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Quad. Near Thompson and Green River, Utah
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Author Miser, H. D.

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Locality J-12
(Index map coordinates)

State Utah. Near Thompson & Green River Utah and along San Juan and Colorado

Notes by Rivers in SE Utah and northern ~~Arkansas~~. Arizona

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This book is a partial copy of 4124 by

H. D. Miser

See note for a complete copy of 4124.

June 30, 1921. Left Washington, D. C. on B & O train 4:30 P. M.

July 1, 1921. Arrived St. Louis, Mo. 6:15 P. M. Kate and Katherine took train for Fayetteville, Ark. at 8:20 P. M. I took Wabash train 10:30 for Denver, Colo.

July 2, 1921. Arrived Kansas City 7:30 A. M. Left on Union Pacific at 10:40 A. M. for Denver.

July 3, 1921. Reached Denver about 7:45 A. M. where I waited for afternoon train. At 8:30 I got in sightseeing auto and made 65 mile trip through foothills of Rockies. At 3:55 P. M. took D&RG train for Thompson; passed through Colorado Springs and Pueblo.

July 4, 1921. Train followed canyon of Grand River for a long distance. Saw lava flow in bottom of canyon at one place and also saw a terminal moraine. Reached Thompson at 3:00 P. M. Thompson is a small village in the desert. Only one patch (10 to 12 acres) is under cultivation. Sage brush, grease wood, and scanty pass grow on desert.

July 5, 1921. A Mr. Parker and I walked north of Thompson to hill some 4 miles away and climbed to an elevation of 750 feet above Thompson. The Mancos shale, a dark colored shale, underlies desert valley and occurs

in lower part of hill slope. A heavy gray cross-bedded sandstone and some shale probably 1000 feet or more thick overlie the Mancos. This is apparently Mesa verde. It contains one or more coal beds.

I took train at 2:15 P. M. for Green River.

July 6, 1921.

Sketch.

Thursday, July 7, 1921.

Sketch

Friday, July 8, 1921.

Went west of Green River distance of 13 miles, - walked 10, rode in truck 3 - to San Rafael Reefs, and carnotite prospects.

Sketch

Carnotite is associated with silicified logs in massive pebbly cross-bedded ss. Ore contains 2% or more carnotite. Occurs as pockets, largest yielding 150 bogs of ore.

Vanura mines are on placer claims of the Radium Company of Sellersville, Penna. The claims are 13 miles SW of Green River on San Rafael Reefs in sections 15, 16, 21, 22, 27, 28, 33, and 34, T 21 S R 14 E and sec. 4 T 22 S R 14 E.

First work done by Larimer Bros., of Philadelphia, prior to 1910. Work begun in 1910 by Radium Co., of America which has done assessment work during every succeeding year except 1919 and 1920. Some ore was shipped by this company prior to 1919. It is said to have contained 2 to 6% carnotite. It was hauled by truck 13 miles northeast to Green River where it was shipped to the company's plant at Sellersville, Pa. No ore has been shipped this year.

The mining camp consists of 3 or 4 wooden buildings in the desert. Water for drinking is hauled from Green River. The water in San Rafael River and a creek some 5 or 6 miles east of the camp are not usable.

The carnotite occurs at a single definite horizon near the top of a sandstone member of the St. Elmo formation. The sandstone dips some 15 to 20° E. with the slope. It is cross-bedded and pebbly and contains silicified logs and dark streaks of carbonaceous matter. The carnotite is associated with the logs and this carbonaceous matter. Where pockets of ore do not outcrop their presence is indicated by brown stains along cracks in ss. Overburden of ss. ranges from few feet to 15 feet. Openings are pits and sheet tunnels. Rock is loosened by blasting.

Saturday, July 16.

Messrs. Loper, Douglas, Trimble and I left Green River, Utah, in Douglas' Ford car for Bluff, Utah. We left Green River about 10 A. M. and arrived at Monticello, Utah, at 2:30 A. M. July 17, a distance of 120 miles from Green River. We encountered muddy roads several miles south of Lasal and the Ford limped and stopped on such roads until we got to within 2 or 3 miles of Monticello. We left Douglas in car at that place and walked to town where we slept on bales of alfalfa hay in a barn.

Sunday, July 17.

Monticello, 7037' above sea, is located on gently eastward sloping remnant of peneplain, dipping east from Blue Mountains. It is apparently continuous from Blue to La Salle Mountains and extends many miles to east. The snow-capped mountains and mesas of Colorado apparently rise above its level. At and near Monticello it is capped by a few feet of water-worn cobbles and pebbles and loam. Underlying rock here is Mancos shale. This plain is about 200 feet higher 5 miles south of town.

Sketch

The Dakota underlies the peneplain over large areas south of Monticello. Gravels and loam underlie it in places.

The peneplain extends to within several miles of Bluff.

Sketch

Traveled from Monticello to Bluff on truck, a distance of 47 miles.

Monday, July 18, 1921.

5211 elevation (14.27 miles south of Blanding of south edge of Dakota peneplain.

We arrived with truck loaded with boats and supplies at a point about 4 miles below Bluff. Truck unloaded about 10 a.m.; ate lunch, towed boats, launched and loaded them and they left at 12;45 p.m.; 4412 elevation of terrace on side of San Juan just north of launching locality.

About 4 miles below Bluff a heavy cross-bedded sandstone (color?) comes up above water level.

San Juan at and near Bluff is very shallow and spreads out over sand bed. About 30 years ago it flowed in narrow channel.

A little farther west a terrace truncating the thin-bedded dark red sandstone of the La Plata is 4460 feet elevation. The distance down stream across this terrace remnant is more than 1 mile. Well rounded cobbles underlie the surface loam.

Sketch

This (Butler) wash runs south. The above mentioned limestone and the overlying sandstone dip south enough for the ss. to disappear below bed of intermittent stream. The valley fill about 20' thick has been largely eroded. The sides of the gullies cutting this fill are vertical at most places.

Cliff dwelling on Butler Wash consists of 3 rooms about 7 feet square built of sandstone (rough masonary). One room has a small closet 6x3. Each room apparently had one door. Walls largely torn down. Highest now standing is 6' high.

The heavy gray ss. at the mouth of Butler Wash is exceeding cross-bedded. One bed about 50' thick is cross-bedded thus

Sketch

Water elevation at mouth of Butler 4248.

4332.0 elevation at one place on down stream sloping terrace in gap in Comb Ridge.

The heavy sandstone on Butler apparently thickens down stream to 300' or more. One bed between 100 and 150 feet has cross-bedding like that described above. In fact I think it is same bed as the one of which I made a sketch. The bed is chiefly yellow and brown in color. The following is a generalized sketch for the country I crossed during the day.

Sketch.

Tuesday, July 19, 1921.

Sketch

Chinle for $\frac{3}{4}$ miles above its mouth has deposited a layer of red soft mud in its bottom and along its bank. At one place I tried to cross the stream but I went only a few steps until I had to turn back. I sank in stiff mud above my knees.

The agglomerate overlies or has been injected into Chinle, DeChelly and Moenkopi formations.

The Moencopi, as exposed at the entrance to the canyon (entered at 10:30 a.m.), is composed of brick-red sandstone, shaly ss. and sandy shale in even bedded layers.

Sketch

Rocks at dame site are cut by joints 1 ft. or more apart but are not prominent. Rock ledges run down to edge of water. Whatever fill exists is below water level.

Agglomerate at Mule Ear consists of pebbles, cobbles, and large and small boulders of rocks including granite, diorite geniss, schist, and marble. Garnets were found in all kinds except marble.

a.4300 Chert and ls. Forms vertical cliff.
Shaly gray ls. shaly ss. sandy shale (gray & red
some cherty gray ls.
massive gray ls. with a few chert nodules and some gray shale
dark grayish black sandy shale
cherty gray ls.
shaly ss.

as much as 20' wide. River is swift.

b. projecting ledge at top. 30' to water surface at rock monument. Cherty ls. at top and shaly ss. at base.

Sketch

#1 Top of bed "b" (projecting ledge 4325
Water level here 4225. Slope is covered with talus so that rocks through this interval of 100 feet are not seen.

#2 A heavy ledge of appears above water

#3 Top of bed "b" 4360. Water level 4250.

#4 Dove-colored very fine-grained massive ls. at waters edge.
The 100 feet of beds below "b" included red and dark shale, thinbedded ss. and cherty ls.

Sketch

Profile opposite.

Section at 5

1"c" 11' of limestone (apparently same bed as #4) dove-colored, compact, single bed.
1½ sandy gray shale
5½ yellow corss-bedded fine-grained ss.
3' shaly gray ls.
1"d" 6' ls. like 11-foot bed above
8' yellow fine-grained friable ss.
3' gray shale
10' shaly ls. and shale; gray
30' Mostly covered but several exposures of gray shaly ls. and one of cherty gray ls.

The base of c rises about 70 feet above water level from #4 to #5 and it apparently becomes lower to west toward camp so that the crest of the anticline is at or near #5. Mr. Pert Loper knows of no oil seeps on this anticline and I did not see any.

A short distance NW of #5 8 feet of cherty, hard, dark ls. is exposed at waters edge.

Two light showers of rain fell on us at night and wind vlew sand into our bedding. We slept on san bar. River rose 2" over night.

Wednesday, July 20, 1921.

4070 (aneroid) elev. at #6; 4179 actual elev.

Sketch.

The top of the cliffs near second camp is formed by a gray rock.

Sketch

Between the second camp and #7 bed "c" is at or near water level and extends to edge of water.

"8"

Sketch

At "7" the heavy ls. begins to rise and at "8" is 50 ft. above water surface.

"8" Below and above 8 sand and talus bowlders extend from water's level up as high as 100 feet.

"9" Black flint in nodules and lenses in dark hard shale exposed at water's edge. 4080 elev. of water.

Sketch

The flinty shale at 9 is 20' thick. On weathering the shale becomes yellow, but the flint remains black.

A dark gray massive fine-grained ls. (f) with a little black flint appears above water just south of 9.

10. The top of the bed of limestone (f) rises about 30 feet above the water surface. The river has cut a narrow canyon in it. This canyon at places is probably as narrow as 40 to 50 feet. The ls. is slightly wavy. I think this would be an excellent dam site. Only the topmost layers contain chert. The lowest layers appear to be fairly pure

Sketch

11. At 11 on east side of stream the top of "f" is about 1 foot above water, whereas it is about 8 feet above water on west side. This indicates an east or northeast dip.

12. At 12 the top of "f" is feet above water. This ls rises gradually between 11 and 12. This ls. and the cherty shale above it are the most conspicuous beds I have thus far seen in the Goodridge.

From 10 to 1w the sand, gravel and boulder bars are very few and small. The ls. generally forms cliffs extending up from water's edge.

13. 20' gray and dove-colored massive ls. (f) fine to medium grained. Some black gravely flint especially in upper part.

11' gray fine-grained cross-bedded calcareous ss.

"g" 30' massive gray fine-grained ls. to and near water Upper surface

12' flinty shale (gray). 2½ feet of black papery sh. at base

14' At 14 about 15 feet of ls. is exposed on south side of river below the 12-foot bed of flinty shale, whereas at 15 only about 5 feet of ls. is between the flinty shale and the edge of the water. The crest of the anticline is therefore at 14.

Section at 16

16 5' flity ls.
3' yellow cross-bedded fine-grained ls.
4142 (T) water surface
at 16
30' massive ls. to edge of water. It dips to N.

There is a slight dip from 16 to the spring, a dip of 10 to 15 feet in this distance.

The cliff became so steep on the right bank below the spring that we were transferred to left bank.

17 There is a box canyon here with vertical walls rising above edge of water. The rocks are cherty ls. and ls. and include a thickness of about 200 feet from the top of "g" to the water. From the spring to the lower end of the canyon 100 to 150 feet of rise above the water.

A light rain fell at night.

Thursday, July 21, 1921.

The river rose two or three inches over night.

We slept on a sand bar. Small ants got into our beds and crawled over us and bit us all night. The river rose perhaps 1½" between 5 and 7 a.m., but by 8:30 it had gone down about 1 foot. The water became red with sediment and its odor became so bad

that it could be smelled 50 feet or more from stream.

Sketch

Some drift wood in stream. Christenson and I climbed over cliff on south side of the Narrows and descended to stream in talus slope that had formed in crack of the ls. cliffs.

Woods that gorw on San Juan:
Cotton wood
Rabbit brush
Mountain Rush (Brighan Tea)
Chico (a species of grease wood)
Iron wood
Sage brush
Willows, Red haw, grease wood, oak, pine, cedar.

Animals I have observed in Utah:

Cotton tail	Ducks
Jack rabbit	Crane
Coyote	Lizzard
Civet cat	Locust
Prairie dog	Flies
Owl	Ants (millions)

18 At the mouth of the canyon at this locality huge boulders as much as 6 ft. in their longest dimension form a projecting bar which has diverted the channel of the stream to the east. They appear to have been washed by stream from canyon.

