27.

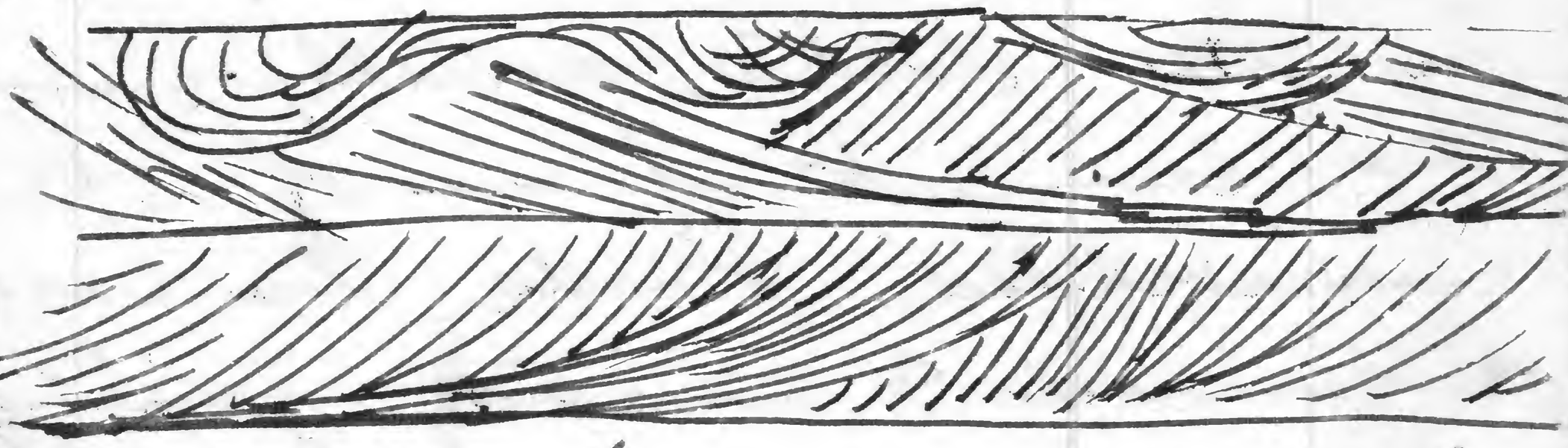
Tracing the red bed in the main canon + also in many of the lateral canons it is seen to be a uniformly bedded deposit a number of thick layers alternate with the shaly beds until towards the summit where the thick beds are indurated + present a strong dark brown colored band beneath a ~~dark~~ stratum of (horizontal) light colored gray sandstone which is succeeded by curved + twisted layers + then by the crossbedded sandstone. This red bed is a result of the conditions which formed the red beds of the Shinarump + Vermilion cliff Grs. In the Kanab + Lateral canyons it is usually capped with a layer of calcareous sandstone all the stratigraphic of the canon are here

ifteau from the henyan.
Continuation of section
above red bed. Aug 28" 79.
The red bed is ~~succeed~~ copied by for
cleanly deposited a layer of
fine grained dark red sd. usually
streaked with white from the
cliffs above. The uppen surface
of this stratum presents a the
following aspect when exposed
on a freshly broken surface.
at bottom black it is
White RD or light buff
Dark red.
The two beds are clearly & evidently shewing that the white sand followed the red with an intervening time.
The buff bed is succeeded by a mass of beautifully banded white & buff sds. Cross cleanly bedded
next comes a great mass of reddish & slightly coh. sds

they extend to the remilion
colored beds beneath
the white cliff. Upon
it is composed of sandal
thick bands divided by
horizontal ~~surfaces~~ lines
separating it into beds
from 25 to 100 feet. The
beds are composed of
evenly bedded layers of
from 1/8 to 1 in thickness. The
thin layers predominating
occasionally a thick layer
(2 in to 12 feet occurs but it usually
irregular & of discontinuous
extent. At various places
in the strata, usually near
the summit of one of the
crossbedded bands the layers
& curved & twisted, giving
a gnarled & knotted appearance.
The finest examples are
seen where it appears as
though at the hollows had

I am uncertain as to how this was filled up & leveled off to make way for the flow for the succeeding stratum. Thickness of beds from Red bed to vermilion beds on back of great white cliff stratum. ~~120~~ 120'.
~~120~~ to Vermilion bed in flat. 700'.
To base of White sd in cliff 1100.

The bluff, gray & red shale layers are intermingled & also deposited in irregular bands. The dark red shale beds spread out towards the summit of the mesa 350 feet above the red bed.



Weathering

The 550 ± 700 feet of strata crossing the interval between the headwaters of Kanab creek (Springs below White cliffs) is c.b.sd. red, tarnish red, vermilion with an occasional fillet of white. The upper portion merges into the white cliffs, and by an irregular line of contact + union. The change is in the color. The upper 400 feet is mostly of a vermilion hue + is a soft easily drainteg olea eD. Tinny low rounded hills below the cliffs. The white cliffs all present a rounded surface to the south and large masses are reflected as buttes. Above the vermilion bed, which is a somewhat fluctuating horizon the true bright gray or white cliff form

Massive light colored
limestone divided into five principal
beds each consisting of
fine crystaled 575 feet.
Calcite sandstone of a
reddish hue. 100 feet.
Upon this rests a limestone
containing fossils.
Strata of white cliff
sandstone.

Colorado

Section II. Upper Kaneb. Buff sandstones etc directly west of Pink Cliffs.

(1)

a. Buff sandstone (hard) alternating with clays or marls.

a. Marls & sandstones hard and not readily disintegrating. 30 feet

b Hard buff sand 20 "

c alternating bands of more or less clay (more often of purple. lead color & white or light gray) & buff sandstone 120.

All this limit found fossil water shells in a bed of light clay. 20 Heavy bedded buff sd/ 30

170.

d. Heavy beds of buff sd. with fossils shells & plants. 30.

e. Light layer of ~~clay~~ buff 60 ft.
clay

f Heavy bedded buff rock with fossils 125 ft. The fossils occur in a calciferous sand which occurs in a somewhat irregular beds near the summit of the mass and also again 50 or 60 feet above the clay bed beneath. Thickness to clay bed 155 feet

g An irregular bed of clay + fine buff sd. Clay bed contains fossil plants 10 feet.

h massive buff sd 5

i Clay + sd in layers containing leaves, ferns & a few shells at bottom dark clay 12 ft

l. Massive round bff 15

k. Soft fine sand with
pinkish clay beneath
holding fossils. 30

j. Massive bff sd with
a few thin layers of clay. 25

m White sand with
veal of fine sand to
near the summit 170

The section above the white
sand consists of bff sandy clay
with occasional layers of hard
sandy shale which weather
into thin slabs and form
a steep bank. Lithologic
changes are rather abrupt
and the contacts are
sharp. Fossils are
abundant in the
sandy layers

Usually in hot conditions
+ coffee boil water in pot
then eat. The mixture of
fine pellets and flaky pieces
etc. The Munsell color
called clay weather to a
light gray that is the
Next below. The color
at the summit of the
ashes is 5 to 8 feet thick
+ fine sediment as fine as
talcum powder. The light gray
white and light gray colors
easily + has caused the
cliffs to weather back
expanse of the Upper
Member of the Chinle
Formation.

(M)

At the base of the Wind River Mountains a thick sandstone is found 15 to 25 feet followed by alternating Reds and clays for a long distance. The clays have weathered to form a deep sandy soil.

Buffalo Bones

Resting on the sandstone, through the sandstone, and resting on the white sandstone (Marks A 500 to Mark C) Mark A 375.)

Below the 500 foot level the rock recedes more abruptly for a short distance and then [illegible]

Below white add-
ed. This is followed by a coarse
sed. Yellow, iron stained in
many places + below white
a bed gray. a few shells
are scattered in the
hill sides. It is the to of
the Astra Sch.
The upper 2 or 3 feet
(part) contain few shells,
below is a mill. shows a
small with a few of the
many species of Gastropods
+ also Lamellibranchiates.
Gastropods etc, 25 feet.
The lower bed, yellow sandy
hill side in places weath-
ed the others lies below.
40 feet.

The central portion is a soft yellow Rd + in the Alangate Astoca is so thickly placed (mouth up) that the shells touch each in in great masses Its bed is from 2 to 6 feet in thickness & persistent as far as yet examined. Exogyra was seen lower in the bed but was not seen with the Alangate forms. A curious commingling of fossils occurs in the 2 to 6 ft bed. (Recollections).

Specimens in Museum (M). Nov 27" 99

Above the Astoca bed there is a bed of limestone about 6 inches thick made up of Rhodetta in a soft matrix

Link Valley Camp. Depth 15 ft
T. A.M. 7550.

a 9200. Base of Camp

b. 9050. Base of L.

c 8875 175 Base of c.

Adding with 30 ft 8875 = 8975
d. 8850 — 125
with + 25
150

8850
e. 8575 — 275 + 25 = 300
Rest Hill 8600.

Top of hill, turn of f. 1/2 mile
south 80 East
line with stake in hillcrest
east 8125. Top of Kenyon
of Butte in. 7925.
with 250 700
150
850+

7925.

State land 30 detached on Lick valley side.

Prairie and fallow by clay etc. Lick mt Centre in Lick valley but mt 3 miles east.

7925.

Sect III

Section north of Clarkston.

Sept 15, 1879.

Dirty limestone

Landstone greyish, calcareous

Pink by wash from limestone

Conglomerate at base 50 feet.

50

a Indurated sandstone.

yellowish brown 15

b

Light colored sandstone in strata 3

with partings of black &

purplish colored clay & sandy.

150

c Buff red, massive in layers

+ also shaly in places with

slight partings of marl. 175

d. Massive buff red sandstone

in thick beds by buff red

+ a thin bed of white limestone

at intervals. 150.

e. Buff red with calcareous

stratum coming from it. 40.

Below this there is a succession of massive buff beds with clay partings denoted by weathered clay on sloping outcrops cobble rids to a massive buff and laminated 25 feet thick which rest immediately above a fine conglomerate & white sandstone. 300.

Below this there is a succession of fine conglomerate alternating with buff beds 130.

Below this there is a succession of buff beds with a few clay beds the lower central portions is sandy & below a white coarse sandstone. 170.

960

g. At 191 a yellow sand-
stone is exposed
& below. 40'

h. Massive buff sandstone
one half mile north the
same beds without
fossils. It has the same
lithological characters be-
low in outcrop of 2 miles
no fossils were seen.

h
i Massive buff sandstone 2
50

i. Buff sandy layers
having into one
another & the in-
organic layers with
a few limy layers
with concretions
nodules (near the
top) 785 feet

Red shale fracture into
angular fragments 10 feet
R.

~~The red shale contains~~
Root and stone, both with
an intercalated mass of
brecciated red shale in a
matrix of siliceous volcanic
matter. The shale is both
and is embedded in the
accretion lava at all angles
and in every shape. The
mass is ten feet thick
in places.

Section below not
taken.

Comparatively few fossils
were seen in the limestone
of this section both the
detached and the reduced
mass consist of fossils with
slight exception.

Date on stalk attached
above the massive endocarp
of the asteroid there is an
hyaline matrix of bloodstone
and argillaceous shale with
a bed of dark brown shale
six feet from the base which
contains symbols of Silurian
and fossil shells. A limestone
shale occurs above this and
then an argillaceous shale
succeeded by a black bituminous
shale 50

100 feet

Nearly the same succession
occurs above the asteroid bed
in the Kanab Canon. Examined
on the 27th autocop. Sept
27th 1879.

dickinson east side of
Dirk valley, continued across
from west side.

Top of Triassic shale
1 Red marl with conglomerate
150 feet

2 Gypsum. White nearly pure
30
3 Conglomerate followed
by red marl
200

4 Shale
Marl 300 feet.

5 Brown shale
6 - x
7 10 Rock (all shale)
8 One conglomerate
marl -
White rock stained
with blk yellow.
75

This is offset by a fault of
conglomerate of varying

thickness. For a distance of
100 feet it changes from a thickness
of 1 foot to six. The transition
immediately ensuing is here
as rich valley may be known
as a ten foot band of light
buff sandstone as which lays
on broken thin parcel thin
layer all not the fat thick.
a few yards away, on either
mount as on the Kanab valley
side just below Lime old
place. The strata above are
also very variable. The coal
seams are not at all persistent
and the sandstone vary very
much in thickness.
Not a workable bed. The
most beneath are much
heavier & massive than
any line of outcrop.
Had my present mine I should
place all the workings the

One tacan [illegible] the
[illegible] to the 215 feet of limestone
and sandstone

Inadale

a. Sandy limestone, white to light buff, fine grained, thin bedded, in layers from thin to 2 feet in thickness. Fractures smooth and resulting in coarse angular blocks. Light gray wh. 35 40

b. Shaly limestone 60 65

c Limestone, hard 10

d Shale, sandy 50
Shaly, & sandy layers 25

e. Coarse colored limestone with fossils 25

f. Massive gypsiferous marl 25 50

g Coarse conglomerate, formed of the fragments

Dep 39

rounded, rolled sandstone
limestone. siliceous pebbles,
etc. Spiritual Silicified wood,
cement with a few fr. 1/15.

h. Bed of gypsum with marl
Gypsum in thick layer 30

i. Loose reddish marl hills all marl in places
with remains of con-
glomerate on the sides
indicating, decomposed
conglomerate. 200.

j. Arenaceous gypsiferous
marl, cream colored.
banded with red & greenish
arenaceous beds. Capped
with a yellow sandstone 325

k. The sand is about 2 feet
in thickness & holds
layers etc. this is followed
by a bed of clay, dark

from cutanic weathered
matter & matting to a
~~subsoil~~ subsoil limestone
40 feet.
h. Amatter band of yellow
and followed by light
colored loose incoherent
clay with a dark band of lignite
of clay like coal fumes. 2 inches
20

k 2 Dark and datane matter
white with a dark angular
coarse shale with a band of
impure lignite coal, with
shaly partings. 4 feet thick
succeeded by, 6 inches
more of partially carbonized
vegetable matter. 2 5.

1/2 3
Yellow irregularly laminated
band of sandstone 3 feet
followed by green-coarse
clay band, dark weathering
k Lb 2 5

l. Massive pentrally c. b.
buff sandstone below more
evenly bedded centrally &
hard calciferous lagen-
ae & irregular obvl.
Contains leaves etc. 45'
Shales dark brown hackly &
micaceous seam of dark-
shale occur near the
upper portion between the
thick layers of rock 45'

m. Argillaceous shales. Hardening
into layers of from 2 to 8 in
thickness, breaking irregular
fragments. Containing shells
&c. 30 feet from summit of
this bed there is a seam
of coal 3 feet thick & 6 feet
below another of 9 feet.
Clay shale beneath seam.
Lost next buff rock

60

No. flowing bluff 2d. Rest me
bare [illegible] mine indurated clays
sedimentary bearing rocks in the
bare hortion. The upper
layer is a dusk yellow, thin
bed of hill covered with
volcanic matter.
Total of rock 25 ~~30~~ ~~35~~

D.

No. 10 feet of bituminous shale
followed by a light colored
sandstone holding numerous
fossils 20 feet. Note the
finest exposure of
over 5 miles of outcrop
on the Big Tkanah valley
Here is here a conformable
layer of volcanic matter
which follows the line
of rest shale which
holds above fossils as
in bed below. This
is succeeded by shales
and sandstone in thick

The unconformity between the Eocene is the Eocene and the Cretaceous valley.

Plan

[illegible] 5 feet.

Bituminous argillaceous shale with concretionary nodules containing Ammonites Bacculites etc. etc. Small Exogyra 80
ft: in patches.

15 feet of drab colored argillaceous and shelly 90 feet of 20 ft yellow sandy shale which is capped with hard sandstone at Toh 105.

Note. It is more argillaceous than bituminous. The nodules containing the fossils vary from 1 in to 2 feet in diameter & are usually flattened. They occur about 20 feet from the base of the zone in a matrix of nodules & a more crystalline character with but few embedded fossils.

The gravelly shale continues across the low flat between the South + North sides of the ~~Rock~~ leading from North Fork Valley and is again taken up in the foot hills on slopes of the hills to the South. Concealed partially, offlaps shales + arenaceous clays ~~to~~ 150 feet. (Estimate)

~~75~~ feet of arenaceous shale + the ~~Rock~~ is ~~75 feet of~~ 200 feet of dark colored clay shales followed by 275 feet of arenaceous shale with argillaceous beds the whole marked by fragments of vegetable matter in places slightly gypsiferous. The upper part is chiefly clay ~~to~~ some fine sandy shale with a dark clay ~~to~~ [illegible]

1915.

n. Massive bff and underlying detached 50.

Note for A. On the river valley side there is a bed of soft coal 4 or 5 feet thick beneath the sandstone in the bituminous shale. It was also seen in a ravine on the Kansas side above Lilm Alcyhlare.

Note on fr. The nodules with fossils were found after the geological hammer on the Dirk Valley side. When exhausted the results the nodules break often in many pieces leaving empty cavities. The small specimens can then be found in many small pieces.

Partly parting of Lam-
-oal bed. Dark yellow
sid. resting on white sand-
-stone which passes down
into arenaceous clays etc.

a ?

	Buff sand		2
e	Bituminous shale		30
	Sandstone		2
4	?	Arenaceous shale	20
5		Dark bitu. shale	12
6		Clay bed	3
7		Coal seam. Dark brittle. Lighter Lignite Banding coal seam parting into hard lignite	9
8		Clay shale. brown to grey	60

9	Limestone		1
10	Arenaceous clay		23
11	Shale		5
12	Gypsiferous clay		23
13	Coal		10
14	Ar + arg shale		45
15	Rock		10
			197.5

This core hole is located from the Grassie Pit situated on the Kandalla road. The other cores of that section are circled in this. K2 contains the coal seam (7).

Section from the middle of the White Cliffs on the west side of the Kaiparoro Range.

Jurassic.

a. Limestone, mostly reddish-grey, very hard, brittle rings under the hammer. Contains fossils in the lower shaly layers.

b Sandstone. Consolidated grey + purple, mostly reddish fine grained sandstone with a limestone band about 4 ft. from the top of the W. C. Sandstone. The purple grits are very white + the yellow ones are often stained rusty to dull red.

c. Reddish Cliffy W. C. Sandstone.

b. Unnamed in bed c.b. soft
sandy dolomitic ss etc.
extending across valley.
600 — 700

c Gray to red fine c.b.
ss. Massive & laminated
in beds from 2-5' to
100 feet. 300

d Red sandy dolomitic
Red - = Red Lyd. (3 measures) 125

e See pg 16
Gray arenaceous to
red band. 320.

f See pg 15.

g Encroachment.

h.g Massive stratum
partially c.b. 20

g.h Light red & olive
sandy bedded &
with lenticular layers
of gray sandstone 20

i Rock red sandstone.

h Brown lazy alternating with shale. Not fossiliferous a rocky face a slope tells done the gray od beneath (8912) 180

j Light gray od 5

k Bedded sandstones ranging in colors shades of red & gray. The layers are irregular in thickness and are undulating faces of bare in- -durated rd. 230.

l Thin layers of sandstone
x alternating with beds of yellowish shale Rolls fair teeth etc 20

m l Massive, reddish brown, hayey, 50

n m alternations of sandstone layers + argillaceous shales holding fish remains etc 25

Pg 8.

o n Yellowish + reddish shales with 1 ft. sandstone layers

Pg 7

p o Reddish brown sandy argillaceous shale with fractures & shale breaks & thin layers of fine sandstone & fish remains etc 120

Pg 6

q p Marls + shales with bands of ech. 70

Pg 5

r q Reddish brown sandy marls & white sandstone 20

295.

Shawnee.

a Shale, gritstone. Dark purple, brown, green thin beds green disintegrates from — grey sandstone foothills. 650.

Pg 6.

b Grey Conglomerate 50

Pg 2

c Red shale hard shale 30

d Massive layered separated by thin shale by 1'. 135 50

e Brown soft shale by sandstone 105 90

f Light colored soft shales 5550 Feet 5450 with 25 120 x12 5

g Red Cypress shale 1300 100

h. Limestone lime[illegible]
holding a cast of fossile
and also in the lime-
stone mill fragments
shells. Gasteropods brach-
iopods and lamellibranchs.

i. Red marl 4.W 6
15.W 40

j. Impure limestone with
indurated gypsiferous
shale beneath.

k. Red gypsiferous shale.

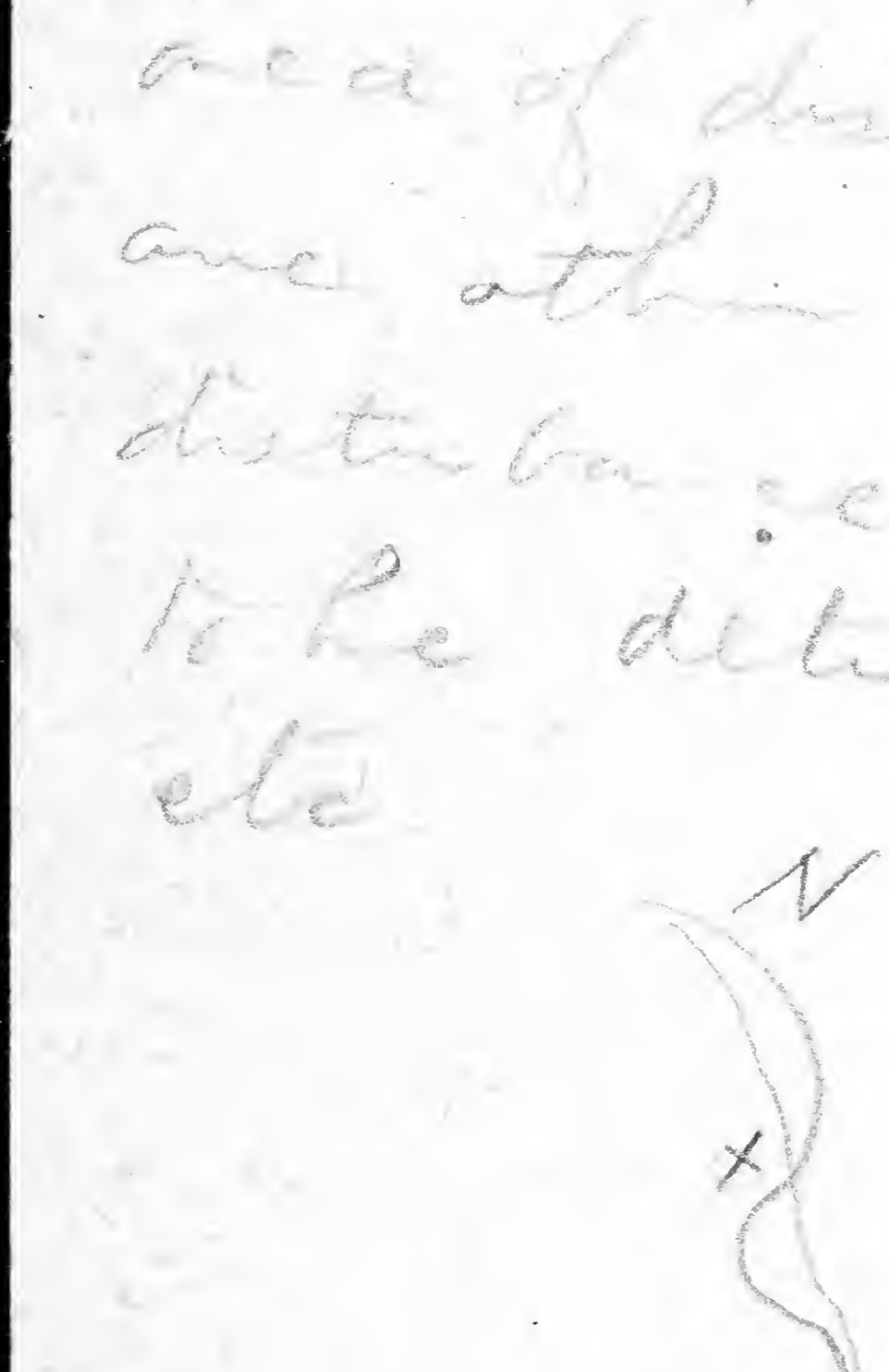
l. Impure limestone slabby
beneath (See fig 54) 25 (Westh) 10.

m White marl 2 but with
occasional layers (no cl) 70

Dan mart side is covered of Lun-
Eyk marl that alternates
Poleôt on Butte in west side

On the west side of the
Kaal wash just before
reaching the office of
the Cairn. The limestone
of the face of the Phoenix
Spire rises to the east and
north

making a sheltered
by the uplift it is a local
area of disturbance. There
are also numerous
fractures but no slight
displacement



Shri Sh.

Rathnam

Note.

The limestone capping the low cliffs south of the Pleasant Conglomerate on the east and of the Kanab wash, ends, down to the western margin of the cliff, indicating a fold and a

fault as far as the Shinarump Conglomerate.