Sketch

19 A canyon here empties into river. A few scattered boulders are in bottom of canyon and there it is practically no talus in it. But the boulders and rock fragments that have been washed from it form a bar 600 feet long and 20 to 30 feet high which has pushed channel to west. The largest boulder, 9x9x7 feet, but others of almost same dimensions were seen. The surface is conical with the highest part at the mouth of the canyon. The bar merges with one to the south.

Very small canyons that do not reach back into cliff more than 50 feet have collected water that has plowed or formed ditches in talus at base of cliff. These ditches are several feet wide and 4 to 5 feet deep.

20 Cherty ls. at rapids dips upstream. The beds from the top of "g" to the water are apparently 300 feet thick. A canyon with its boulder leg is opposite 20. The bar has pushed the stream to the west forming rapids. With a fall of 2.9 feet in 370 feet. The corners of the bowders in the boulder bars have been rounded off by erosion.

Another boulder bar to the south has form a small rapid. It and some of the other streams from the canyons have kept open channels 6 feet deep in the bars.

21 Here is what appears to be the top bed of the Goodridge formation. The elevation of the water surface at the top is 4105 (T).

Between 20 and 21 rock ledges are at water's edge for most of distance. They reach the water at a few places on the south side.

Sand storm again blew sand into our beds and sprinkles of rain fell at times during the night. The river rose a foot or more from 5 p.m. to about 5:30 a.m. and then began to fall rapidly. It again got very muddy and had a bad odor.

Friday, July 22, 1921.

Sketch

We, on the night of July 21, dug 2 holes on a gravel bar at the edge of the river and fairly clear cool water ran into them.

The canyon just east of July 21 camp would be a favorable place for a dam site. Here the beds of the Goodridge dip 12 to 20° W. (down stream) and they, at most places on north side and at many places on south side, extend to water. Some of them in fact project out into the water. I do not think the fill below the bed of the stream would be very great.

20 The ls. bed at the top of the Goodridge is massive gray fossiliferous, is 7 feet thick, and contains some knotty jasper. It is overlain by a conglomerate with ls. pebbles and a sandy matrix.

Sketch

Lime Cr was flowing a small clear stream on the morning of July 22.

There are long stretches of gravel and sand from below mouth of Lime Cr. to July 21 camp.

One terrace remnant is above mouth of Lime Cr. and another, the higher, is below mouth of the creek. Both are capped by well rounded pebbles and cobbles. The lower one is 50 feet above water.

At the mouth of Lime Cr. strata are flat

(Pages stuck together; 2 lines erased)

syncline therefore at the mouth of this stream.

A third terrace remnant a little lower than the higher one is just NW of the higher one.

21 A large terrace here stands 125 feet above river. A small remnant at 22 stands at about same elevation.

23 The top of a 7-foot bed of calcareous yellow ss. is 12 feet below the top of the Goodridge. Ls. dips 3° upstream. This ss. is apparently the same one as that exposed at the July 21 camp. The Goodridge goes below water about 3/8 mi. SE of point farthest NW in goose neck.

From mouth of Lime Cr. NW. ledges of rock extend to water almost everywhere.

24 Top of Goodridge is about 135 feet above water. Ls. bed at top of Goodridge is 2 feet thick. It is very fine grained and dove colored.

The top of the ss. at the July 21 camp is 11x5½' below the top of the Goodridge.

25 The Goodridge here dips 10° down stream. The July 21 camp ss. and a red ss. bed above it project into the water. The fill below the bed of the stream is probably small or none. A rough rapid is here. Only a few small sand and boulder bars are between 24 and 25.

The July 21 camp ss. according to Hyde is the Goodridge sand. At 25 there is said to be an oil seep near the water's edge. I saw a place where some blasting had been done. Christenson told me that the prospectors tried to blast a place where oil would accumulate.

The Mexican Hat is formed by sandstone in the Moenkopi Other mesas in the vicinity are also formed by the same sandstone. This ss. is cross-bedded, light brown, and is apparently 30 feet thick on the broad mesas. It is overlain by red and gray shales, mostly red. The Mexican Hat is apparently 20 feet in diameter and 5 feet thick.

26 The top bed of the Goodridge about 2 ft. thick is exposed about as follows on east side of river.

Sketch

Between 25 and 26 on R. bank there is a flat 10 to 20 feet above water. It is as much a a hundred yards or more wide and is underlain by wind-blown sand and pieces of red shale from the Moencopi. A few very small remnants of the 125 terrace were seen between 25 and 26 on south side of river.

An oil well is said to have been drilled many years ago about 1 mi. E-SE of Mexican Hat. I saw some casing at old site. The sand and rocks are poorly cemented together by a brown bitumen.

27 The Moencopi is the surface rock between 26 and 27. The rocks come down to the water practically all of the distance on the west side and most of the distance on the east side.

A sprinkle of rain fell at 2 p. m. and at night.

Saturday, July 23, 1921.

I saw Goodridge well No. 4. Oil was pumped from this well and used at other places for drilling.

Elevation of gravel at Goodridge 4300 ft. 4060 elevation of bridge. The gravel caps a fairly large area northeast of the bridge.

Goodridge bridge. 1. The top limestone bed of the Goodridge is 2½ feet thick. 2. 5 feet soft ss. brown to black in its upper 1 to 2 feet as if it had been saturated with oil.

3. 7' hard brown ss.
4. 1½' red sandy mud rock.
5. 6' hard brown ss.
6. ½ brown shale.
7. 5 yellow fine-grained soft ss.
8. 3' red mud rock.
9. 10' red ss.
10. 3' red mud rock.
11. 2-3' lavender shale.
12. Goodridge sand. Bridge is anchored on this. This ss. forms a narrow bar canyon at the bridge.

The Goodridge formation disappears below the water in river ½ mi. above bridge.

From 27 to bridge cliff comes down to water entire distance on left bank.

Bars of sand, gravel, and boulders are on right bank from 27 to mouth of Gypsum Creek. At the mouth of this creek the river enters a canyon in which there are very few small bars.

Sunday, July 24, 1921.

In forenoon went to Spencer's Trading Post and helped pick out supplies for next 10 days and then list the remaining supplies. Then wrote letters and made out June and July expense accounts.

In afternoon I walked about 4 mi. from the bridge to Alhambra Peak. The Peak is between 150 and 200 feet high, is apparently 500 to 600 feet long and is composed of an olivine basalt of some kind. Two or three dikes 2' or less wide extend SE from it for a distance of at least half a mile. The dikes are composed of a biotitic basic rock of some kind, perhaps a monchiquite. The peak looks like an enlargement of the dikes. A few fragments of a granitic rock occur as inclusions in the basalt composing the peak. When I approached close to the base of the peak two black eagles with a spread of 5 to 6 feet circled around the top of the peak and kept their eyes on me. When I walked some 1/8 mile from the peak they lighted at some place. After I returned to the camp I washed my clothes.

A sprinkle of rain fell at night, and the river rose about 1½ feet.

Monday, July 25, 1921.

The river in rising the night before broke into our well in a sand bar and it had to be repaired by building a new dike of sand and rock by relining it with rock, and dipping the muddy river water out of it.

I stayed in camp all day except late in afternoon when I went to the Trading Post to get information about the mail we expected to get from Bluff 28 miles away.

Taylor Norton, packer, was due today but sent word that his arrival would be delayed on account of his having to take one of his sick friends to some springs. We intended to start down river today but we were unable to do so on account of Norton not coming.

Loafing is a hard job and I read, slept, and washed my clothes. Clouds covered the sky late in the afternoon.

Small seeps of oil issue from joints and other cracks in the Goodridge sand east of the bridge. Their irregular distribution indicates that the whole ss. is not saturated with oil.

Tuesday, July 26, 1921.

Stayed in camp all forenoon. Deepened well, wrote letter, fixed package (containing blanket) for mailing.

In afternoon went to village of Mexican Hat where only John Oliver and a Mr. Louie live. Mr. Oliver keeps a very small stock of goods. We gave him our mail to take to Bluff tomorrow and requested him to bring our mail from that place. We have not received any mail since we left Bluff July 18.

Norton did not arrive today. We got word that he would be one week later.

We returned from Mexican Hat to camp at 6:30. Trimble and Christensen reported a 3-foot rise in river since 5:45. River rose another foot in next half hour and became stationary and then began to fall by 8 o'clock. I moved my bed to higher ground.

A shower began to fall about 6:30 and continued for about two hours. The heaviest rain passed east of us.

Wednesday, July 27, 1921.

River had fallen 3 feet over night and we began to get ready to start down river at noon. Since Norton would likely be a week later we thought it best to start down river and leave word for him to meet us at Honaker Trail.

The Goodridge sand at bridge is 27 feet thick.

Oil seeps at bridge occur through distance of 200 feet or more.

We packed up and left Bridge Camp about 12 noon.

Sketch.

28 Here the rocks dip at a greater angle to the east than they do upstream and downstream. A heavy bed of sandy gray limestone 20 ft. thick dips 15° E. It projects far out into water on south side Between bridge and 28 there are only a few gravel and sand bars. The beds of red ss. all apparently lie above the heavy sandy ls. at 28.

29 A thick bed of thin-bedded ls. dips 5° E. It is the topmost ls. cliff maker.

From 29 to 30 there are very small sand and gravel bars.

31 The triple bed of ls. exposed in the canyon east of Mexican Hat is here represented by four beds of ls. Near water level there is a gray fissile fossiliferous shale. On south end of rock ls. appears to lie in horizontal position.

32 On outer bend are 3 boulder bars formed at the mouths of 3 short steep canyons. Small rapids occur by each bar.

33 The uppermost of the quadruple ls. beds forms surface of neck which is not more than 75 feet above stream. The joint south of the neck is capped by the beds above topmost cliff-making ls. There is a low dip down stream. A bed of ss. several feet thick is between 3 & 4 beds from top.

34 Fairly large gravel bar.

Red shales extend down to top of quadruple bed of lss.

35 There is a low dip down stream apparently to NE. The base of the top quadruple bed comes down nearly level with water.

In 1894 and 1895 $4,000 worth of gold was gotten at water's edge by Walter Mendenhall on east side of river. Worked only during low water. Rag

streaks found between high and low water. This is farthe rest up stream that gold was found in paying quantities. A machine consisting of a series of riffles was used. The machine was designed by Mendenhall.

36 The third or fourth of the quadruple ls. beds appears above water.

The river began to rise slowly about 5 o'clock. At 11:45 a heavy rain storm accompanied by much lightning came from the NW and passed southwest of our camp. We, however, were in its east edge.

Thursday, July 28, 1921.

By 8 a. m. the river had risen about 6 feet and had covered the spots where several of the party hat slept. About 6 o'clock when the river was rising rapidly Blake and I set out with field glass to find his rod on the opposite side of river a short distance above camp. Soon Bert Loper and Hugh Hyde appeared towing an empty boat upstream. Loper and Blake rowed across stream and found rod about 18 inches above water. The turning point, however, was at foot or more below water. Mr. Trimble got a sight on the back station and established a new one on high ground on the east side. Drift wood including logs and stumps as much as 18 inches in diameter covered much of water surface. On account of this drift and swift water rowing is dangerous and we will not break camp until stream lowers at least 5 feet.

River ran down between 2 and 3 feet by noon and became clear of drift. We broke camp and started down river at 12:30.

Sketch

37. 4 ft. calcareous ss. overlies cherty ls. near water level. This cherty ls. rises above water at 37. At 38 its top is 15' above water and below 38 it dips NE.

Sketch

38. Low neck underlain by red and gray shales that immediately overlie the quadruple ls.

39. Section at 39.

red and gray shales

Quadruple ls. beds

- 12' Coarse-grained gray massive ls.
- 11' Thin layers of flinty gray ls. in papery gray shale; all fossiliferous.
- 9' Massive drab compact ls. with nodular black flint at top.
- 3' Concealed. (cherty shale).
- 8' Massive compact dove-colored to drab ls.
- 2' Gray sandy shale grading into ss. below.
- 3½' Cross-bedded calcareous yellow ss.
- 5' Lowest bed of ls. massive, compact, dove-colored, with some jasper.

40. Rocks between base of quadruple ls. beds and top of heavy ls. are 70' thick. They consist of sandy ls., gray shales, cherty ls. and a knotty black chert about 30' thick. This weathers brown and is the same as the prominent bed in Soda Basin and farther east. This chert bed begins to rise above water a short distance upstream from 40.

Between camp and 40 there is talus at base of cliffs at most places. This talus consists mainly of boulders and small rock fragments. Bert Loper says gold is found at places in with rock fragments, but pay streaks would be found for most part below present water level. At base of chert there are 18 inches of papery black shale.

41. 15' Massive cherty ls. below knotty chert.

At 40 and down stream the river has cut a narrow canyon in heavy ls.

Friday, July 29, 1921.