The general dip of the undisturbed strata is

viewed from further east or south the stone is seen to be the western end of a synclinal anticlinal arch. The entire structure is as follows.

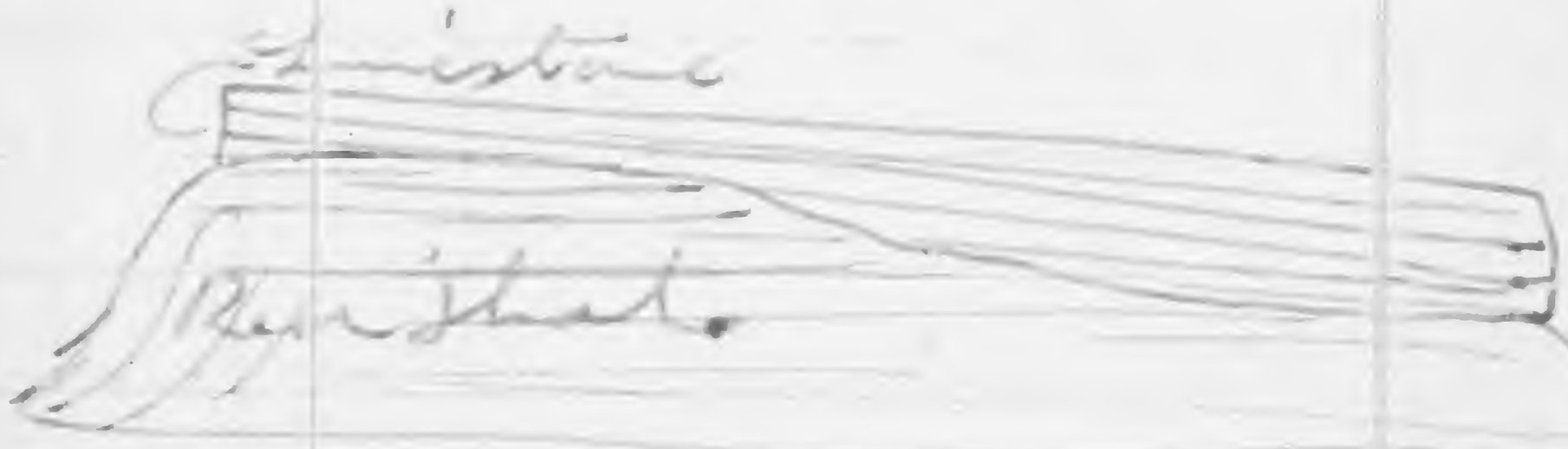
at the line separating the limiting sands. E

or a. the western margin of the dip the dip is as the strata the cuves upward moving gently at first & then down to the east forming a basin-synclinal at c. as there is a gradual rise to the east of c. followed to the south by the general dip of all the strata. The western side of the eastern dip may be seen extending south for a long distance across the flat towards the mouth of the canon. A cross section of the mouth of a stream x = 11

shows a case like this x. is a crest & but the dip is seaward as S. is.

The flat south of the Smith
is broad and with the exception
of low outlying hummocks
of the hinder the marsh
is covered with the broadleaved
cattail out as to the confluence
with the Ouachita in
the distance on far as the
line of poplars. A fine
mountain ~~for~~ for afternoon view
can be to the south. To the
West the view is the fine
view of the hill. The wooded
cliff, forest about two miles from
the. Headlands + ~~hummocks~~ of our
hunting dog cover that add
to the varied surface by hunting
the side view of the terraced
cliff. Below the low cliff
the plain ~~is~~ changes with the white pine bluffs
the west line of ~~hills~~ hills
and headlands. The prairie
hunting life a ~~good~~ good
bird shot with the bird

j page 54. rest on the nodular
surface of the red shale beneath.
This is well shown in the
cutting just to the east side
of the creek South of the cliffs.



+ Up creek in bottom from 10
to 30 feet. Contains many
fossils, The upper portion is
a sandstone holding small
shark plates. 1/
+1 mile N.N.W. the limestone is
not over 1 foot thick but a
thick bed of gypsum &
anhydrite replaces
it. near the base a few
ft. sandy layers 2 to 6" thick
hold lamellibranch shells.

The fossils occur in the limestone, sandstone, arenaceous shale with gypsum, laminated layers alternate of gypsum & sand & argilliferous shale. Impure argillaceous limestone with fossils effaced by gypsum.

O. section at the west side of the road wash taken near the base of the Khamsin Conglomerate.

The upper surface of the shale was eroded prior to the deposition of the overlying conglomerate as may be seen in most good exposures of the line of contact of the Conglomerate and shaly sandstone.

The entire section was carefully measured with the exception of 75 feet of the lower red marl.

the conglomerate at the point where the section was taken is darker than usual and in fact is a very dark red color for a mile or more along the exposure at the land locks the water in many places being nearly full white sandstone c.b. the pebbles are all agatized. No fossil wood was seen at this point.

1 C. & d.
Shaly sandstone. about ½ inch from running 20 feet from the summit into a massive sandstone. Pebble mostly red cracks occur in the shaly portion 135.
Hill called C. & d. of section (Shinarump).

2 C. Dark red arenaceous shale with seams of gypsum.

e e Thin bedded argillaceous and vertical
e of section. 105

a b
Grey gypsiferous marl,
argillaceous, with bands of hard
colour near the base 125
f of section.

f f
Red calcareous gypsiferous
marl, Col Sandy Shale near
middle and near the summit 300
Measured 225 feet
estimated 75 by formation
+ dip.

5 h Impure limestone holding
fossils. Gastropods at this
horizon 4

o i j
Red gypsiferous marl 15

i j Shaly impure limestone
varying from 2 to 4 feet

with arenaceous gypsum
beds beneath. a few of the
sandy layers increase up
to 6 in thickness and or
holding fossils a hundred
red more separate thin
a somewhat similar shale
and limestone beneath.
On an outcrop butte on
the east side the entire
land is limestone the
lower stratum being five
feet in thickness. 25:
The last bed is varying
thickness as it rests on the
uneven surface of the
gypsum and dates back
to the shore erosion.

Section continued on next
page.

8 Red gypsiferous marl with Cerithium limbatum & Melanopsis [illegible] 106

9 Yellowish sandstone with red gypsiferous shale 3 to 6 feet 37

10 Chocolate colored limestone containing casts of fossils and also a few fair formed specimens 15 to 25

11 Cream colored limestone with red fossils in upper portion. Small chert nodules 25

12 Cream colored shaly limestone 32

13 Limestone gray & yellow with much chert 31

150 Chalky limestone, clunch in layers, marses, weathering black.

Contains numerous fossils. Productus altus etc— 34

Section of the cann wall. Each pedestal at the foot alkaline springs.

Cann limestone with red layers 11. of fine in section. Fine form the summit of the cliff at this point to the marine clay limestone the strata are much horizontal, irregular bedding. The surface undulating and the irregular distribution of the chert.

150

Marine ledden clay limestone 200

A fault cross N + S and the
contact was discontinued.

Section of Cliff below Shiney Cove.

1. Red fossiliferous calcareous sandstone forming the cliff. Beneath this the beds are exposed to the north as limestone with sandstone bands and some 4/5 arenaceous rock with chert & limestone 200 feet

2. Massive chalky limestone beds, jointed, 100 below by cliff.

North 1 mile.

Cove indented by a sandstone Capes the cliff back from the edge a short distance.

1 Chalky limestone with large fragments of sponges 150

2 Massive bedded chalky limestone 250

Bone of wood bed 4950
Yoke of rocker bed 5725
875

Pendulum with Calcifer
to hang in entrance.

65

Yoke of pendulum 5995
Bone 5725
270.

270
25
295

125

Yoke of pendulum 2.2 — 6100
125.

Symbol of Ph.

125

Shady Lane tune, Yellow hammer
Bright White Chit. 65.
Purple Wing finch —
6200

Magpie Chaffinch 6500
Left 6425

225
2
250

Some tea cups & saucers

3 Chert limestone thin
beds fossiliferous calcareous
sandstone and yellow
sandstone. Holds — 65
1 fossils in Calciferous
horizon.

3 Gypsum bed with
alternations of pebble
sandstone 125

4
c Cream colored limestone
massive dense like. a
arenaceous limestone and
to sandstone. (Chazy) 85
b Sandstone with. Light-
gray, with cast of fossils (Chazy?)
Production etc 140
c

Light colored dolomite with
Calciferous Fossils, Black
like arenaceous limestone
longer than the mass,
stone to outcrop of mass

		nodulatone.	~~15~~ 40	~~15~~
	d.	Grey c.t. nodulatone	~~25~~ 30	~~25~~
5				2 45
	9	deep red ~~fiddle~~ sandy		
		with shaly friable		
		partings	25	R
	6			
		Partially c.b. purple		
		and 20 m 30 feet from		
		this mostly reddened		
		above	2 10	
	c	Layer of grey red followed		
		by somewhat massive		
		otoolite oolite separated by fissile		
		shale. (Rich red)	2 50	
				1 75
		Reamed by tarmac +		
		dustlock Sand. can		
		game 775.		
	b	red with c.b. grey red		
		as on. shelly oolite C.T.F. 1 m		
		west.		

Section of Mannie c. b. conkretion
& matrix below.

6. Massive bedded c. b. and.

L.L. — — — — 3/5.

This is a remarkable rock in
color. Just after it makes
its appearance in the cañon
the white stratum is gray
to buff with dusky bands.
The massive beds of a
purplish hue and again in
reddish. Five miles below
the purple the dominates
at the summit with gray
red & buff below. It is a
great mass with no any
regular division in colum
or stratification. Near
the summit a stratum of
shaly limestone is inter-
calated at one locality
for a few hundred yards.
This is also recharacter-

at the contact between
some arenaceous c.b. strata and
somewhat calcareous.
as a whole the group is
predominately shaly with
thin buff followed by
purple and reddish buds.

alternating purple and
reddish colored argillaceous
& some c.b. may be found
in same band or layer.
as a band of 20 feet may be
purple & fourteen in reddish.
Limestone occurs in nodules
& also in shaly partings
with fissile argillaceous
the same varies
as to thickness. The c.b. and
colors.

9

10

16

B — 150.

& grey c.b. and, when surface
somewhat megalithic.

92

8 Purple red. mottled c. b.
with sl. shelly limestone
at the top. 25

Marine c. b. buff colored
ad 58.
2. g.
Bar 150 155

9 Purple sandstone (non-
-marine) c. b.

10.

Note for 2. pg 66:

A careful measurement with locks level gives of the massive sheet bed on the east side 2 mile east of the section a huge bed gave 265 feet for the massive sheet this included about 15 feet of the lower and thin beds which were included in the sheets below. The formation gave 250 feet.

Note on 3. pg 67.

Near the upper portion massive sandstone lying unconformably 2 to 3 in thickness. Landslide shells occur as on west side.

At this point I picked below Chinese Camp coal vein the same beds. Top of massive sandstone clearly is a level with. Thickness 150 above on

the west side. As seen with
bed is land.

The limestone beneath the
gypsum bed is somewhat shaly
for a few feet but rapidly passes
down to the thicker creamy
colored magnesian limestone.
This is more sandstone on
the east side and the mass
as a whole is thicker by 50
feet than the same on the west
side.

1/4 Oct 22d-79.

1/4 mile above mouth of Kinnikinnick on the Colorado.

1 Massive indurated sandstone. 20

2 Greenish micaceous, shale and fossiliferous calciferous sandrock and to mottled gray limestone (Silurian) 30

3 Greenish micaceous and micaceous shale (Silurian) 115

4 Gray limestone alternating with thin micaceous shale passing into mottled limestone. Passage beds to the mottled limestone 70

5 Principal siliceous beds, [illegible]

Lower Kaibab Canon, Wotanoki
3 miles from the Colorado.

1,

Calcifer, sandrock at top and bed, buff sandstone between. Limestone, flaky and stained a reddish hue by the water from above. 3-feet

2,

Grey and dark colored limestone, fetid, fragmentary and massive, with the limestone. The grey limestone is in layers of various thicknesses (varying from small flakes of 5 feet to the finest shaly limestone).

The meteor and comet
of the period. The limestone
land is essentially a
repetition of the upper in
lithological character, the
same Trilobites being
represented in each,
the coralline matter is
open in the lower half,
chiefly, also, near the
junction.

This band is a portion
of the Potsdam group and
carries the Primordial
up to the Radnor.

It is broken up into small
beds by shaly partings,
usually argillaceous, and
again subdivided into
thinner strata and shaly

Upper beds	45.	
Centre "	295	
Lower "	70	450

>>

3 Greenish Maccaeum shale
Maccaeum shale over
lain by gray sand-
-stone, passing upward
amaccaeum limestone Volume
of preceding ——— 100.

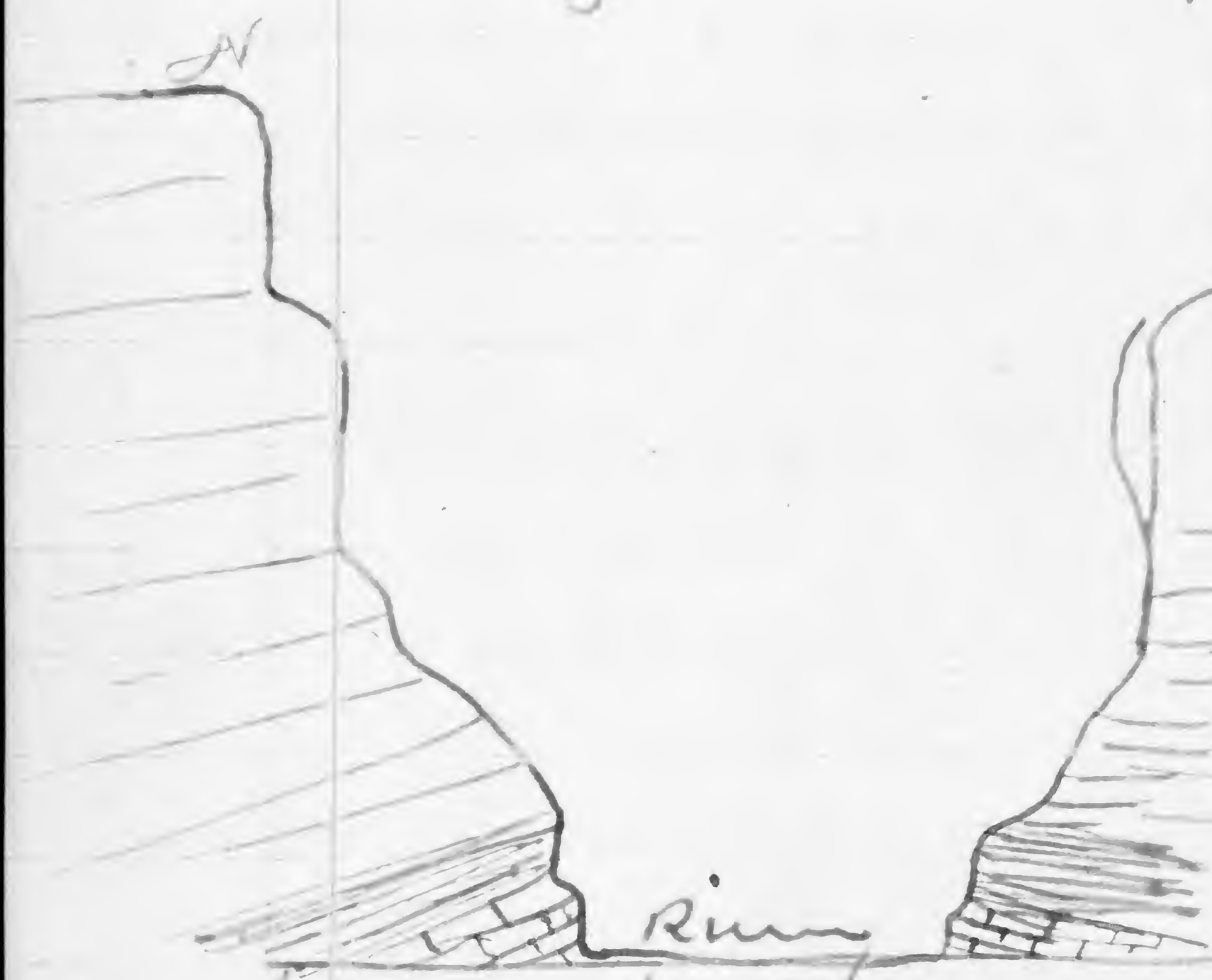
Add section 1/2 mile up the
Colorado. Page 74.

Sand Silicates remain
ligula and Hyolithes.
in 3 also in base of (2.)

Starts at mouth of Canon. Top of
Lower division of limestone (2)
crops out 1050 ft above the Colorado
S. W. 2 ft Calcareous
Yellow sandstone at
the base of the Lower group
mies to the N.E. going up the
river above the mouth of the
Kanab Canon. About 2 miles
above it is 150 feet above

the water and just below
the Knoll capon it bares
beneath the water line.
a half mile above the flats
on the south side dips 15° to
the N. N. W. + on the south
side of the rim 12° 15° to
the S. S. E. The higher strata
(limestone) do not adhere to
particles of this strong dip

S



Fecal pushing out of
shells at base of Cap
rocks

Pp. Talus slopes from on the east side of the canon about ½ mile from the Colorado. Oct 27"

1. Gray (light) limestone, resting beneath banded cherty limestone. A coiled fossil and a disk most shaw any fossil remains that could be identified as such. 85

2. Brecciated, fissile, thinly fissile, with a few limestone layers in the central portion 35

3. This kind of formation forms a shelf which extends all along the cliffs on each side of the canon taking the form of the canon above it even the cliffs.

3 ... ...

gray limestone ... 20

zone of ...

4. Impure limestone, anhydrite in places, with masses of calcspar. Gray mottled with purple and brown-gray on weathered surfaces.
90 feet. Forms the summit of the gray limestone cap and dominates the entire area. Forms cliffs 20 feet + becomes more massive thereafter proceeding 25 feet. 185

5. Gray and ~~impure limestone four~~ ~~to~~ buff sandstone with ~~lenses~~ lenses of impure limestone 50.
Below limestone (4)
Fig 75.
Like mottled limestone near the base of the overlying mottled limestone but in relief.

61

Dec 12th

The marine Neo-
Liassic with intercalated
limestone layers and collected of
fossils from the zone. They
have a subcarboniferous
aspect

146

The Lias is in layers
of various & irregular thick-
nesses coincident with
the bedding & some about 1/4
of the mass. Fossils are
in abundance near the
central top when found. Below
most none seen,
Spirula, Ostrea, Gryphaea. Nodosaria
etc with many species of
hydrozoa coccia.
Thickness of bed 145.

These tests should be made
made in fair weather
the shutter undisturbed

Oct 31 1917

In coming up the canon
motorcycle should slow down
& the corner of Sherman
Ave & the depression of Pinedale
etc. prior to the arrival of the
lieutenant along small curves
two of the upper portion of
the hill in shade.

Remember the shutter speed
three miles above mile a line
10 ft + 75 ft by 60 = 1/2 second.
= 150 feet. Thus one must
be ready to pass at this point
as below & the trajectory of
the shutter in this time
or previously noted. The
shutter is light colored or
matting black

Section of the Mineral Line
taken along the channel
Near mine the Landmark
Springs mine Arizona

The upper portion 250
feet was measured by the Locke
level. The remaining portion
with the line & a chain dis-
-tance with the level.

' Shaly grey limestone with pink
chert and intercalated ane-
-rous layers 255

2

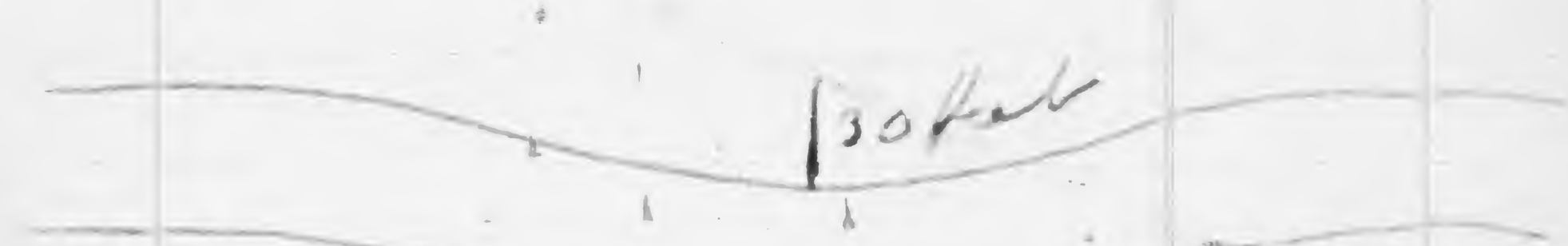
Massive light grey lime-
-stone with some nodded
bedded chert layers near
the summit. Also at 200
feet below a band of chert
layers intercalated with
the limestone. 487.

Fossils were found at various
horizons but were generally
near the summit. A strong

Synonyma decora in great abundance in the form of casts of the stem etc. near the base.

Another section of this rock was taken two miles south of the canon, all but 75 feet measured by sounding lines by which last foot was obtained

The upper layer of the lime-stone. (the two upper beds) are very minutely bedded forming undulations



This irregularity is lost in the higher beds above

so that at the base of the purlin the pressure is normal.

The masonry light arch is usually divided in four equal parts with radial joints which form the abutments for the horizontal arches.

The arches oblique to the stratification occur at the extremities of the conformers.

Portal section. Head of Canon in Sandstone of Lower Kanab Canon. Area

Going into the wide flat floor with high red cliffs and the mountains in the distance. Note the flat shale

300 feet

Looking from the head of the canon. The floor of this canon is very irregular. Below the main surface of the limestone will be found variations of from 0 to 50 feet. Above the pink cliff may run up into the vermilion cliffs in some places 1000 feet. The sandstone above is 400 feet in thickness. The

the section was taken.

The first bed is a bed of
fine sandstone.

The highest mountain
of the mineralized region
is Star, that was measured
is 2700. The highest general
average is about 2000 to 2300.

Local faulting in C.O. on
whitehead mountain
Cliffs.

8 8

176

Faults.

Pg 4. Fault in Lincoln Co. on [illegible]
Land Creek. By

Pg 11. Fault 12 [illegible] E. of Land in
Lincoln Co.

At the mouth of the Kaibab
Canyon in the Grand Canyon
a small stream flows into the Colo-
rado from the west. Just
upstream from the mouth the
Kaibab limestone forms the
cliffs of the canyon. The
Coconino sandstone forms the
cliffs of the canyon
about the village of Kaibab.
The fault strikes N.W. with
the downthrow on the S.W. side of 65 feet.
The Coconino layer rises at
the mouth of each small
stream for 1/2 mile (?) before
it goes down to the creek
level. The Kaibab
limestone is not found
on the east side of the