Sketch

River did not rise during night but fell.
41. Top of heavy ls. 4425; water about 240 lower. A bed of black papery shale 1 to 2 ft. thick occurs at base of black knotty flint at same horizon as the black shale above the Narrows. From camp to 41 the stream has cut a narrow steep-walled canyon in limestones, knotty cherts, and sandy shales, with the ls. predominating. They form

cliffs and talus-covered benches. Christensen, Lober and I started out from camp about 7:30 a.m. and followed one of these talus-covered benches to 41, a distance of about 2¼ miles. The farther we went the higher the bench rose above the stream and also the farther we went the chances of getting down to the stream became so slight (it in fact looked impossible) that we returned over the same route to camp, reaching there at 10:45. The plan is for Blake, Hyde and me to go in boat down canyon to a point NW of 41 where Trimble can get a sight from 41. We three started down the river in the boat about 11:30 and reached destination 42 about 45 minutes later, but not without mishap. It all happened this way: From the camp Blake headed boat to left bank to avoid swift water against cliff; when we reached 40a it became necessary to cross stream to avoid swift water on left bank. When we approached middle high but short sand waves began to form. They got higher and higher - probably as much as 6 or 7 feet high. Blake hit them endwise. Finally the boat hit a steep one and took water. Hyde grabbed a can and began bailing. Blake says, "Hold your head." I grabbed off my hat and began bailing with it. Blake, who saw what was happening after we took the first water, says we hit two more waves that poured water into the boat. After the water quit coming in we headed for left shore to bail all water out. Blake pulled heavy at ores and broke ore lock when we were almost to bank. Blake said water was shallow; Hyde jumped out and then we followed. The water was bailed out and lock fixed. I got as much water as possible out of my compass, camera, monocular, aneroid and note book. After we reached 42 I dried all my instruments in hot sun. Loper with Christensen, Allen and Trimble came through all right

River fell for 2 or 3 hours beginning 7 p. m.

Saturday, July 30, 1921.

River fell about 2 feet during night and it is lower this morning than it has been since the day we left the bridge.

Near 42 there is considerable talus at base of cliffs and some sand bars, but at places the rocks come down to water's edge.

43. Boulders as much as 18 feet square in river and on talus slope on NW side. Cliff is gray, indicating that rock has fallen from it fairly recently.

From 43 to 44 some 30 feet of cherty ls. and gray fossiliferous shales appear above water gradually dipping north or northeast though the beds are slightly wrinkled. The highest wrinkle (anticline), which is at 44, is 5 feet high and 100 feet long. At 44 cherty ls. extends down to water's edge and the lowest forms a flat bend a few to several feet above water.

Yesterday and today I have noticed a great many gray spots on cliffs and high slopes, indicating that rock has slid down slopes or fallen from cliffs.

1. A prominent break in rocks is at 44. It trends south 65° east away and is nearly vertical. A short narrow canyon has been formed in it high on the cliff on southeast side of stream. The vertical displacement, if there is any, is not more than 1 to 2 feet. Water surface 3974 (T)

2. Some 250 to 300 feet down stream there is another break with the same trend and hode. The dis-

placement as revelaed on the north side of the stream is 6 inches and is on northeast side of fault. A similar displacement appears to have taken place on south side of stream. Small canyons have been formed along it on both sides of stream. The highest 6 in. described above is between the two breaks. Two joint faces with same trend as of breaks show horizontal slickensides. These are between the two breaks.

3. Some 250 to 300 feet farther down stream there is a third break with a 565 ft. trend and vertical hode. Horizontal slickensides show on northeast fault face on north side of stream.

4. About 250 feet farther down stream there is a similar fault. Horizontal slickensides show on southwest face of fault on south side of stream. Stream in vicinity of this fault runs west (way).

Huge boulders, some as much as 30 to 40 feet long have fallen from cliffs at and near faults.

45. On southwest side of river there is a lens of cherty ls. about 30' thick and 200 ' long. At either end it thins to a thickness of only a few feet. Base of lens runs level.

3970 (T) W.S. rocks are horizontal. They rose gradually from 43 to this place.

Between 45 and 46 there are two similar but smaller lenses of ls. The rocks come down to water at many places.

From 45 to 47 the beds dip about 75' down stream. At 47 there are 2 lenses of ls. The largest is 100' long and the top 15' of it is exposed. The ls. is massive, compact and dove-colored. The fossils become silicified on weathering.

46 to 47 talus slopes.

48. Talus slopes on outer bend. Strike of cliff formed by joints N 30 W.

From 48 to 49 strata have risen 50 feet to SW. Rock layers come to water at places, sand and talus at other places.

49. 0-8" black papery shale with limy
1' sandy ls.
2' calcareous ss. to water's edge

Odor of gasoline strong in this vicinity. Christensen found small streams of petroleum and gas coming from sand in edge of river. A chip saturated with it was set on fire by him. Hyde and Loper also noticed odor.

50. Canyon on southeast side at bend in stream. Boulders as much as 8 feet long have been carried 2/3 way across river. These boulders have pushed main channel to NW bank forming a rough rapid. Strata have risen about 40 ft. from 49 to 50. At 50 just below mouth of canyon there is a lens of cherty ls. 30' thick and 20' long. It gradually thins out on either side passing into comparatively thin-bedded limestones

52. Rocks between 50 and 52 lie practically horizontal Southeast of 52 there is a sand bar 200 ft. wide rising as high as 20 ft. above stream. Some rock fragments, gravel and boulders are scattered through it, especially its lower part.

From 51 to 52 rocks dip 3 to 4 ft. to N.

53. Rocks lie flat. Sand, gravel and boulder bar about $\frac{1}{2}$ mi. long and as much as 350 ft. wide. Drift wood indicates that water has flooded west of it.

This afternoon I saw a beaver swimming in river and 3 box elder saplings.

Clouds covered sky entire day and light rain began to fall at 4 p.m. Showers continued at intervals all night and until 7 next morning.

Sunday, July 31, 1921.

Bert Loper and I walked from camp at foot of Honaker Trail to Mexican Hat, a distance of 9 miles, to get the mail at John Oliver's store and to get sugar, salt and baking powder at Spencer's Trading Post. I bought 44 pounds of beef for 10¢ a pound. I employed a team from Mr. Oliver to take us to head of trail.

Clouds concealed the sky most of the day and light showers of rain fell on us.

Monday, August 1, 1921.

A light sprinkle of rain fell about day light. Late in the night the river began to rise and by 7 a.m. it had risen 6 feet to its highest stage.

Stream fell from 3 to 4 feet during the day and in afternoon changed its color from buff to red. About the middle of the afternoon when the stream was red the fish came to the surface exhausted to get air. The members of the party who were in camp caught with their hands some 300 lbs. of fish, but most of them were thrown back into water. When I reached camp at 5 p.m. I caught several fish with my hands and threw them into water.

I tried to use Woodruff's section, but I found it somewhat generalized in places and apparently too detailed in others, so I made the following section at Honaker Trail.

Sketch

Sketch continued.

Tuesday, August 2, 1921.

Allen, Loper and Blake walked from camp at Honaker Trail to Mexican Hat to take and get mail and to employ young Oliver for packer.

Projecting ledge half way up Honaker Trail is called the Home.

Wednesday, August 3, 1921.

Staid in camp all day.

Thursday, August 4, 1921.

Sketch

Honaker Trail to 54. Rocks appear to lie in a horizontal position. Gravel bars are indicated. Talus is at base of cliffs at most places.

54. A thrust fault with a hode of 15 to 20° to east and an upthrust of about 3 feet is revealed at base of cliff on north side of stream. The apparent direction is N - S. The same fault is on south side of stream and can be followed with eye as far as 100 feet above stream. Displacement there is between 1 and 2 feet. On north side it can be observed as high as 75 feet above stream.

55. At mouth of Box Canyon there is a boulder bar 225' wide and a little longer. The highest part, which is near the exit of the canyon, is 25 to 30' above water. Boulders are as much as 6 feet in their longest dimension and corners are somewhat rounded. Small rock fragments are also present. Similar, though much

smaller, bars are farther east. The larger ones form rapids in river.

About 200 feet below canyon on northwest side of stream there is a second thrust fault. Hode is 15° up stream and thrust from upstream side is 2½ to 3 feet. It apparently does not extend more than 50 feet above river. It was not seen on south side of river. Slickenslides trend N 40° W magnetic. Rocks shattered somewhat next to fault.

56. Boulder bar at mouth of canyon is made up of boulders as much as 10 feet in their longest dimension. Bar has pushed stream to northwest forming a rapid.

C. L. Christensen, Moab, Utah, buys and sells Navajo rugs!

57. From Honaker Trail to 57 rocks appear to dip with descent to stream so that crest of anticline is at or near the trail. From 56 to 57 talus slopes extend to water and rock ledges are exposed at water's edge at very few places. At and near 57 there are 3 or more small box canyons with boulders at their mouths.

58. Box Canyon. Boulder bar extends 2/3 distance across bottom of canyon and is 200 to 250 feet wide. Largest boulder is about 10 ft. in longest dimension. A break in 2 rocks with hode of 20° up stream is at mouth of canyon. Amount and direction of displacement could not be determined but amount is apparently small. Rapid here is very swift and river is probably about 75' wide.

59. A box canyon and boulder bar similar to those at 58.

60. Between 60 and Honaker Trail rocks appear to dip down stream with about the same dip as the descent of the

stream. Rock ledges come to water's edge at very few places. At most places there are talus slopes.

Just below 59 is a bar worked by Dulin and Grant Elliot in 1894. Nephi Claim was name at time. 3,000 in 30 days taken out. Greatest production of any bar along San Juan. Gold recovered from sand and clay among angular rocks.

From 60 to 61 rock ledges extend to water's edge tho through much of distance on south side they do not lie horizontal but are slightly warped. The highest fold is not more than a few feet. On right bank of river there is talus.

Sketch

62 rock ledges on right bank. Talus on most of left bank.

63

Sketch of a bad rapids.

64 Bar of boulders, rock fragments, and cobbles.

65 Box canyon to north. Boulder bar at mouth about

250' wide. Stream south of bar is apparently not more than 50' wide. Here is the worst rapid I have seen. A big concealed boulder is in middle of stream in lower part of rapid.

66 Heavy ledges of cherty, dove-colored, fine-grained ls. are at water's edge for half a mile on right bank except at boulder bar; 15 feet of them are above water at bar. About 1/8 mile to southwest they pass beneath water surface. These beds appeared above water about 60.

67 A very small box canyon with a boulder bar at its mouth. Rapids at its side. Limestone boulders here and limestone ledges upstream from here show grooves that have been eroded by sand and water.

68 Small narrow box canyon with a talus slope but no bar at its mouth. From 67 to 68 limestone ledges are parallel with water surface and occur over much of distance.

Friday, August 5, 1921.

About $\frac{1}{2}$ mile below camp we saw a mountain sheep across river from us on left bank. Christensen started down stream in a run to boat for gun. Sheep started up stream and Blake, who was up stream from us, was unable to head him off. The sheep therefore got away but Christensen did not know it until after he ran three miles down stream and one mile back where I met him.

From 68 to 69 there are frequent cliffs of limestone at water's edge. Elsewhere there are bars and talus slopes to water's edge.

At 69 there are several large limestone boulders that have fallen from cliff. The largest is 60 feet long.

69 to 70 Talus and bars on right bank. Cliffs of DeChelly sandstone may be seen above canyon at both ends of this long stretch.

Sketch

Across river from 70 there is a narrow box canyon with a small boulder bar at its mouth. The bar is sufficiently large to form a rapids.

71. Box canyon, boulder bar and rapids. Rapids long and rough.

Sketch

72 John's Canyon is a hanging valley whose mouth is 60 to 75 feet above river. No water coming from it today. Fall has carved an illiptical basin 70x100' in which clear water stands. A gray cross-bedded fine-grained sandstone thick about 35 feet below base of heavy Pink bed.

Section just north of mouth of John's Canyon
Pink bed at Honaker Trail.

20' massive fossiliferous ls. gray.
20' drab fine-grained ls. sandy.
30' gray cross-bedded shaly ss.
1'+ shaly earthy gray fossiliferous ls.

73 The pink bed of the Honaker trail section reaches the water surface here.

Before Bert Loper reached A from B a bed in his boat jumped into water, but he recovered it in an instant. At A he joined second boat. Loper and Trimble got in first boat, Hyde and Allen got in second boat with Loper rowing and Trimble holding rope to second boat. Loper headed the boats from bank to near mid stream, but before he got very far out an ore lock broke. Yet the party went through the rapids at a fast rate. The second boat struck a boulder and began leaking and it missed the cliff by about a foot. By the time the boats reached the first landing below, the second boat had become well filled with water. The boulder had cracked the boat on one side for its entire length. The beds and food were unloaded, the water bailed out and the boat repaired. We then ate lunch and soon thereafter went to the pot hole at the mouth of John's Canyon and went in swimming in clear water.

From 70 to 74 Cliffs extend to water's edge over much of the distance and the bars are therefore comparatively small in number and size.

Saturday, August 6, 1921.

G Goodridge
M Moencopi
D DeChelly

Sketch

75 Canyon with hanging valley is 100 feet high. Boulder bed extends most way across stream forming worst rapids I have seen thus far.