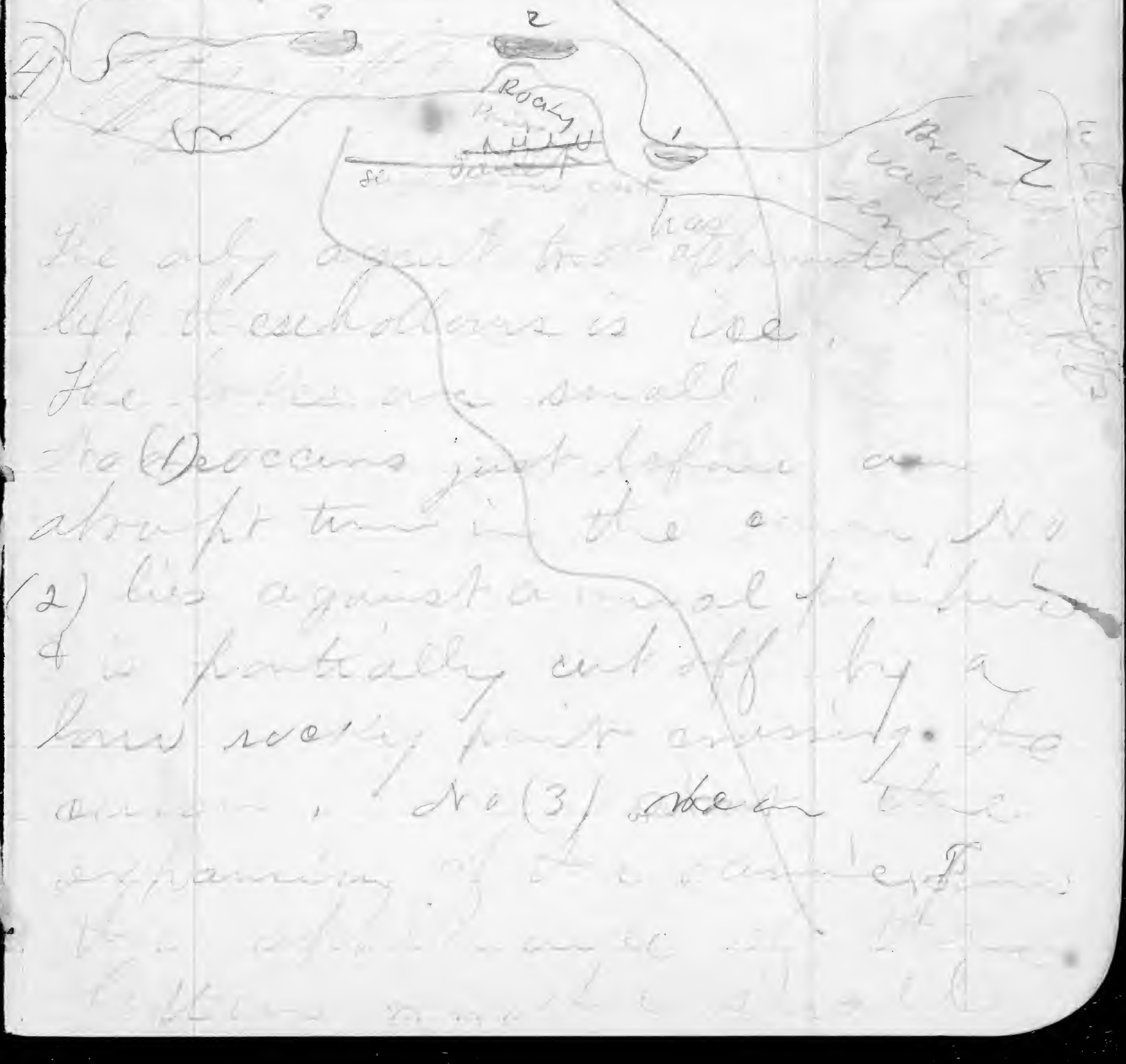
of the above lines on a
line of S. 60 + N. 81 + lines a
distance equal to the length of
100 feet. Cross the Kodak Corner
3 miles above Kodak Junction
two parties start at the 2 X corners
& set stakes at the corner
to the true line. Commence
following the
[illegible] 30 d(a) = 0
[illegible] E
[illegible] W
[illegible] Line of Vermilion Co.
The general direction of
the first part of the line is
slightly [illegible] with a gentle curve
to the west (But slight) In
the vicinity of (a) East side the line
has a number of bends. Turn
with four [illegible] of the
hills down to the [illegible]. The chain
should not be [illegible] to the
[illegible] at a time.

(52)

(Re-examined)

(Re-examined)

Fig. 1 Cross section of U.S. Ins. with a fault 50 feet in line. Together of the Cross divides the U.S. Ins. Cross of the part Hanover has also the appearance of a slight fault. Right up the valley



The sky sect has left Hanover is bad. The strata are small. Hanover just before the (2) lies against a small fault & is partly cut off by a low rocky point which the (3) shear the appearing of the sect

Ladelist slay below the
mentioned of the name(s)

On the summit of the hill 2 m. S.W. of Pilen sold Place Kanab (Upper) valley 8800 feet there is a cap of basaltic lava 300 feet thick. On the west the top of the Pink cliff limestone known division is on the same level as the top of the lava. The strata dip North 2½° with out apparent ~~E~~ or W dip. It is on the west side of the fair Knoll from the Pink cliff uplift west of the divide at the N end of the upper Kanab valley. On the east the Cretaceous strata of the Paria caal division cross from the Sevier fault on Sink + Kanab valleys up to the large canon that leads up to the land bed. The strata preserve uniform dip slightly west & west south until it passes beneath the lava. There is no

8825
8575
250

1-621

evidence of a monoclinal fold. To the north the formations rise from the N.W. No evidence of the presence was seen on the land called hill.

On the west knoll south half a distance on lands with a dip of 100 N.W. 8825. No means of determination of the position of the formation existed beyond that probability that it belonged to the division of the Cretaceous. The must be a fault east between this hill and the knoll valley lower down.

8575 - 8825
250

a little south and 250 feet lower the schedule became in position dipping N.W. 100. With 75 x 250 = 8325 feet

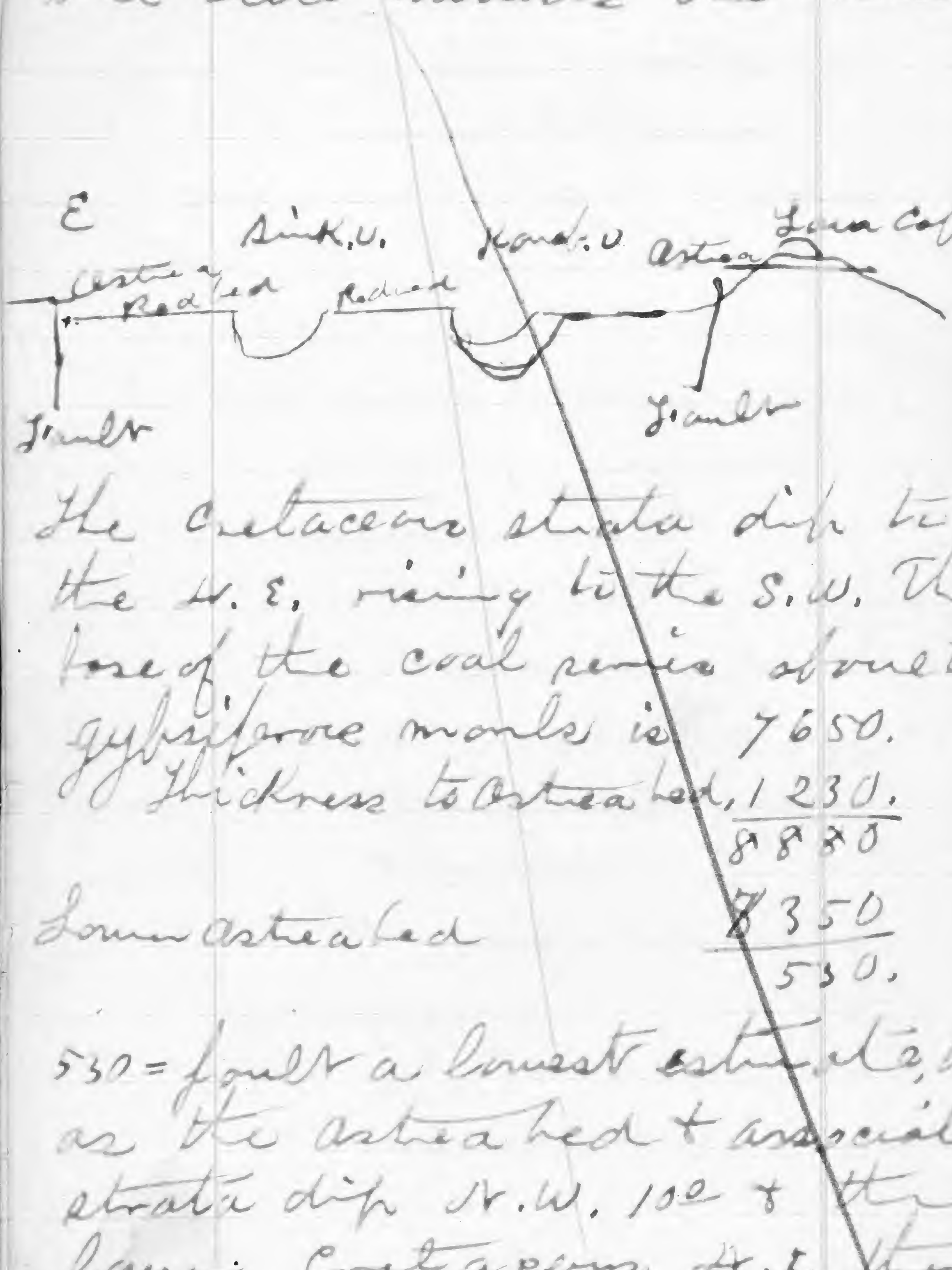
Astea a red beneath conglomerate on top of hill. Flint is a continuation of the dike & strikes nearly 1/2 mi N. across the Lansing Ledaum dip 10° N.W. ×

The Astea Ledge again occurs to the S.W. at a level of 75.8 feet below the above rock. + dip 4° N.W. exactly like not the dolomitic ×

Also occurs again with strong N.W. slope at 8450 also in S.E. & again 8350 in high hill N of upper Volcano in valley below Silurian. Beach Lava is 3° N.W. The rock is filled with the Astea shells.

Position of large fragments of the Astea Ledge and the conglomerate underlying it occur at different levels. For 300 feet below and the

hill side towards the Cretaceous.



The Cretaceous strata dip to the N.E. rising to the S.W. The base of the coal series at Mulette Ghyllfoot moors is 7650.

Thickness to Lower Red, 1230.

8880

7350

530.

Lower Red

530 = fault a lower strata level with the Red + associated strata dip N.W. 10° + thus. Lower Cretaceous N.E. the is evidently an uplift towards the Belmont the earth of the strata west of the fault. From the Lower Red occurring at

different lands in the Eocene
line there are several
faults. The most
west side of the valley to the
north towards the Pink Cliff
uplift. The strata on the
other side of the long valley
canon are separated by a
still greater downthrow
to the west, in fact I would
regard the cretaceous strata
as having been elevated.
The land flow occurring at
top of the hill limits to
the cause of the disturbance
especially as the faults are
on a line with the volcanic
lava.
The fault or faults crossing
on from the Eocene fault
on the west side of the Kanab
Canon runs about north
cliff & about midway
ward through the long
valley Canon.

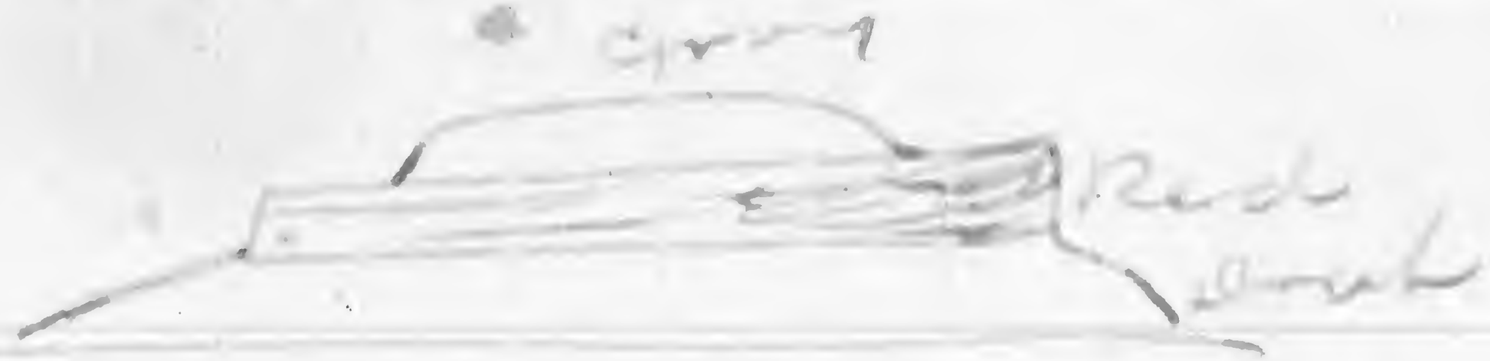
The eastern, c, of the pair on the divide separates the catchment of the valley from the tentary and S. W. Lifts on the western hills on the Long valley canon. No evidence of a fault was observed in the Kent Canon white Cliffs or in the canon east to the 2d afluig with Johnson canon. In the Work no observations were taken in the White Cliff or the long valley canon cuts off faults in that direction.

Note. From the base of the
grey sandstone (sometimes
conglomerate) Lower Pic
Pic. Cliff limestone to the
arenaceous clays beneath
the massive sandstone next
below the astarte bed often
to be a great natural growth
of shore detritus by the fragmen-
tation of sandstones & clayey
fronting it in great minority as
compared with the rest.

The next division consists
of clays & marls arenaceous
soft easily disintegrating
plastic extending down to the
next bed or shale above the
sandstone containing many
fossils. This division forms
low wooded hills readily
eroded & sometimes to the
right hand of hummocky
ed.

3: The ~~gard~~ sandstone grades
towards grey clays
& shales & bituminous
clays with coal seams &
thin seams of gypsum.
Passage shale & marls

4. The gypsiferous clays
& calcareous sandstone passes
to Red Jurassic limestone
Jurassic to White
Cliff sandstone.



Butte south of limestone cliff.

Butte south of limestone cliff.
12 mi S.S.W. of Kanab
Unconformity with nearly horizontal overlying Red Beds.