76 Box canyons on opposite sides of stream. Each has a boulder bar. Largest boulder 14 feet long. A spring charged with H_2S has a fairly strong flow. Would fill 43 in pipe. The odor of the H_2S is perceptible for many feet from the spring. The spring issues at edge of sand bar from base of a shaly limestone with nodules of black flint. This ls. bed is 15 feet thick and is overlain by projecting cliff of massive compact dove-colored limestone. Blocks of this ls. have fallen from the cliff and water emerges from around them.

77 Canyon with hanging valley. About 150 feet above river. Boulder bar at base of cliff. Just west of mouth of this canyon there is a thrust fault on north side of river. Fault plan dips 10^{o} up stream and displacement as indicated by a bed of chert at base of cliff is 2 inches. It is in a heavy cherty limestone about 50 feet thick and could not be detected above the top of

this bed. No slickensides could be found. Fault does not occur on opposite side of river.

78 Canyon with hanging valley 125 feet high. Boulder bar forms rapids. The heavy cherty limestone that forms the crest of the Hron at Honaker Trail goes under water here. It contains a bed of gray, fine-grained, cross-bedded sandstone about 3 feet thick near top. This same sandstone was seen at Honaker Trail. The heavy chert bed that is so prominent in and near Soda Basin and Honaker Trail is also present here, but I have not seen in this vicinity any exposures of it that are brown.

79 Canyon with hanging valley 60 feet high. Boulder bar at mouth is 400 feet wide from inner side of bowl at foot of falls. Rapids here.

80 Box canyon with bar and rapids at mouth. Hanging valley 20 feet high.

81 Canyon, boulder bar and rough short rapids. The lower limestone of the quadruple limestone beds passes beneath water here. It is overlain and underlain by sandstone at Honaker Trail. Sandstone above the lowest quadruple bed is 7 feet thick. Rapids 3 ft. high. Saw two mountain sheep just below canyon. Loper and Blake unloaded boats on boulder bar above rapids. Loper ran boats through rapids in fine fashion, not taking more than 2 or 3 gallons of water in each boat. Christensen, Blake, Loper and I carried outfit across bar and reloaded boats.

82 Box canyon, boulder bar and rapids.

83 to 84 There are numerous oil seeps at edge of river on right bank from mouth of Slick Horn to a point $\frac{1}{4}$ mi. east of right angle bend, the total distance being $1\frac{1}{4}$ miles. The oil is a brown liquid that flows easily. Bubbles of it come up through water and on reaching sur-

face break and the oil spreads as thin films on the surface. The odor of petroleum is strong in this vicinity. We did not detect the odor of gasoline as we did at the Honaker seep. The oil comes up as bubbles in water, as minuted streams from ss., ls., sand and gravel. The ss. and ls. are not in place but are loose boulders embedded in sand and gravel. The residue of the oil is a black asphaltic substance.

At bend of river $\frac{1}{4}$ mi. west of 83 underneath a narrow cliff on right bank I found a cliff dweller clay jar that would hold about 3 quarts. Allen and I went to the place late in the afternoon and found grains of corn, a burnt corn cob and a partly made bed of charcoal several inches thick.

About 3/4 mi. south of mouth of Slick Horn Canyon there is a normal fault with a trend of about E-NE (magnetic) with a vertical hade and a downthrow of 4 ft. on east side. Fault is visible on both sides of river.

Russian thistle was used for mattress and served well.

Sunday, August 7, 1921.

River rose about $1\frac{1}{2}$ ft. in afternoon but was down again next morning. It is 7 ft. lower than high stage of trip.

Moencopi formation. Thickness as measured by hand level near trail to mouth of Slick Horn Canyon is 380 ft. Composed largely of sandy bed of shale; rest is red shaly ss. There are no heavy clear beds of ss. in formation here as at and near Mexican Hat. Sandstone (gray and brown) at base of formation contains ls. pebbles 1 inch or more in their longest dimension.

DeChelly sandstone. The thickness of the ss. capping the mesas in the vicinity of Slick Horn Canyon is about 400 ft. Sandstone is brown, heavy bedded, and cross-bedded. Edges of ourcrops are sheer cliffs. No sharp

break between DeChelly and Moencopi is apparent. In fact thin layers of red shale continue 10 feet up into DeChelly. On freshly fractured surfaces the color of the sandstone is cream to brown.

Section of Goodridge formation at mouth of Slick Horn Canyon.

Sketches

25' Red sandy shales, red shaly ss. & gray & black sh. yellow, cross-bedded in lower part. The ss. in this bed is apparently source of oil for there are no seeps except where it comes down to or below water level. Ss. is above water level at the seeps nearest Slick Horn.

No gold mined below mouth of Slick Horn Canyon. Al Rogers and Bill Clark mined gold above boulder bar at mouth of canyon in 1890. Gold in paying quantities not found down stream; prospecting done there.

Many years ago Mr. Goodridge dug a shaft at the mouth of Slick Horn to get oil. It is said shaft was half filled with oil. We did not find shaft. He brought an engine and other machinery for drilling, but when he got within a stone's throw of the drilling locality the engine broke loose from rope or something else happened so that engine rolled about 50 feet down mountain side to base. The engine was of course broken and it was never reparied.

A boulder bar some 400 ft. wide at mouth of Slick Horn Canyon.

Monday, August 8, 1921.

Sketch

Fall of last half mile of Slick Horn Canyon is 150ft.

83. Boulders of ss. and ls. as much as 40' long have fallen from cliffs on both sides on to slopes and into river forming narrow rapids.

Goodridge formation at mouth of Grand Gulch runs about 75 ft. above river. Water fall at mouth of Grand Gulch about 50 feet high.

Along south course of river below Grand Gulch the strata lie about horizontal.

84. Box canyon, hanging valley and boulder bar and rapids.

Oaks plentiful below mouth of Grand Gulch.
Hick berry
Virginia Creeper
Poison oak

Light showers of rain fell in forenoon and between sundown and dark. River rose a little early in morning of August 9.

Tuesday, August 9, 1921.

85. In this bend there is a high sand bar about 400' wide and much longer. Mountain sheep live on grasses and shrubs on it and on nearby slopes.

The Moencopi disappears just above mouth of Buckhorn Canyon, a box canyon in the DeChelly sandstone. From Buckhorn Canyon to where Goodridge goes under there are very few ledges next to the water. Large boulders have fallen from cliffs in this stretch.

Saw 2 mountain sheet 9 a.m.

86. Canyon discharging red flood over falls 25' high at lowest place. The ascent of canyon could not be seen. This may be Moonlight Creek. The DeChelly dips about 1° W. above mouth of Moonlight. Below mouth of Moonlight the DeChelly dips between $\frac{1}{2}^{\circ}$ and 1° upstream and sheer cliffs rise from water.

87. Crushed zone in DeChelly ss. May be a fault. Zone shows on both sides of river and runs about N-S.

Some beds in DeChelly as much as 20 ft. thick. Cross-bedding was found to be 18°.

88. Fault with trend of N. 10-20 E. Hade 75° to E.

Displacement as shown by heavy-bedded ss. is at least 10 feet on east side. Rocks here are horizontal

Sketch

Cross-bedding L in DeChelly ss. 19°.

Cliffs near and below Moonlight Creek are at least 600 feet high.

We all to in boats from mouth of Moonlight Creek to 89. The sheer cliffs extended to water's edge except at the sand bars which are as much as 300 feet wide and $\frac{1}{4}$ mile long.

90 A box crevice with very small flowing stream. Sand bar at mouth.

Red sandy shale occurs as several beds in DeChelly. Such beds are as much as 4 feet thick.

Loper, Allen, Trimble and I were in our boat going down stream. At 3:10 we were going sidewise in shallow water. Boat hit high but small sand bar and over balanced all except Allen. Boat turned to angle of 45°, but we soon arighted ourselves before boat took water. Nothing got wet.

Between mouth of Moonlight Creek and 91 there are large sand bars. Some of the bars are partly submerged and some are covered with only a few inches of water.

It takes a good boatman to pick the deep water channels.

We had to travel in boats most of day on account of the sheer cliffs rising from the edges of the water. We were lucky to pass through the canyon by 6 o'clock when we found a camping place. We went between 9 and 10 miles during the day. If the river had been up 1 foot more there would have been difficulty in getting stations on sand bars that were used most of the time. Then if it had been a little higher the sand waves would have been large enough to fill boats with water.

Wednesday, August 10, 1921.

92 Box canyon whose walls are formed by Chinle. Fragments of granular gypsum on surface. It occurs as thin veins. There appears to be one bed of it 2 feet thick high in bluff. Fragments of silicified fossil wood occur at places on surface south of this locality.

Section of DeChelly ss. at Clay Hills Crossing.

Sketch

4' Brown and gray ss.
1' Brown ss.
1½' Gray compact shaly ls.
18' Red sandy shale and some red ss.
3' Gray ss.
12' Red ss. and red sandy shale.
3' Sandy brown shale.
3' ss. like 7-foot bed.
4' Sandy brown shale.
7' Massive brown hard ss.
Gray cross-bedded ss.

Sketch

Sketch

Thrusday, August 11, 1921.

Bert Loper and I took a light pack on our backs and walked 20 miles to Red House. I sketched geology on way. We found no water until we had reached the deserted stone house. There we found two ponds that had been filled with recent rain water and the red mud had not completely settled. Hundreds of tad poles in ponds but water tasted good just the same as we were very thirsty. My tongue had been sticking to the roof of my mouth for more than an hour before we reached water. We slept just outside the house.

Friday, August 12, 1921.

The Chinle formation is composed of 3 subdivisions or units of apparently equal thickness.

1. Lowest . Red sandy shales and some red shaly ss., evenly bedded; weathers into fluted cliffs. Shales predominate.
2. Middle. Red shales, less sandy than those below. Contain beds of brown earthy thin-bedded to massive ss.
3. Top. Lavender, pink, red, yellow, green and gray shales, black chocolate brown.

Fragments of fossil wood seen as far north as Red House. Some fragments are from trees that were 18 in. in diameter.

Sketch

Mormon road built in 1880 by Mormons who traveled from Hole in the Rock to Bluff to settle that place.

Flood of Oct. 1911 reached height of 50' at places. Water has not been as high at any other time within

memory of white people who settled the San Juan about 1880. Road used for only few years thereafter. Send Bert Lober 2 each of Clay Hill Pass pictures.

Sketch.

Friday, August 12, 1921.

Bert Loper and I walked across desert from Red House to camp at Clay Hill Crossing via Clay Hill Pass, a distance of a little more than 25 miles. We filled our canteens at Red House and did not reach more water until we arrived at camp. Needless to say we got very dry, but not so dry as on Thursday.

The dip of the Chinle in Clay Hill Pass is 2° to W.

Bert Loper mined 20 oz. of gold at Mendenhall Cabin the next year after Mendenhall and others quit mining. He used copper plates and quicksilver. Light shower fell about noon.

Saturday, August 13, 1921.

Loper, Christensen and I moved camp about 2½ miles down stream to the mouth of a small canyon where there is a willow thicket. I stayed in camp all day; washed my clothes; mended my shoes and did odd jobs. I needed the rest as I had been on the move every day since we left Honaker Trail.

A rather heavy shower fell just about dark.

First mosquitos of season. Numerous. Molested us at night although we slept on bench above willows.

Sunday, August 14, 1921.

Gold mining from Slick Horn to Mendenhall began in 1903 and continued for several years. Some mining done across river from Mexican Hat.

Honaker Trail built in 1904 by prospectors along river. Gold ground ran from 50¢ to $10 per cu. yd. Very little wash gravel. Mostly with angular ls. rock. Rockers and amalgamaters used. Very little sluicing. Only hand machinery. Mining began up as far as mouth of Chinle.

Mining done by a dozen or more companies, partnerships and individuals.

Mining from Clay Hill Crossing to Zahns Camp began in 1902 and continued for several years.

Bert Loper and I got in boat at camp near Slick Horn Crossing in afternoon and went down river almost to mouth of Copper Canyon where we camped over night. The river was shallow at numerous places so that we had to wade and pull or push boat. A heavy rain storm fell in Copper Canyon about dark and some of the north edge of it fell on us

Monday, August 15, 1921.

A heavy rain storm fell in Copper Canyon about 1:30 am. and a light shower from it hit us. About daybreak a 3rd rain storm hit the same canyon and we got a few sprinkles. At 7:30 a.m. a fourth rain storm hit Copper Canyon and we were in the edge of it. The combined fall of the four rains in Copper Canyon must have been at least several inches.

We towed boat upstream all day, going a distance of 7 or 8 miles. The cliffs, willow thickets, and rising river made towing very difficult. We had to cross river 7 times during day on account of cliffs.

We camped by river at night. Mosquitoes were thick. River rose several inches during night and fell some 15 or 18 inches by morning.

Tuesday, August 16, 1921.

We towed boat to camp, a distance of 5 or 6 miles, reaching there about 1:45 p.m. Towing easier than day before.

Wednesday, August 17, 1921.

I studied gravels east and northeast of camp below Clay Hill Crossing.

The gravels cap hills almost as far east as the mouth of Moonlight Creek. They generally overlie the red sandy shales of the Chinle, but a few patches apparently rest upon the uppermost bed of the DeChelly. The gravels that are farthest east are in a shallow syncline which extends south from the vincinity of Clay Hill Pass across San Juan River. Not only do the uppermost beds in the DeChelly occur in the syncline, but also some of the lower beds of the Chinle. No gravels could be seen north of San Juan River and I have attempted to map largest areas in syncline south of river. The gravels in the syncline are exactly like those near camp, both in the kind, size and shape of the pebbles, and in the calcareous cementing material. The gravels in the syncline are as high as 600 feet (estimate) above San Juan River.

Thursday, August 18, 1921.

Moved camp to Piute Farms (abandoned) in forenoon. In afternoon mapped geologic formations northeast of camp.

Mosquitoes bad at camp. Built 7 fires with cow chips to make smoke bowage. Bowage was effective until wind blew it in wrong direction. Wind storm with sand late in night. Later there was light sprinkle of rain.

Friday, August 19, 1921.

Mapped rocks between Piute farms and Clay Hill Crossing. These gravels are from less than 20 to more than 300 feet above river. They occur mostly in gently sloping terraces but these are connected at places over fairly steep slopes. The gravel areas, both high and low, are of same character. Beds are generally 10 feet or less thick, but at places are 15 feet or more. They overlie at practically all places the Chinle formation. The pebbles are cemented over much of the area by earthy calcium carbonate which is concentrically banded around pebbles. Many shells of this carbonate occur on surface and resemble in appearance shallow cups. The pebbles range in size from a small fraction of an inch to 1 foot in diameter with the largest near the base of the beds and the smallest near the top. The usual size is probably 1 to 3 inches in diameter. All are well rounded and are generally flattened. The kinds of rocks represented include limestone, chert, quartzite, sandstone, conglomerate, and numerous kinds of igneous rocks. The limestone is obviously from the Goodridge formation and the limestone pebbles may have been the source of the calcium carbonate that has formed a cementing material at many places.

Wesley Oliver, packer, arrived late in afternoon with mail and provisions.

Saturday, August 20, 1921.

Rain began to fall about 3 a.m. and continued until about noon. Stayed in camp in forenoon.

Chert pebbles, fragments of silicified wood are common in terrace gravels. Hematite pebbles are common near base.

Rain storm with considerable rain came up about 6 p.m. Rain fell good part of night. At 11 p. m. we moved bed to top of mesa 80 feet high mi. south of camp to get away from mosquitoes.

Sunday, August 21, 1921.

Stayed in camp all day. Rain fell most of morning and until 1 p.m. One hard shower fell. Aggregate fall

probably one inch. In afternoon we dried bedding. Loper, Blake, Hyde, Christensen and I made pup tents for our bed in torps. Rain fell late in night.

Monday, August 22, 1921.

Light rain fell early in morning. River rose 1 foot or more during night. Pup tents were a success in keeping out rain and mosquitoes.

Stayed in camp in forenoon. In afternoon I took compass bearings on the points of the Mesa of Wingate ss. south of camp.

During afternoon river rose about 2 ft. and changed its channel from near middle to south bank. Earth from caving banks sank one boat and nearly sank the other. The ores and one ore lock were lost during flood. Stream here, according to Mr. Trimble, is 3,300 feet wide. We believe the high stage of the flood in the canyon was probably 35 feet above low water.

Tuesday, August 23, 1921.

River had run down probably 6 inches by 6 a.m.

Organ Rock to south end of Wingate Cliff east of Copper Canyon S 38 W

Sketch

Left camp 6:40 a.m. Arrived Organ Rock 11 a.m. ahead of approaching storm from SW. Took pictures of Organ Rock Rock is 375 feet high and rises that distance above base of Chinle. The lowest beds of the Chinle forming the rock are brown fine-grained earthy sandstones, and brown sandy shales in nearly equal proportions. Area of Chinle

here is 1,000 to 1,200 feet long. Trends S 200 W. Four very small areas are just northeast of rock. Dip is 1° to W. at rock.

Sketch

Rocks in Chinle dip 1° S. This area is therefore end of anticline.

I went due east of Organ Rock a distance of 26 mi. The north end of Train Rock is estimated to be 2.4 mi. farther east than I went. I passed over uppermost beds of DeChelly entire distance. From 2 to 3 mi. east of Organ Rock there is a large bowlder area. Boulders are blocks of sandstone as much as 100 feet long and 25 to 30 ft. high that have weathered out of a heavy bed near top of sandstone. The sandstone from a point about 2 mi. east of Organ Rock to Train Rock dips a few degrees to east. Train Rock is in bottom of the same syncline that runs north near the mouth of Moonlight Creek. The syncline seems to be wider here than farther north. The engine with cow catcher, smoke stack, bell and cab is at north end of Train Rock. This rock is a narrow mesa composed of the Chinle formation with red shaly beds in lower half of slope and heavy sandstone (somewhat gray at distance) and some red beds in upper half. Red beds are on top. This sandstone appears to be 200 feet or more thick and is almost certainly the same bed that appears in the lower third of the Chinle south of the Piute Forms. In fact this sandstone does not occur at Piute Forms, but appears a few miles to the south gradually increasing in thickness. It forms a prominent band in the Chinle Cliffs and its color is gray.

On my return to Organ Rock I could see clearly from elevated ground the mesas of Chinle to the southwest, south, and southeast. There is no question about the sandstone in Train Rock being a part of the Chinle.

Organ Rock is in a shallow syncline with a northward trend. All of the beds in it are below the gray cliff-maker that is in Train Rock, though this cliff-maker would be only a short distance above the top of the rock if it had not been eroded.

A light sprinkle of rain fell on me between 1:30 and 2:30 p.m. and a second one fell at 4 p.m. Heavy thunder showers passed around both times. Another sprinkle at 5 p.m.; the heavy shower passed to west of me. At 8 p.m. a heavy downpour at camp for about half an hour.

Wednesday, August 24, 1921.

Sand Hill east of Piute Forms is covered with fine to coarse brown wind-blown sand which has concealed not only the gravels but also the Chinle on the crest and upper slopes. There are, however, a few exposures of scattered pebbles especially on the slopes.

Sketch.

Thursday, August 25, 1921.

Some time after midnight there was a heavy rain. One shower at 4:30; another at 7:30 a.m. River rose about 2 feet by morning. We had planned to move camp down stream today, but could not do so on account of river. Party worked down stream from present camp.

Sketch.

On both sides of river at 95 there is a bed of gypsum about 2 ft. thick at base of middle unit of Chinle. The brown shales between this bed and the ss. beds in this unit contain numerous seams and veins of gypsum up to 1 inch thick.

96. Sandy area 5 to 10 ft. above river. Trees, bushes, and Russian thistle on it. Drift wood indicates that it has been flooded. Four very small patches of gravel.

97. Sand Bar.

98. Heavy gray ss. at top of middle unit of Chinle is about 50 feet thick. Within few feet of base there

is a 6-foot bed of conglomerate with pebbles of white quartz, gray and black chert and earthy sandstone, and silicified wood up to 2 in. in diameter, in earthy sandy matrix. Sandstones in this division are ripple-marked. The size of the ripples are such as I find along river both close and far apart, 1-4 inches, and indicate shallow water conditions during deposition of sand. Parts of logs of fossil wood with conglomerate.

99. Small patch of gravel on end of point 4200' (aneroid).

100. Patch of gravel 4370 (aneroid) on top of middle unit of Chinle. Calcareous concentric shales on surface here and at 99.

101. Point of rock just north of first long canyon on west of Piute Forms. Patch of gravel here at same elevation as 99. Lining cups also present.

Sketch

Friday, August 26, 1921.

Moved camp today. Bert Loper took one boat and Blake took the other. River still running full but lower than on morning of Aug. 25. Much drift going down after boats got started as if river is rising.

Sketch

102. Gravel on bench formed by conglomerate in bed of Chinle; a little lower than 99 and 101.

103. Few very small patches of gravel on top of cliff at 3900' (aneroid) 3890 (aneroid) top of cliff; 3830 base of conglomerate member of Chinle. Thickness 60 ft. This thickness consists entirely of coarse cross-bedded sandstone with pebble bed and abundant fossil logs at base. The conglomerate is lenticular.

Section between 104 and 105.

4840
3975
865 Variegated shales of Chinle
4840 top of Chinle and base of Wingate
3975 top of green shales with thin layers of ss. These grade into overlying green shales with no ss.
3820 (aneroid) elevation of stream
Sketch of unconformity in Chinle at 104

The variegated shales of the Chinle contain a comparatively small amount of silicified wood. They contain some brown conglomerate which was presumably calcareous before weathering. They contain very little ss. Calcareous concretions with surface are numerous. The shales have weathered in their exposures to a stiff clay that becomes very hard on drying so that climbing over steep slopes is difficult and dangerous.

Rough sketch showing relative position of areas of Wingate ss. near Clay Hill Crossing and Piute Farms.

Sketch

The above measurements, which should be checked in the office by more careful plotting, show that the Wingate ss. capping the mesa west of Clay Gulch is 900 ft. thick. The entire thickness has the same color. Lower 3/5 is cut by numerous joints and falls from cliffs in huge blocks leaving smooth faces on cliffs which are largely a very dark brown. The upper 2/5 is also cut by joints but weathers into more or less rounded surfaces and alcoves. The cross-bedding in it is very conspicuous.

103. Patches of gravel extend downstream to end of sand bar on west side. Landslides from either side have partly bound gravel areas.

106. Top of sandstone cliff just south of mouth of Clay Gulch.

Stayed in camp in afternoon; did washing, shaved and took bath.

Late in afternoon Mr. Gerdine of the U.S.G.S. and Mr. Schanks of the Edison Co. arrived with Oliver's pack train from Bluff. They brought mail and small quantity of provisions.

Sunday, August 28, 1921.

Gerdine, Schank and Oliver left for Bluff early in morning.

Moved camp in forenoon to near mouth of Copper Canyon.

Stayed with camp entire day.

Monday, August 29, 1921.

Elevation of river at camp 3750 (aneroid)
" " base of Wingate east of camp 4880 (aneroid)

Sketch

Blake reports the occurrence of a 4-foot bed of gypsum on the lower part of the Chinle North of Piute Farms.

Trimble and others report the occurrence of a log 3½ to 4 ft. in diameter on Clay Gulch about 2 mi. above its mouth.

Sketch

Two boulder fans in stream flat north of mouth of Copper Canyon. Composed of ss. boulders up to 9 ft. in longest dimension. Most common size 2 ft. in longest dimension. Slope of fans between 2 to 5°.

Tuesday, August 30, 1921.

Stayed in camp entire day, writing letters, except late in afternoon when I panned some sand from a gold prospect. Sand at this prospect is mixed with ss. fragments and boulders. It and the boulders are in a landslide that has come from Wingate ss. cliff to east. Block sand found but no gold.

Wednesday, August 31, 1921.

Sketch

a. Reddish brown ss. cross-bedded, fine-grained. Less massive than beds above and below and much of it is shaly. The thickest shaly bed is at top where there is a narrow bench with oaks, cottonwoods and cedars at places. There is a small spring where I climbed point. Seeps at other places and many on this bend.

107. Stream runs S 40° E parallel with strike. LaPlat dips 20° N E. Ss. near middle of LaPlata has a lavender cast.

The highest beds on the crest of the mesa on the Nokai anticline N. of San Juan are the lavender tinted beds of the Wingate. The sandstone here lies flat, but to the N. W. and W. of 108 they dip about 5° S. W. for many miles The N.W. extent of Copper syncline is not known, but it extends for 10 miles or more beyond my traverse. The youngest beds in it are described in the section on p.69.

Sketch

Red unit of La Plata at and near 108 support many cedars. The light brown beds above it to west and east are cut by many canyons and gulches and support very few cedars; country where they occur is very rough, sandstone weathering into domes; sandstone exposed practically every where; very little soil. Country falls off west of 108 but rises near canyon to W. and N.W. It also falls off to E. and N. E. but rises gradually from Copper Syncline to east edge of La Plata escarpment. The plateau west of 108 is like that to south across San Juan except there is a level plateau as indicated on sketch map.

109 A dripping spring with enough flow to fill a 2-

inch pipe issues on cliff about 25 feet above stream. Beds here are interbedded variegated shales and limestone at top of Chinle. Beds dip few degrees down stream Water is cool and tastes O.K.; like soft water. 1461 paces (1.46 mi.) distance. I was on stream above spring.

Sketch

Thursday, September 1, 1921.

110 Fan of ss. boulders, sand and fine rock fragments overlying bed rock which is exposed at places.

111 Stream silt.

112 Stream gravel. East part of gravel area is overlain by clay, sand, and boulders of rock slide.

113 Fan of ss. boulders, sand, fine rock fragments.

114 Gold prospect. Small cut apparently made by hydraulicking in ss. fragments and sand of rock slide. Pump, pipe and ruins of stone boulder remain. This is the place where I got a sample for panning on Aug. 30.