Tertiary strata west of the
Lorraine uplift west side of
the Broadway (anticline)

Cream	colored clay	50 feet
1 White sand	"	25 "
2 Pink (dark)		1
3 Cream	colored sd.	50 "
4 Cream	colored hard	100 "
5 Pink (reddish)	hard	
	Total	150

6 succeeding white sand
capped with buff sd,
such as occurs beneath
the Pink cliffs, & stony
iron stained sand
rocks which form a
down, 300 —

7 just to the S.W of this hill
there is a hill of white
bedded limestone
similar to the limestone
that underlies the red clay land

165 166 167 ..

A small shell was found
from the sandstone. No
fossils yet observed in
the limestone. ——
~~the limestone.~~
Dip due east to the N.
& while but S. W. 3 or 4 feet
in a mile. The high bluffs
on the Kansas River are
limestone

Upper Kanab. Head of Valley.

The Pink Cliff runs N & S as far as much the cretaceous running in nearly a parallel line for along distance just west N. of this divide; cuts into pink valley — the Fourth. The cretaceous is limited as much in width across the divide to be replaced by the medium conglomerate which forms most of the pink cliff uplift on this way to the Pink Cliff uplift to the west of the trail over the divide. The cretaceous rock comes round south of the conglomerate & Pink cliff uplift

N. of the divide. Journey down the head of Kanab valley. Left at 8 & may be near

extends south for miles
in the Reno Valley x
Rocks south + w of Uhliff
(P. C.) have not yet examined

Sept. 8" 1879.

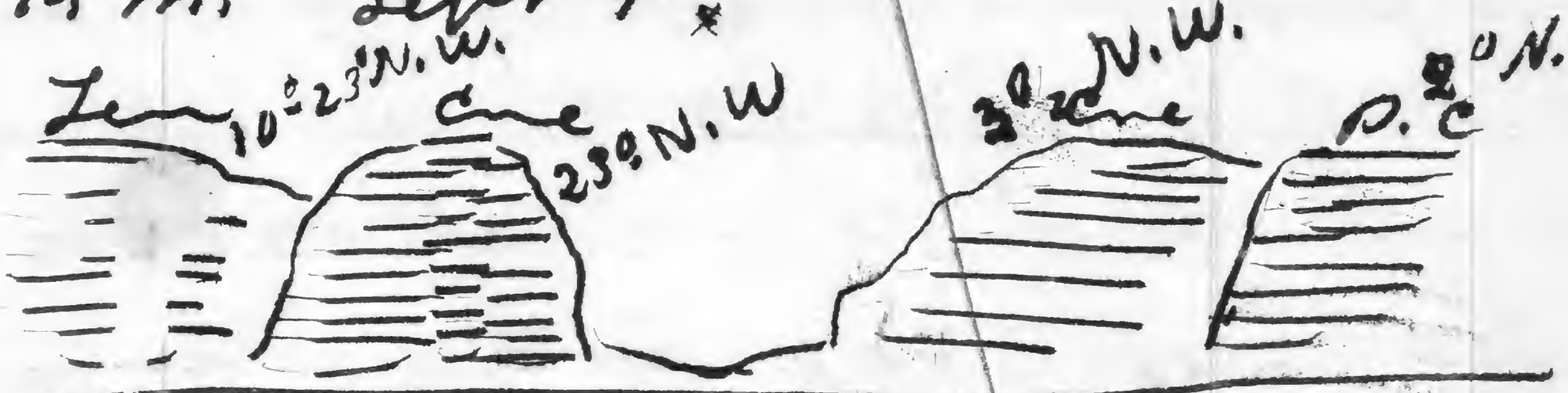
South of the Pink cliff uplift
the sandstones beneath rise at
an angle of 28° for a mile
the dip is N. W.

Elevation of Rock cliff
Uplift 8925 feet. Strata beneath
retain the same dip 28° N. W.
and pass down through
the Tertiary and beneath
the Pink cliffs to the uplift
portion of the Cretaceous.

The distance to the Cret.
outcrop in the valley to the
S is 1½ miles. Elevation

On the outside of this
uplift Tertiary limestone
may be seen leaning against the
sandstone, inclined

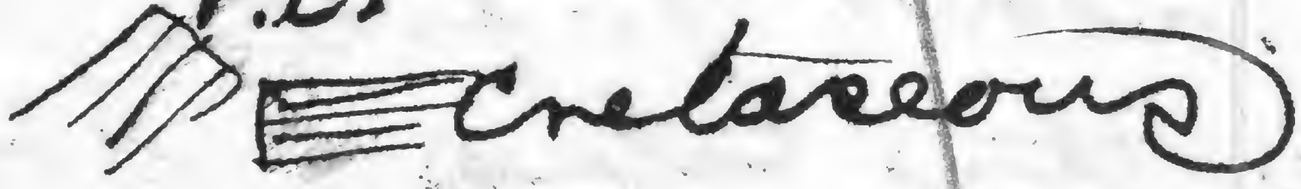
at the limit 17 of contact at
the same angle but a
short distance back it is
reduced to 10° W. 23° N.W.
assumes the horizontal
position E. & W. with a
slight dip to the north.
Whether a
N.W. fault exists
~~Fault~~ to the west was
not determined at date of
writing Sept 9th 1879.
Elevation of Lansing hill west
of Cretaceous uplift ~~2400~~ 2500.
1 P.M. Sept 9th.



E + W section south of P.C.
Uplift. 1½ miles.

A fault or synclinal is shown by sketches 1 & 2 take 1½ miles west of Lantry Hills, the strata of the Lantry ridge dip 2° N.W. & the strata on the Hills west 1 mile dip 5 N. ° The hills west of Chinook Coulee and Lantry Ridge are capped with Bearpaw shale. Ridges of Bearpaw shale cover the Lantry Ridge & Chinook Coulee. The fault passes down the valley west of the Hills & appears to have caused the valley. The Bearpaw shale on the Lantry Ridge is the same as the valley side.

Upper Kanab valley. West side
8250. B. at 2. P.M. Sept 8. 79.
The Pink Cliffs facing W &
S.W show a slight dip to
the N about 2°. The Cretaceous
strata to the west have the
same dip & the Astarta bed
16.00 feet from the summit
of the series of Cretaceous
beds is a marked feature
of the landscape resting as
it does 8050. feet above tide
with the high Pink Cliff back
feet above tide.
On the left the beds of the
Pink Cliff of the west side
of the valley dip N.W. at an
angle of 28° resting against
the cretaceous rocks



To the east the
strata have the uniform
dip to the north and consist
of layers of beds (apparently
still) cannot tell. Color
white. Capped with a reddish
brown. The Glendale formation
may lift the pink cliffs in
defense the white beds &
the reddish ledge are dotted
with white limestone
miles west of Kanab
valley (white). The summit
of the pink cliff which to the
west side is 8925. 2:30 P. M.
Sept 8./79 A little west
of ~~road~~ on the descent
leading down to Kanab
valley there is an area
of reddish colored conglom-
-erate, about 75 feet exposed
above the talus. Its
the matrix is a reddish brown
fine sandstone argillaceous
material + has embedded

in it fragments of fine limestone & sandstone breccia also small pebbles of quartz. The pink rock formation The bed would appear to be made from the destruction of the pink cliffs limestones & sd.

Barometer 8800. 4.0 P.M.
Refr. 8. " 1879. Lat 52 N.

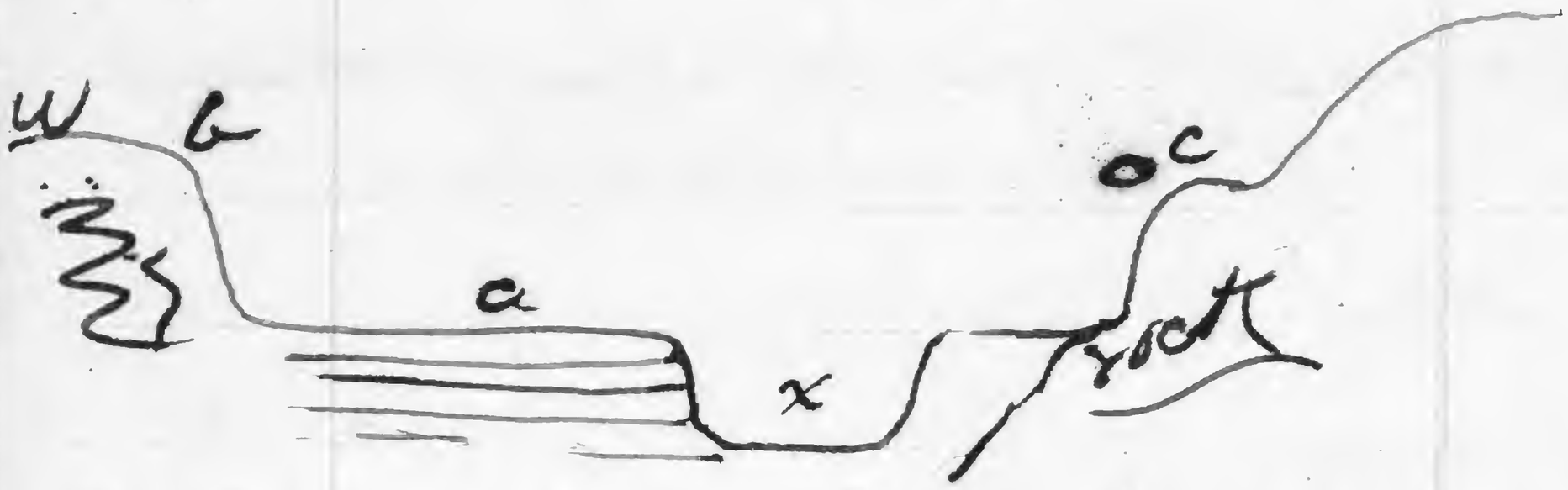
Cretaceous hill E of last 9100. 4.30 P.M.
See sketch of valley & divide from this point.

Stain of reddish encrustation & pebbles of same extend 175 feet high up the hill than the summit grain above mj. 8800.

Ostrea rest 8275 on line of rest south of Camp. Refr 8. 0879.

While walking around
the island fossil hunting
Richard Mantell discovered
a strange fossil unlike
any he had ever seen before.
It was a perfect fossil
of a human skull.
Richard Mantell decided
to take the fossil back
to the museum in London
to show the scientists
there.
Richard Mantell
never arrived
at the museum.
The ship he was travelling
on sank in a storm
and Richard Mantell
was drowned.

The sandstones of the lower portion of the Crosbeddeck sds of the W. C. Gh., are usually very fossil when exposed to the weather at an angle to the criterion. The general appearance of the beds is such that it appears that the layers were laid down by a gentle current such as a tidal heavy strong current, tidal or storm level off the bottom and formed a smooth bottom Surface. a layer of sand which then turn underneath the shifting sands which in turn were laid off again etc., etc.



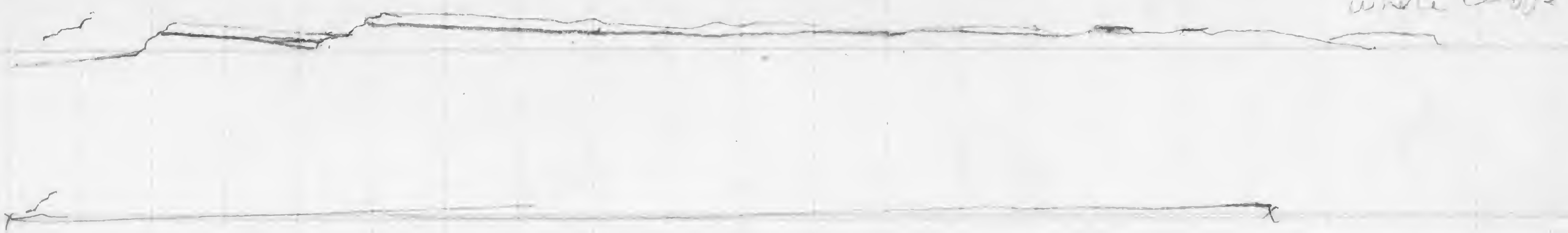
x Present bed of sprigs + sleam of Kanab creek. Vermilion Cliffs. a deposit of sand etc., unevenly bedded + showing source of material in the red + light colored layers caused by the wash from the red and white beds above. Right of terrace 35. (b) a second terrace of sand extending to the west & (c) the red sandrock has a grayish color probably owing to the upper terrace having rested against it. The lower terrace a can be traced down the canon for two miles or more evidences of the upper terrace (b) is seen but a short distance.

The west side of the white cliff on the south side of the Kanab Canon has cut it differently than the white cliff (Summit) is elevated a few feet above the western edge of the same canon. This must be owing to the fault which crosses from the upper Kanab Canon S.E. to the Johnson Canon on S.E. of Coalter. The White Cliff also has a slight dip N.E. from the Kanab Canon. As from the Long Valley fault to the Johnson canon.

No evidence of a fault was obtained at the mouth of the Kanab canon in the white cliff.

The lava flowing from the volcano at the head of the canon in the white Cliff

Juniata down the old bed
canon of the Kanab valley
entering the present Grand
Canon & flowing for a long
distance on the east side.
Like the last flow the
Canon has been more much
larger on the west side
& the lower stands a black
wall on the eastern side
carving finely like a
great snake down the canon
following the old ancient
channel of the stream. This the
canon. Near the head of the
lava stream the volcanoes
divided the old valley into
two water sheds one flowing
down through the old drainage
line on the west cutting the
Kanab fault to enter the main
canon. The other main stream
channel down which the present
road runs.


white cliffs


127

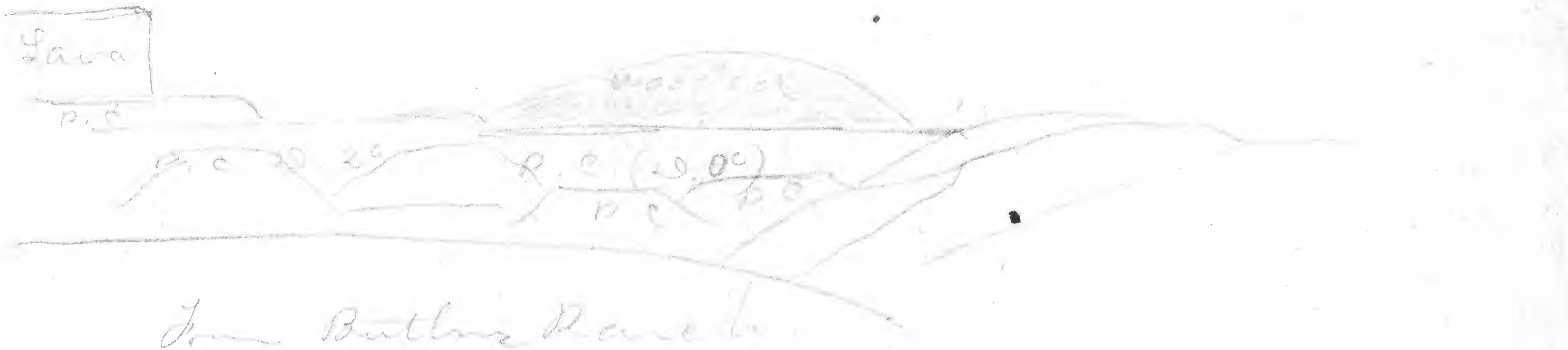

Succession of Vanilla - salt w of Kuwait

1. Dark hick l resting on eroded surface of 2.
2. Pink cliff Limest dip 3° N.E.
3. " " " " 2° W - 4° N. to
base beneath lava beds.

Taken 6 miles south of Hillsdale from W side of lava rim.

Nov 14" 79.

Explanation to
P.C. returned at
end of next
ft. 24th a
Sec Rec



Sara Butler Parent

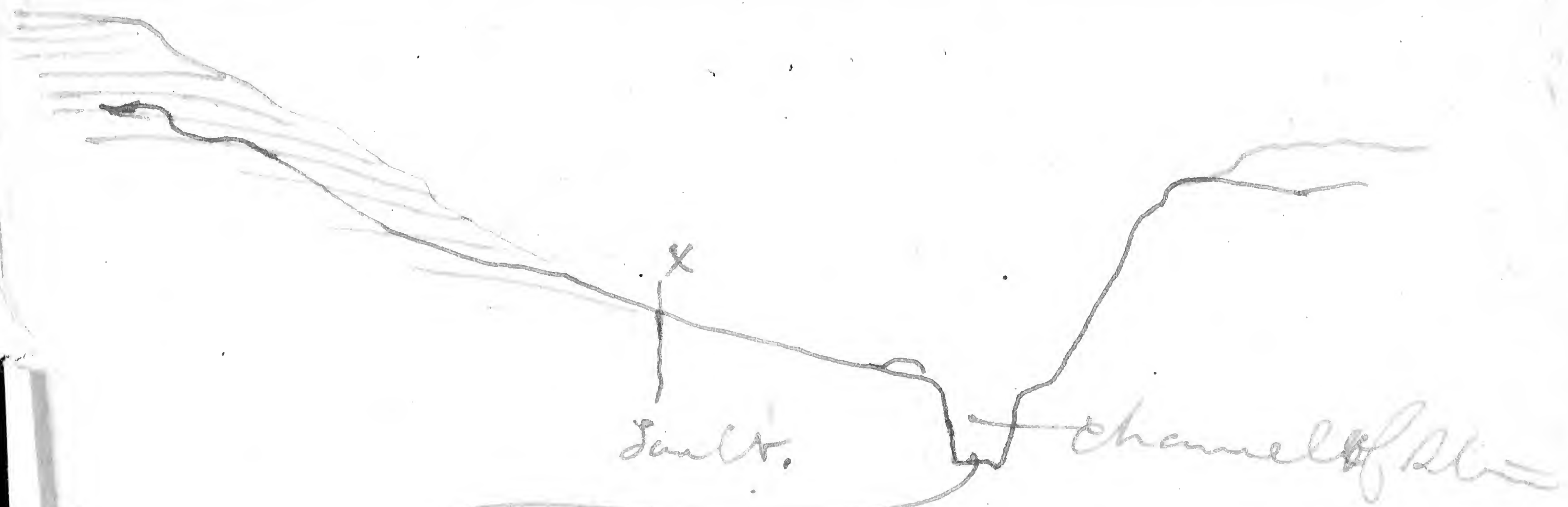
0

South of Cliff Lunch
Kanab Canon. Utah. Oct 6" 29
(1)

Breach from Chemini
of the cliff west side
300 feet above the canon
bed. The strata of the
upper 150 feet are seen
to be nearly horizontal
and also curved more
or less in beds not in
relation to any depression
suction but as the it
bed when which they
were deposited was more
or less wavy.

2

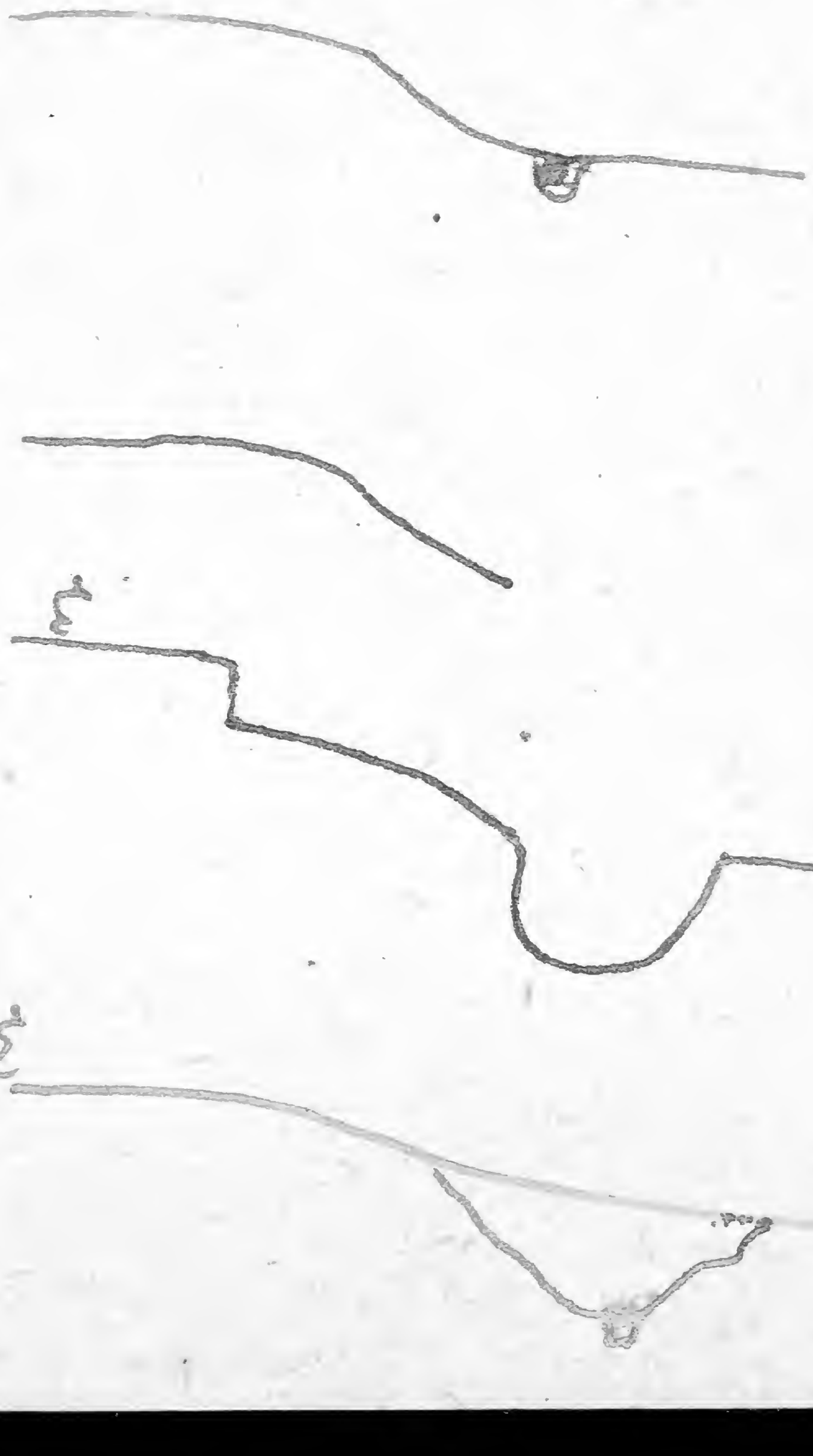
When I read between the lines of the man above and below the left hand corner of the fruit is my daily sum. He dam there is to the west and is more feet. The state land towards from the east and more toward the west slightly.

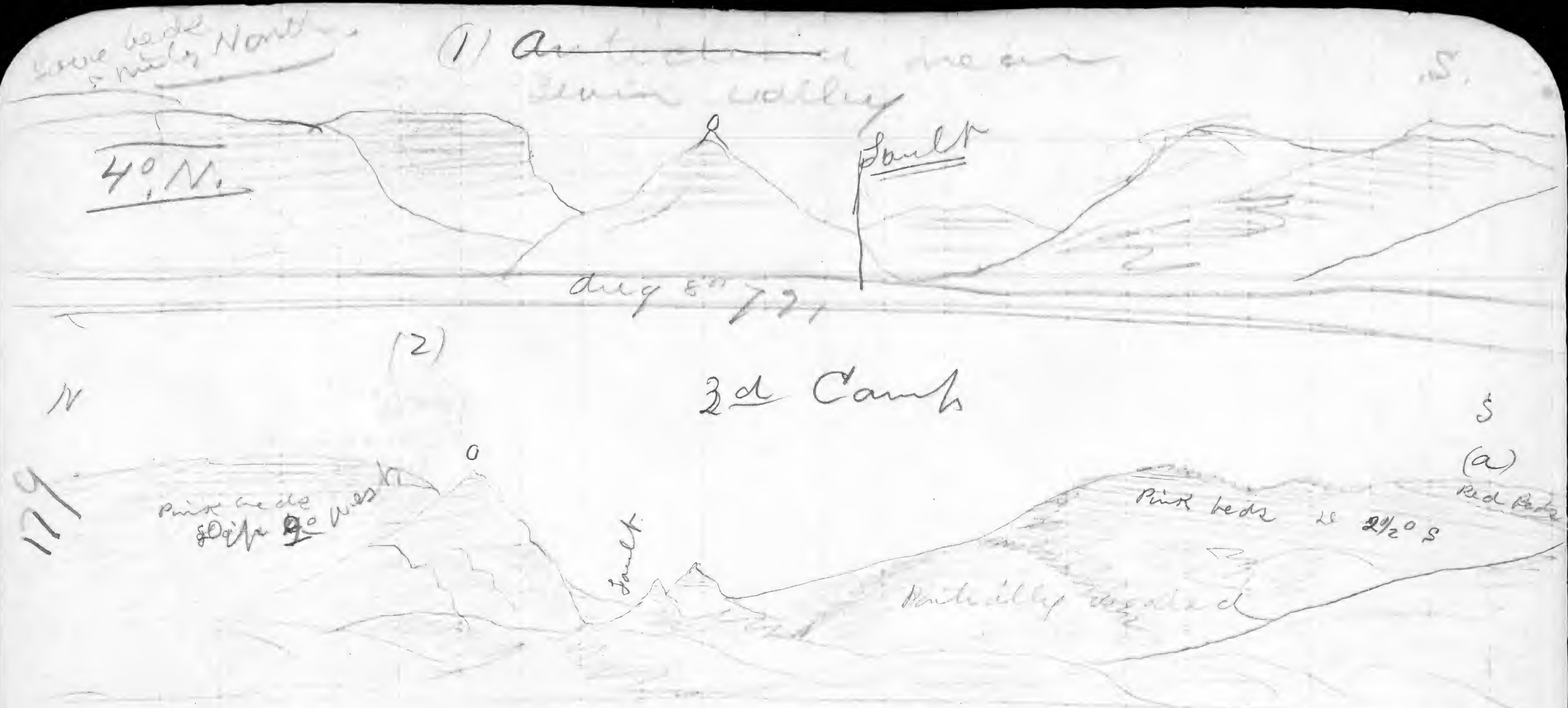


a fault occurs at x. It may be seen also
to the east

Section across Cañon at
Utah Alkaline Springs.