115

Sketch

116 Rock walls of cyanide plant, fine shavings and can of cyainde still here.

117 Gold prospect. Shallow pits in gravel. Other pit pits are scattered over gravel area.

I looked at apparent high terrace gravel S.W. of Clay Gulch with field glass at a distance of about 1 mi. The glass shows angular fragments of gray rock and also a bed of it. I doubt the existence of gravel there.

118 Gravels overlain by landslide material.
119 Few feet of gravels overlie a sandy loam.
120 Gravels partly concealed by landslide material.
121 " " " " " "
122 Gold prospect. Shallow pits in gravel. At first visit upright boiler was on bank. Before second visit it had fallen into river on account of bank being bedded.
123 Pebbles here and elsewhere in the vicinity have been cemented by calcareous material like that near Piute Farms and Clay Hill Crossing.

123. 4170 top of ss. beds in green and red shales.
4070 base of green and red shales with thin-bedded and shaly sandstone in upper half.

Mouth of Copper Canyon.
Dip of conglomerate member of Chinle is 2° N. W. (mag.)

Sketch

Friday, September 2, 1921.
Provisions almost exhausted; for breakfast coffee, cream of wheat and corn bread; for lunch 2 biscuits.
Mouth of Copper Canyon. Conglomerate ss. member of Chinle forms box canyon here and also on San Juan it extends to bottom of canyon and how much farther I do not know.

124 Channel 10 ft. deep and 120 ft. long and 30 ft. wide in sandstone. Sandstone on bottom.
Buried Canyon near mouth of Copper Canyon. This is buried by an old landslide of ss. (now largely sand) that apparently came from east. A ridge of the material extends across lowe part of canyon and has diverted drainage through rock channel at 124. Canyon is filled with sand and ss. fragments to within few feet of tops of walls between the dam and the locality where it passes out of sight beneath the landslide material at the S.E. end. Tops of canyon walls are about 100 ft. apart at spot just before they pass beneath landslide to S. E. A little water to N. W. The bottom of canyon where it emerges from beneath fill at N. W. end is about 50 ft. below tops of canyon walls. Slide that dammed canyon is very old as most of the ss. has weathered to sand. Younger slides at S. E. end of canyon still composed largely of ss. fragments.
125 Old landslide has filled canyon. Depth at lower end about 2/3 height of main canyon wall.
126 Landslide of variegated clays, sand and ss. have filled canyon which at lower end is a little lower in elevation than bottom of filled canyon to S. Drainage has eroded some of the material. Uneroded landslide material is still clinging to nich in wall on S. E. side below main body of L. S. The trend of the canyon where seen is same as that of ravine in landslide.
127 The bottom of the filled canyon here is a little higher than it is at 125.
128 Bottom of filled canyon about same elevation as that of 127. Filling material is sand and sandstone fragments and boulders.
129 Filled channel 15 to 20 feet deep.
130 Fairly wide channel about 30 feet deep filled wit with recent landslide.
I went 2 mi. upstream beyond Mr. Trimble's 3900 ft. contour and there found the cream colored cross-bedded

ss. of Train Rock coming up in stream bottom. I went $\frac{3}{4}$ mi. farther and found underlying beds. The following section is here revealed

Sketch

Conglomerate ss. member of Chine in Copper Canyon contains numerous lenses of congl. with quartz and quartzite pebbles up to 2" in diameter and contains numerous logs and parts of logs especially near base. Logs have been silicified in part and carbonized in part. It is reported that copper minerals including Copper malchite and azurite occur at base of ss. and members of the party have seen specimens that are said to have been found in the canyon. No mining has been done and I saw no openings on the cliffs as far as I went to south.

I took picture of rock composed of cream-colored ss. member of Chinle. On it was painted with black point the following sign

5
ZAHN BROS IN FRANKLIN CAR
LOS ANGELES TO SAN JUAN RIVER
FIRST AUTO THROUGH THIS CANYON

SEPT. 14,
1915.

This rock is about 6 mi. S.E. of mouth of canyon.

Wesley Oliver arrived in afternoon with mail and provisions.

Saturday, September 3, 1921.

Moved camp in morning and spent large part of day repairing shoes.

4200 elev. of flat 1 mi. N. of mouth of Nokai.

Scouted down stream in afternoon to find next camping places

Sunday, September 4, 1921.

Spent entire day in camp doing washing, repairing shoes & resting

Monday, September 5, 1921.

131 Ss. in green shale from crest of this hill.

132 This ridge is composed of ss. fragments and boulders and chert fragments of landslide origin and much of surface is covered with wind-blown sand.

133 Small hill composed of sand, clay, ls. and ss; this is a landslide remnant.

The conglomeratic ss. member of Chinle consists of 2 parts - or halves. The lower half is a pebbly cross-bedded ss. with fossil wood; it forms canyon walls. The upper half 100 ft. thick, grades into lower half; it consists of ss. cross-bedded with shale. Ss. is massive and shaly. Shale is mostly green but some is red.

Tuesday, September 6, 1921.

Sketch

Balance Rock, $\frac{1}{2}$ mi. N. of mouth of Nokai, is an outlier of the cream-colored ss. of the Chinle, 30' long, 25' high and 15' wide, on base of sandy red and gray crumbling sh. 5' high, 8' long and 4' wide. The base is so weak and small for the rock that it is difficult to understand how the rock is still resting on such a base.

De Chelly on east side of 3850

3800 - water level

7. Bottom 5-8 - massive crossbedded cream colored & buff ss. with 2 beds aggregating 3' thick of brown sandy shale near top.

Dip of De Chelly on east side of Nokai anticline is 9° upstream. Dip of this ss. on west side of anticline is 4° downstream.

6. 24', brown sandy shale and brown shaly ss. 1 or 2 thin beds of ls.
5 4' massive gray ss.
4 5' brown sandy shale
3 6' massive gray ss.
2 45' brown sandy shale & brown shaly ss. A bed of gray ls. 1' or more thick near top.
Top 1 5' heavy gray ss.
Red shaly ss. and sandy shales of Chinle.

Just below the mouth of Nokai there is a fault in the pebbly ss. member of the Chinle and underlying beds. A sketch of it is as follows:

Sketch

Sketch showing relation of beds on right bank of San Juan river N. of mouth of Nokai. The dashed E lines may represent the lines of movement that took place during the faulting.

Brown shales with a little brown shaly ss.

Sketch

Notes on river pebbles. The kinds of pebbles include ls. from Goodridge, ss., qtzite, qtzite congl., quartz, various colors of flint, chalcedony & agate, moss agate, arkose, quartz breccia, granites (gray and pink), trachytes schists & gneisses. The ls. & qtzite pebbles are most abundant; all well rounded; agate & flint less rounded than others; coarse-grained granites are probably roundest Most of them tend to a flattened shape.

In level areas all pebbles are dark colored except quartzos and flints which hold their colors. Ls. pebbles generally weathered. Coarse-grained igneous rocks always weathered except on steep slopes where pebbles are freshly exposed.

134 Gravel on hill ½ mi. N. of mouth of Nokai 58' thick Cemented at top and bottom.

Wednesday, September 7, 1921.

Katherine, my baby, 3 years old today.

135 Landslide material consisting of sand, ss. fragments and boulders.

136 Landslide material consisting of sand, ss. fragments and boulders on a vein of gravel.

137 Landslide boulders on shale in place.

138 Gravel on top of low terrace between two shallow gulches.

139 Very old landslide and wash material overlain in one area by stream gravel. Ss. has mostly weathered to sand. Material of same age as that filling the old canyon near mouth of Copper Canyon.

140 This terrace has same elevaton as the larger terrace to the north.

Pebbles on surface ½ mi. N. of mouth of Nokai

No. of pebbles of each kind within a few square feet.

Quartzite	114
Sandstone	5
Schist	5
Porphyry	79
Granitic (granite)	9
Limestone	12
Quartz	14
Flint	20
Conglomerate	2
Gneiss	6
Chalcedony & agate	2

No. of pebbles in area near first count.

Quartzite	159
Sandstone	3
Schist	3
Porphyry	107
Granite	15
Limestone	13
Quartz	4
Flint	10
Conglomerate	3
Gneiss	6
Chalcedony & agate	2

Quartzite, limestone, porphyry, and granite, and conglomerate pebbles are largest.

Thursday, September 8, 1921.

Helped move camp in forenoon.

141 Stream wash consisting of ss., ls. and chert fragments.

N

Sketch

S

Rough sketch showing relative position of areas of Wingate ss. at and near Copper and Nokai canyons.

Friday, September 9, 1921.

I walked up Nokai Creek. I mapped rocks as far as contour map goes and then went a few miles farther. From the crossing of the 3900 foot contour to a locality 2½ miles upstream the pebbly ss. of the Chinle is the rock formation in the bed of the stream and in the walls of the numerous stretches of canyon. At a distance of 2½ miles S. of the 3900-foot contour the red shales beneath the ss. appear.

Two miles S. of 3900-foot contour there is a cliff

dwelling on S. W. slope on right bank of creek. Indians have partly torn walls down to build crude huts. The walls that are left are several feet high and are of two rooms, the larger being 8x12 ft. They are smooth and built of ss. slabs held together by red clay.

I continued in afternoon to a locality 5 miles by stream (about 3½ miles in straight line) above 3900-foot line. From 2½ to 5 miles the pebbly ss. of Chinle forms tops of canyon walls and the shales below it form lower parts of walls.

Sketch

Pebbly ss. at the farthest point S. I reached on Nokai appears to have much the same thickness as it does at the mouth of Nokai.

Saturday, September 10, 1921.

Cream-colored ss. of Chinle in S. side of Canyon S. E. of Gable Camp is 90 ft. thick. Cross-bedding angle of 24° measured. This ss. north of Gable Camp is 60 to 65 feet thick. It is overlain by 55 feet of red sandy shale and shaly red sandstone like that of Organ Rock.

Sketch

5025 (aneroid) highest elevation of top of pebbly ss. S of Gable Camp. Apparently 100 ft. higher on crest of anticline north of Gober Camp.

5005 ft. top of ss. where I climbed down from wagon road into Gable basin; 5 mi. by road from this point to Spencer Camp.

4955 base of ss. at this locality. Thickness of pebbly ss of Chinle is therefore 50 ft. This thickness is of the massive lower bed only. It varies and I believe 50 ft. is the minimum.

4630 ft. top of 55-foot bed on top of cream-colored ss.

Sketch

Sunday, September 11, 1921.

Hector N. Zahn		1902
	U	1903
Los Angeles, California	S	1915
	A	

Sign on rock at Gable Camp.

Mapped rocks in vicinity of Gable Camp.

142 Areas of stream deposits consisting of cherty ls. and ss. boulders and fragments up to 5 ft. in longest dimension of local origin and poorly rounded, and some pebbles (well rounded) of distant origin. The material of local origin was transported to present position by Nokai Creek.

143 This triple-ridge area has level crest. Underlain by terrace material apparently as much as 15 to 20 ft. thick. Material consists in large part of boulders of ss. and ls. from Chinle and ss. from Wingate, but there are many well rounded pebbles and cobbles of quartzite and other rocks of distant origin. Upper few feet cemented by $CaCO_3$. Cups and irregular fragments

of cement are numerous on the surface.

143 Terrace material entirely of local origin base on west slope is 90 ft. below crest and 15 feet below crest on east slope. Dip therefore to west. Thickness between 50 and 60 feet. The material in the next high hill to west is also entirely of local origin. It is roughly assorted and crossbedded in these two heels.

144 Material in this ridge is about 40 feet thick, has local origin and is roughtly assorted.

145 Material of local origin.

Gable Camp worked in 1892 and again in 1902, 1903, and 1915 by Zahn Bros. Camp known as Zahns Camp but named by Zahn Bros., Camp Angeleno.

Area worked over comprises between 2 and 3 acres and includes several areas, the most important of which are indicated on map. The gravels that have been worked are patches of same terrace which slopes a little to west. Gravel is apparently as much as 6 or 8 feet deep, but will probably average not over 5 or 6 feet thick. It consists of well rounded pebbles up to boulders up to 2 feet in longest dimension. Most of pebbles coated with film of $CaCo_3$ though they are not cemented together. Some sand and clay between them.

In mining gravel has been dug to a depth of 1 to 5 ft. Pebbles the size of a person's fist were discarded in cuts. Gravel apparently dug with pick. Some dry screened apparently. At
Method of recovering gold not known. Wood obtained from drifts along river. Machinery consists of boiler, pump, pipes, and riffles.

Sample of concentrates obtained by panning clayey gravelly sand from surface. Gold is flour. Pay streak at and near surface.

Monday, September 12, 1921.

Moved camp downstream from Gable Camp to Spencer Camp.

Cream-colored ss. of Chinle is massive consisting in places of as few as 4 beds. The crossbedding extends clear across each bed.

Gable sandstone lentil is a good name for cream-colored ss. of Chinle. Name from Gable Camp also known as Zahn's Camp and Camp Angeleno. This ss. on Train Rock and vicinity is called De Chelly by Gregory.

Nokai sandstone lentil (name from Nokai Creek) is an excellent name for the pebbly or conglomeratic ss. in the Chinle. This sandstone near Gable Camp and in the vicinity of Train Rock and the head of Nokai Creek is called Shinarump conglomerate by Gregory.