West side. Red Trail Red 5925.
East side Same Bed. 5750
175

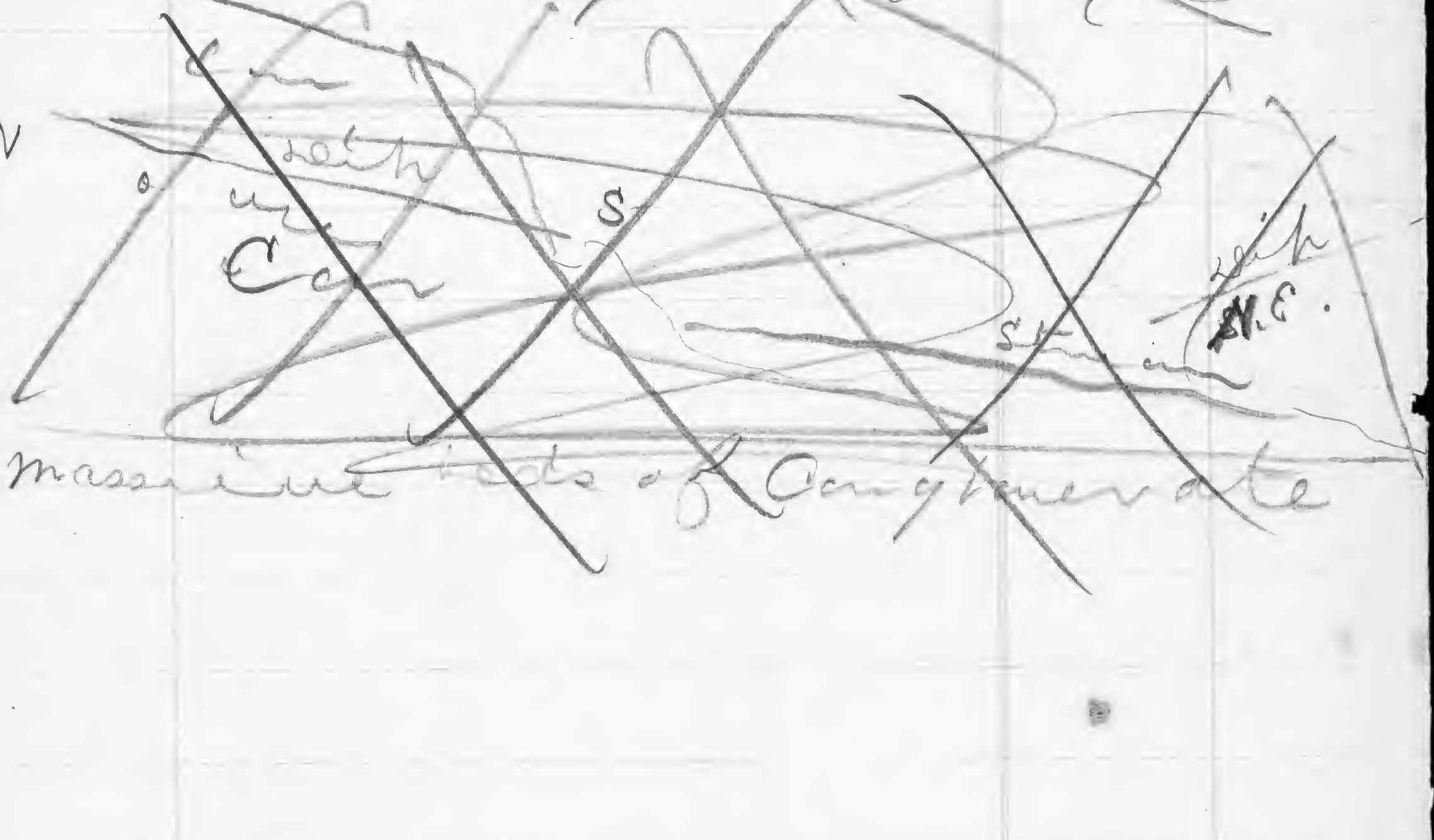




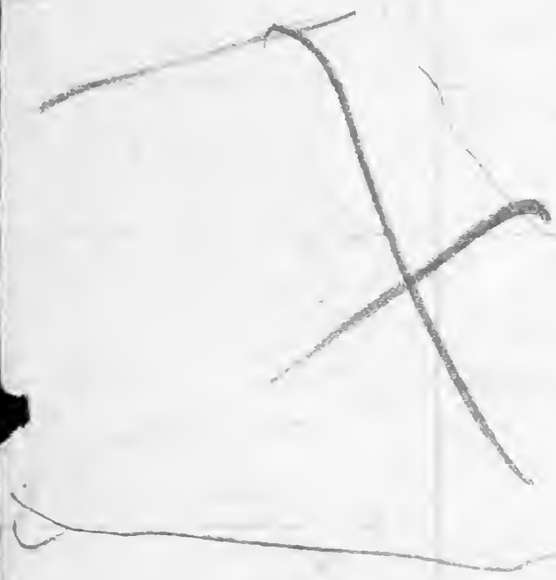
17

Seen from 2 mile to the south of (1)
The reddish beds at (a) rest when x against the eroded
Pink Beds. The Pink beds pass beneath lava beds to
the north. South the hills are wooded + the bedding
does not show as well x as west. See note of Nov 17th

Leaving El Paso Aug 7th 79



Measurements of Encampments



Fremonts Pass. Aug 6/79

South side, 5 miles w/ Pass from the west entrance.

Base of section light colored thick bedded sandstone (2) with layers of breccia(?) conglomerate intercalated, about 60 feet.

The conglomerate is composed of broken, angular, fragments of volcanic rock and larger rounded stones & bowlders of from 2 to 3 feet in diameter. The sandstone matrix is of medium hardness & when the broken stone are removed gives the appearance of a bed of ~~mortar~~ cobblestone work. Near the summit the sandstone is more of a yellowish color & is immediately overlaid by a thick depth of volcanic rock. (1) 30 feet thick. This is evidently

an unconformable bed. The entire Paleozoic succession has thus been deposited rapidly. The sandstone dike is dehanited and mingled with the products of volcanic eruptions & the broken & rounded fragments of beds of lava etc. Dike of underlain Sandstone strikes 15° N. Above the sandstone bedded sandstone layers there is 4 or 500 feet of coarse conglomerate this may be seen extending down the river for several miles. If the dike is retained + the strike. a uniform the opposite hill should give the following section.

conglom

(B) Embedded sandstone, conglom, with

conglomerate

(A) Cong
E.b. sand
Cong
a volcanic rock flow

Cong

(C)
E.b. sand
with

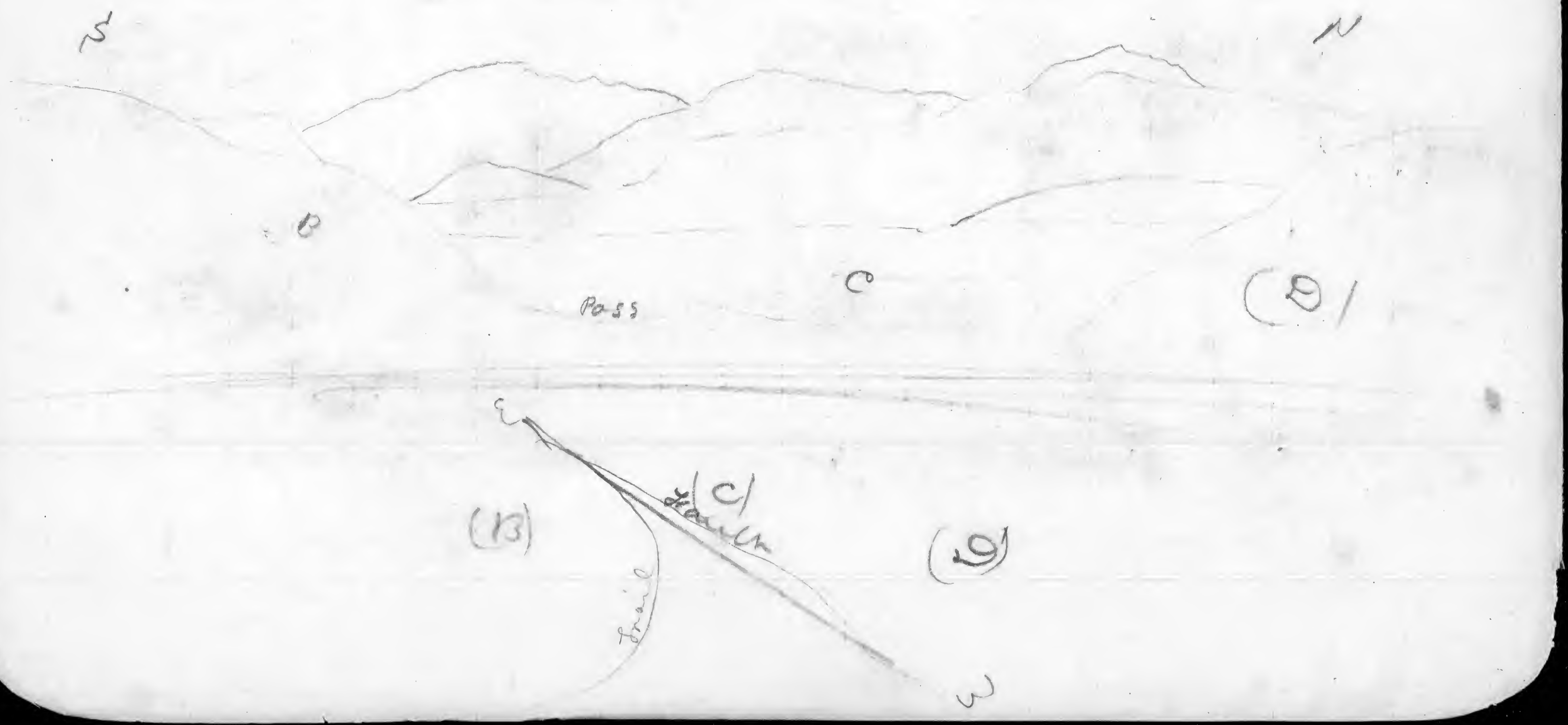
Cong

E.b.s. Cong

Cong

E.b.s.

(D) No


S
B
Pass
C
(8)
(13)
(9)
C
W

at Pahranagat, Lincoln Co. Nevada
Dr Newberry stated that there were
well preserved silurian fossils occur.
Primordial. South of Ogden and
also 50 miles south of Salt Lake City.

Wahsatch range & Sierra Nevada elevated
at the close of the Jurassic. Whelan pg 24. Y
slight changes on late as the Eocene
Tertiary

Watkins Report.

Sect III = Upper Laurentian or Archean.
" IV = " " "
" VI = Lower " " "

Sect Pg 270 = Kanab Sect?

Received from Mr Bodfish

1. Clinometer.
1. Locke level.
1. Lake line - 50 feet

6000
577
22

Acid air dum 60
100
577
10.0 m.
5785 10.20
840

Record of specimens

Vermilion Cliffs.

Conglomerate.

Annularia (Shimaumuh).

Lo fish bed from toh-	250
Fish beds thereon	100
Lo toh of Shimaumuh	210.
Shimaumuh marls	540.
etc	350.
Estimate to toh of conglomerate	350.

Record of specimens
Vermilion Cliffs.

Conglomerate.

30.