145 Base of Gable sandstone disappears below water at mouth of this canyon and top disappears at a point about midway from either end of sand bar across river from mouth of canyon.

146 A few gravels on low slopes but not enough to map.

Tuesday, September 13, 1921.

Top of this sandstone forms bench.

Sketch

Lavender ss. member of Wingate contains round ss. concretions ½ to 1½ inches in diameter in some layers at places. Two of them collected. I saw white chalcedony mixed in clay 8 inches thick near top. Lenses of compact, gray pure to sandy ls. are common. At one place a bed of thinbedded ls. 2 inches thick was seen capping a mesa.

I climbed with Bert Loper a high mesa north of the San Juan and we climbed a mesa near locality 108. The reef that passes northward past the mouth of Nokai Creek apparently tends as is indicated in the sketch on page 70. The dip flattens to N. W.

6200 top of mesa
3750 elevation of River at Spencer Camp
2450

The flat surfaced mesa west of 108 dips gently to north in south part and dips south in north part. The surface appears to be parallel with bedding of heavy light brown sandstone that overlies the lavender-colored member of the Wingate. The surface of the mesa therefore shows the structure of the rocks.

Sketch

Wednesday, September 14, 1921.

Moved camp early in morning across stream to south bank.

Bert Loper found several well rounded pebbles of hard coal near Gable and Spencer Camp. He thinks they came from Durango.

Heb. Christensen found petrified log 40 feet long north of Spencer Camp.

In middle of afternoon I and others of the party went in river for a swim. Others preceded me into deep water next to south bank. I followed and, after swimming for a short distance with fairly swift current, attempted to reach sand bar a short distance to right, but swift current from sand bar prevented me from making much headway. After I had spent most of my strength I turned and headed downstream with main current but went diagonally for south rocky bank. I soon found myself beneath the surface and I struggled back to the surface. Probably an under current took me down. I then swam as best I could on my back and also face down. I did not stay on top of water so very well but did not get strangled. I regained some of my strength and as I got nearer the south bank I began to touch bottom at places. I caught hold of a large boulder projecting into the river and got out pretty well exhausted, but felt none the worse for the experience after a few minutes. Altogether I floated and swam some 1,000 or 1,200 feet.

P. S. I did pass through one whirl pool.

Thursday, September 15, 1921.

Wrote letters in forenoon. Wesley Oliver, packer, arrived early in afternoon with provisions and mail. How good it is to get new grup and get word from the outside world! In afternoon read mail and finished letters.

Spencer Camp.

This is located on left bank of river at point where Nokai ss. passes below river. There are 2 or 3 small cuts in talus material from the Wingate ss. on slope 50 feet or less above river. Talus material consists of sand, ss. boulders and ss. fragments, all friable. Machinery I saw consists of gasoline engine, a roll and a crusher. Attempt was made to recover fine gold that cannot be obtained by panning but only by assay.

Bert Loper says red shales in Chinle contain as much as cent gold per ton and the gray shales contain a smaller amount.

On west dip slope of Nokai ss. just east of Spencer Camp there are a few small patches of thin gravel deposits, but not sufficient to map. Outliers on north side of river and on this slope are erosion remnants of lower part of variegated shales and remnants of landslides.

Friday, September 16, 1921.

Sketch

Moved camp downstream.

147 Hanging valley from canyon.

148 Base of Wingate 3900 feet (?) above sea level.

149 Base of Wingate here about 50 feet above river. There is a small area of grass and bushes from water to base of cliff as if there is a spring at the base of the sandstone.

From 148 to 149 There are domes and ridges of light brown sandstone on both sides of the river. This sandstone is above lavender sandstone beds and is between 450 and 500 feet thick at places. There are a few alcoves in this sandstone. A cliff dwelling was seen in an alcove (September 13) between 1 and 2 miles northeast of 148. A small cliff dwelling high in alcove to south is the larger of the two. Walls of dwelling several feet high. Two alcoves are in lower sandstone just below 149 and on right cliff.

150 Base of lower bed of Wingate goes below river. Cliff extends to water's edge.

151 3850 (aneroid) elevation of river.
4250 " elevation of small gravel bar on lavender beds of Wingate.

152

200 4300 top of lavender beds } Contains no
4100 base of lavender beds } conglomerate.
3850 elevation of river.

At 151 and 152 lavender ss. forms a bench about half an inch wide. Light brown ss. above it occurs in patches on it. These patches are domes and ridges with some alcoves.

153 Lavender ss. forms terrace which has patches of what appears at a distance to be wind-blown sand.

From 150 to 153 there are places where ss. cliffs extend to water's edge. Such places are marked "CLIFF" on sketch map.

The summit of the east edge of the Wilson Mesa is across river to northwest from 153.

154 Small spring issues at base of lavender sandstone and flows over steep cliff.

155 Canyon with hanging valley 100 feet high. Sand bar in mouth. Numerous small seeps from lower brown ss. fill large pot hole at base of falls.

At 2 p.m. boat with Loper, Allen, Christensen and Trimble hit sidewise a sand bar with great force and nearly upset. Took considerable water.

Angles of crossbedding in lower light brown sandstone as much as 25°.

156 3950 (aneroid) elevation of river at mouth of canyon whose mouth is filled with sand bar.

4250 top of lavender sandstone
4050 base of " "

Sketch

The upper brown ss. forms continuous walls around this canyon. The walls have rounded surfaces and show

alcoves and domes. Trees in canyon are cottonwood, cedar and oak.

Camped in mouth of Canyon at 156.

Saturday, September 17, 1921.

Wading to push and pull boats unpleasant as water is uncomfortably cold.

157 Here is a narrow short canyon in upper light brown ss. and lavender ss. A very small stream (would about fill inch pipe) is running from canyon and over falls some 30 feet high. Canyon inaccessible at mouth. Top of falls formed by top of lower light brown ss. About 15 feet below top of this ss. there is a line of several dozen small seeps from cliff parallel with bedding.

In following notes the names Wingate, Todilto and Navajo are provisionally used. They are here defined:

Wingate is applied to the 300 to 400 feet of light brown crossbedded massive cliff-making ss. between variegated shales of Chinle below, and brown lavender tinted ss. above.

Todilto is applied to brown lavender tinted, terrace-forming ss. 185 (?) to 210 feet thick between Wingate ss. below and light brown crossbedded ss. above. This formation contains some thin lenses of gray compace limestone round sandy concretions, and white chalcedony.

Navajo is applied to massive light brown crossbedded ss. 450'+ thick overlying the Todilto and underlying surface of the smooth Wilson Mesa. Sandstone weathers into rounded forms including domes and alcoves.

158 Very small spring issues near base of cliff.

Near 157 and 158 Todilto is nearest river. To east upstream and to southeast downstream it rises gradually above river.

159 Navajo 400'+

West of 156-159 the Wilson mesa is visible and comes within less than 1 mile of river at places. This mesa is the one I saw from locality 108.

160 Narrow canyon with sand filling mouth.

161 Two small springs issue from well up in Todilto whose base is about 100 feet above river.

From 153 to 161 and lower on river there are apparently many small seeps from which no water runs over surface. This is indicated by patches of bushes, grass and weeds. Near 160 and 161 on both sides of river there are short talus slopes at base of cliffs.

162 A spring like those at 161.

163 3840 (aneroid) elevation of river.
4110 top of Wingate
4220 top of Todilto; containing lens of white chalcedony at top 2 inches thick and small nodules in red sandy shale. Sandstone crossbedded. No conglomerate here.

From 164 I attempted to measure thickness of Navajo ss. beneath the east edge of the Wilson Mesa. The thickness is at least 800 feet and may be as much as 900 or 1,000 ft The beds in the upper half are gray and buff with a pinkish tint in parts.

164 At mouth of tributary canyon and in bend of river there is a bench as much as 40 feet high on Wingate sandstone. Much of the bench is underlain by wind-blown sand and a thin bed of well rounded stream gravel, up to 2 feet or more thick. Pebbles are like those between Clay Hill Crossing and Piute Farms.

165

4160 (aneroid) elevation of gravel-covered terrace on Todilto.
3890 (aneroid) elevation of river.
270

At 164 rocks dip 1° or fraction of a degree down stream but at east end of gravel terrace dip changes back to upstream.

At. 2:30 Hyde, Blake, and I struck a wide sand bar with our boat. We dragged it down stream for some distance until the water got too shallow for that. Then we had to take it 50 feet to deep water by lifting either end at a time.

River has fallen about 10 inches in last 24 hours, being noticeable after 6 p.m. on September 16. Sand bars now show above water at all positions in stream channel. This fall makes boating difficult and if fall continues boating will be extremely difficult. In last few days river has cleared so that we drink water from it without waiting for sediment to settle.

More thin clouds in sight today than at any time within last 2 or 3 week.

166 Chinle appears at surface from beneath water. Just above this locality and on northwest side of stream there are two alcoves in Wingate. The higher one is directly above the lower one. On south bank of stream are hugh sandstone boulders at base of cliff.

From 166 to east Wingate gradually rises to east and rough talus slopes are at base of cliff.

167 Small canyon with sand bar at mouth.

Sunday, September 18, 1921.

Most of sky covered with light clouds. Fairly warm during night. Wind blew hard part of the night.

In vicinity of 168 there are high sandstone talus slopes at base of Wingate cliffs. The talus almost every where conceals the Chinle.

Sketch

169 Navajo generally continuous on west side of stream. On east side it is patchy.
170 Patches of Navajo.
171 Wingate and Todilto. No Navajo.
172 A small path of terrace gravel partly covered by landslide material.
173 Two small patches of terrace gravels partly covered by landslide material.

Wind began to blow hard from south between 9 and 10 a.m. carrying much sand with it. We stopped at 11 a.m. and unloaded the boats. Mr. Trimble did no more surveying the rest of the day on account of wind shaking palnetable and on account of sand, much of which gets into a person's eyes.

A beaver was seen floating down stream past camp at 11:30 a.m.

Sand blows in gusts and is not in same quantity in air at all places.

The roar of the hurricane over the high cliffs is like that of distant rapids, or the noise of the wind in a forest.

174

Sketch

Gravel. Hill to south capped by landslide and wind-blown sand.

Monday, September 19, 1921.

Wind quit blowing hard about 5 p.m. yesterday afternoon.

This morning at 5:30 thermometer at 55° - cooler by several degrees than at any other time thus far.

Navajo Mountain visible from camp.

3820 (aneroid) elevation of river at camp.
5050 " " " base of Wingate.

Sketch

Tuesday, September 20, 1921.

The eleventh anniversary of the marriage of Mrs. Miser and me.

On nights of September 17, 18, and 19 river rose a few inches and on preceding days it fell a corresponding amount. The wind blew hard these days and cease to blow much at night. The daily rise and fall may have been due to evaporation during the days.

Sketches

Waterfall 20 to 30 ft. high. Small flow of good water. Fall over thinbedded part of Wingate.

175 Natural bridge 1100 to 1200 feet above river in vertical cliff on right bank. Span 50 feet long; arch 50 feet; width 15 feet; thickness 10 feet. Cliff runs north-northeast or northeast. Bridge on top edge of cliff. Formed by enlarging of alcove and falling in of roof of alcove, a part of which remains around edges of alcove. Bridge about 500 feet above base of Navajo.

	(	500 ft.	Navajo estimated
Section of	)	200 "	Todilto
cliff at	(	400 "	Wingate
175	)	200 "	Chinle estimated

Bridge on river edge of alcove. Much of roof still standing. In the part still standing I can see two small holes.

Sketch

Wednesday, September 21, 1921.

Went with Bert Loper and Heb Christensen to rapids at and below mouth of Piute Creek.

Stayed in camp in afternoon to mend shoes.

Bert Loper has been complaining with lumbago for 2 or 3 days and still has it though he can walk around.

Temperature this morning 47° - coolest morning.

Thursday, September 22, 1921.

Temperature this morning 53°.

Went to new camp with Loper in boat and saw beaver on way.

176 Flowing water in Piute and tributary here. Grove of 2 or 3 dozen cottonwoods on high flat between these streams. Water near mouth of tributary has slight taste of sulphur in it and at places contains a white deposit on bottom. Sulphur spring probably here.

Sketches

176 At and below 176 the variegated shales of the Chinle contain near creek level (in their lower part) lenses of coarse gray sandstone as much as 25 to 30 feet thick.

177 An inlier about 700 ft. long (with stream) of the Nokai ss. Exposure shows 20 to 25 ft. of ss. Apparently in anticline.

178 Wingate and Todilto cap mesa east of 178. There are patches of Navajo on Wingate and Todilto west of 178. In vicinity there are downstream sloping remnants of a former valley floor from 50 to 75 ft. above present stream. These remnants are composed largely of well stratified silt but in part of ss. fragments. The thickness of the material is 50 to 75 feet. Valley here is open and there are a few cottonwoods.

At distance of 8 miles above mouth of Piute I saw two horses near a cluster of cottonwoods in a grassy spot 1 mile to south. I looked through my field glass and saw an Indian squaw. I wanted to get information about Piute Creek and the trail crossing it to the west. So I went to the vicinity of the horses. I saw a pumpkin patch, water melon and canteloupe patches, a hut, and an old irrigation ditch a few inches deep that had been used to divert a small nearby flowing stream to irrigate melons. I, however, saw no Indian maiden - not even after yelling Hello 3 or 4 times. After I had walked and stood for some 15 or 20 minutes in vicinity I saw a Navajo squaw riding upstream on a gray pony in my direction. She trotted pony when it was not on very rought ground. She rode up near me; I spoke and tried to get the desired information. We understood a few signs each made but the only words were Bluff City and By motions I made her know that I wanted a water melon. I paid her 50¢. Then she picked out two small melons which we shared. When I started down stream she went back to her horse.

The woman was very friendly. She tried to find out where I came from and where I was going. I tried as well as I could to explain to her and I think she understood that I was on river boats.

4585 (aneroid) elevation of Piute 9 mi. above mouth
3825 (aneroid) elevation of mouth of Piute
9)760
85' average fall of Piute per mile.

Wesley Oliver, packer, due today but did not arrive.

Friday, September 23, 1921.

The husband and son of the Navajo woman I saw yesterday came up on horseback about 6 a.m. while we were eating breakfast. They had 2 watermelons which we bought for $1.00. Hyde talked with man.

Christensen and I walked to point 5 miles down river from camp--½ mile below mouth of DeCha Canyon. We returned to camp in p.m. Spent rest of day in tracing topographic map up river from mouth of Piute Creek.

Oliver did not arrive today.

Saturday, September 24, 1921.

Navajo Indian arrived 7:30 a.m. with dressed mutton. Paid $4.00.

179. Gravel several feet thick and contains at places a calcareous cement cap terrace and overlies landslide material of sandstone boulders and fragments and clay. Valley to west of this terrace is underlain by wash from short canyon that the stream drains.

180 Clay hills capped with ss. boulders and fragments

181 Terrace gravels partly concealed by landslide to west.

182 Stream silt and wash and wind-blown sand.

183 Gravels on point of hill at same elevation as gravels to south.

184 Stream was of mostly local origin.

185 The veneer of stream gravels not thick enough

to map except in patches.

186 Hills capped by heavy ss. in lower part of variegated shales of Chinle.

Sketch

187 Stream wash on landslide material.

188 Stream wash here fills a tributary canyon.

189 Stream wash on landslide material.

190 Landslide material beneath creek and river wash.

Pieces of silicified wood arranged on surface in variegated shales of Chinle near mouth of Chinle so as to show that log from which they came was 45 feet long.

The mouth of Piute Creek is fan shaped. The outer circle of the fan, which is about 1200 feet, is next to the river. The fan has a radius of 500 feet. The fall of the stream within 9 miles above the mouth is 80 feet per mile. Fan has a slope of 2° as measured at one place which appears to have average slope. Fan is composed mostly of pebbles and boulders up to 6 ft. in longest dimension, but in part of sand. Some mud balls up to 18 in. in diameter with pebbles sticking on their surfaces are present. Hundreds of boulders extend into and across river and a few of them protrude above surface of the water. A rapids has been formed here. Floods in Piute, one or more of which took place this year, have washed the coarse material down stream and have unloaded so much in San Juan that the river has been unable to carry all of it away. All of the bars within a mile below the mouth of Piute are formed of pebbles and cobbles from Piute and all of the rapids indicated in the sketch on p. 94 are due to the overload of the San Juan by Piute Creek. The Chinle, Wingate, ~~and~~ Todilto and Navajo are the most abundantly exposed rocks on Piute. Sandstone and limestone comprise coarse material washed by Piute with exception of mud balls.

Saturday, September 24, 1921. (Continued.)

Wesley Oliver, packer, arrived at camp at dusk on horseback. He reports that a recent rock slide on the slope of the mesa west of Nokai Creek has made the trail impassable for packs. He, however, managed to get his horse over. He attempted to get one of the pack mules over but the mule floundered on the rocks and a rock injured the mule's leg. He said the mule was stifled. He left the packs and provisions on

Nokai and came on to camp with the mail.

The plan is for Oliver to return to packs and bring them to Spencer Camp where Bert Loper and I will meet him with a boat. It will take 2 days for the 3 of us to make the trip. Loper and I will tow boat up stream, the distance being 17 miles.

Sunday, September 25, 1921.

My mother 61 years old today.

Loper and I towed boat upstream about 11 miles. We rowed across river very few times. Other times we waded. Some quick sand waist deep. Water cool. We were tired at night and were willing to go into camp. A very hard day's work.

Monday, September 26, 1921.

Section at east edge of Wilson Mesa and at west end of big loop in river west of Spencer Camp

Sketch

Bert Loper and I reached at 1 p.m. our old camp by the big boulder with left bank of the river 6/10 mile below Spencer Camp. Some 10 to 15 minutes later Oliver arrived. He left at 4 p.m.

The Wingate sandstone in the vicinity of Spencer Camp has no thinbedded sandstone at its base at places and at others it has very little.

J. L. Oliver, Bluff, Utah, dealer in Navajo blankets

Wesley Oliver, Bluff, Utah, was packer for party.

In forenoon while wading water waist deep near bank I stepped on a thorn which felt like the sharp fin of a cat fish. Bert Loper says it was a grease wood thorn. It stuck into the main joint of my large toe on my right foot. The pain was severe at first but soon quit.

Our sunburnt legs hurt some today and got more burning. We waded river both days with trousers, shoes, and socks off so that our bare legs were exposed for about 6 inches above our knees.

Tuesday, September 27, 1921.

My right toe is somewhat sore this morning. Our sunburnt legs are also sore enough for us to limp when we first start to walking. Loper's lumbago was fortunately not made much worse by the 1½ days grind in towing the boat upstream. His union suit had a big gash on the right side for two days so that his side is very red from sunburn.

We left Spencer Camp at 7:30 a.m. and after rowing with considerable wading reached the mouth of Piute Creek at 12:30 p. m., making 17.5 miles in five hours. Fourteen hours were required to make the trip upstream.

When we arrived in camp we found Christensen practically laid up with a crick or pain in the small of his back. The paid struck him yesterday about noon. Hyde prepared dinner. Party had bought another mutton and watermelons and canteloues from the Navajo woman I met on Piute Creek several days ago.

Wednesday, September 28, 1921.

We packed camp this morning ; are moving downstream and hope to reach Colorado before the end of the month. Loper towed boats yesterday over rapids at mouth of Piute and ran the second rapid.

Mr. Trimble says Piute Creek has fall of 80 to 85 feet per mile and that rapid at mouth of creek has a fall of 8 feet.

Sketch

Party portaged supplies, bedding and other equipment around rapid at mouth of Piute and first rapid below the mouth of this stream.

191 Bars of boulders, cobbles and pebbles with some sand. Most of coarse material subangular or poorly rounded and has been brought to San Juan by Piute Creek.

Loper says he he made trip down San Juan several years ago that he had to pick boat out of water at mouth of Grand Gulch and carry it over big boulders. Such boulders obstructed stream so that his was necessary.

Thickness of Wingate in vicinity of mouth of Piute Creek is 400 feet. The lower part from say 50 to 200 feet is composed of comparatively thin beds which are lenticular one to crossbedding.

192 Rapid over bar of gravel and cobble from Piute Creek.

193 Gravels on steep slope at base of cliff suggest gravel terrace.

194 Chinle goes under here.

195 Small rapids over bar of cobbles and gravel from Piute Canyon.

196 Gravel bar composed largely of Piute material on west side of river.

197 15' Chinle below 50 feet shaly red ss. of Wingate.

198 Small rapid over cabbles and pebble bar. Mostly from Piute Creek. Hyde, Blake and I nosed boat over most of rapids.

Verify thickness of beds at natural bridge.

Sketch

Sketch

Camped on sand bar at mouth of Cha(?) Creek near stream. First time on trip we can see bottom of bucket after filling it with water.

Thursday, September 29, 1921.

199 Poorly preserved dinosaur tracks (4 or 5 toes) on slab of ss. that has fallen from lower part of Wingate into edge of river on left bank. I took picture of slab.

The lower thinbedded part of Wingate appears to be Gregory's uppermost division of the Chinle. If so the Chinle passes entirely around the first loop of the river shown on this page.

200 Small mining stream of good water. Flow ½ or less second foot at mouth. Boulder bar at mouth has pushed river to north cliff causing a 3-foot rapid. Boulders are ss. and are as much as 18 ft. in longest

dimension. Corners are partly rounded off.

Rocks here are horizontal. The topmost division of the Chinle shows above water to height of 20 feet.

At 200 and 201 the topmost division of Chinle is composed of 15 to 20 feet of massive brown sandstone, shaly red sandstone, and sandy brown shale. Dip downstream with gradient of stream.

202 On right cliff at bend in stream there is a double fault with vertical plane and downthrow on east side. Direction north 35° west (magnetic).

Sketch

The Chinle disappears a short distance south of 202. From this locality up there are many v-shaped channels and pot holes in the massive Wingate. I reached one pot hole 100 feet long and 60 feet wide at lower end around which the surveying party went by walking on solid sloping sandstone 40 to 50 feet above water. I got most of the way around and finally reached a place that was so steep and narrow that I went very slowly and the farther I went the job got more difficult. I decided right there that life is too short to take a chance on such a place by myself. I therefore backed out. The surveying party came back another way to avoid the steep place I would not go over. The flood in this stream this year was 15 to 20 feet deep in canyon. Very few trees still standing. Mr. Trimble found the top of the Wingate sandstone to be 3900 feet above sea level where this contour crosses stream. Worst flood this year for 10 years or more. Saplings 10+ years worn off.

203 Between Piute Creek and the creek west of 203 the Navajo is the country rock at surface. Weathering has cut small canyons in it and has rounded its surfaces and carved them into a multitude of domes of many shapes and sizes with alcoves of large and small size.

204 Areas composed of clusters of domes of Navajo sandstone.

205 Area of loaded Navajo on crest of anticline.

206 Areas of domes and canyons of Navajo sandstone and a few sand domes. Vegetation very scanty; consists of a few cedars, some sage brush, and practically no grass. Vegetation on valleys between domes. Domes are bare rock and most of valleys are bare rock.

207 A level mesa which may be a part of the Wilson mesa is visible zome 4 or 5 miles north of this locality Spring in Todilto.

4500 crest of dome I climbed. Mesa is higher.
4060 base of Navajo

Sketch

By noon today the small stream by which we had camped last night had quit running over the deep sand at its mouth, although it was still running in the canyon.

Early in afternoon we stopped at mouth of a canyon on north side of river. A clear stream with flow of about ½ second foot of exceptionally good water runs from canyon.

Christensen went up bottom of canyon for some distance and reports the discovery of old large lion tracks in the mud. The rest of us got on top of cliff by following a horse trail on east side of mouth of canyon.

Friday, September 30, 1921.

Entire sky overcast with thin clouds this morning.

Sketch

The anticline whose axis passes 205 is a northward extension of the one in Navajo Mtn. a few miles to south

208 Chinle extends up canyon to cliff of Wingate.

4525 top of Wingate)
4250 base of Wingate) Up horse trail to 205.
275

Sketch

Water in the creek emptying into San Juan at Boulder rapid is of good quality between forks of creek and mouth there are several places where sulphur water enters stream. Odor of H_2S at such places is very strong.

After lunch Christensen and I went to mouth of dry stream at 208 and located camping place at Indian hogan and arbor. Loper arrived soon with boats. Christensen and I carried camp equipment some 100 yards to camp site and put up tent fly and tent. When party arrived three of us, Blake, Loper, and I, put up pup tents for beds. After supper party carried boats some 200 feet and put them on dry land near camp. Later boats will be carried entirely around the boulder rapids at 208. Fall of rapids, according to Trimble, 13 feet. Hundreds of boulders of large and small size in channel of stream. Loper says boats might be nosed down main channel next to right bank but that the exceedingly swift water would make such dangerous. Second time in Loper's experience to take boats out.

A few drops of rain - first for September - fell in afternoon. Entire day sky was overcast with clouds.

Saturday, October 1, 1921.

Very light sprinles of rain fell last night. Nearly all of sky concealed by clouds this morning.

3790 (aneroid) elevation river at 208.

209 Stream flowing fraction of a second foot here. Floods this year not higher than 6 or 7 feet. Cottonwoods 10 to 15 years old fairly numerous, though some have been toppled over by floods this year.

3910 elevation

210 Abandoned Indian farms. Irrigated.

211 No trail up this canyon except a very poor one that is now inaccessible at places. Uppermost division of Chinle is generally absent. At places it appears to be as much as 15 to 20 feet thick. Falls in this vicinity are over limestone beds in Chinle. Upper falls, the higher one, is about 20. Limestone near upper falls dips 7° west.

I staid in camp entire afternoon to rest.

Loper left camp early in morning to go down stream on foot to mouth of river. He returned to camp at 6 p.m. He reports distance to mouth is 10 miles. He walked along south side of river until a cliff rimmed him. Then he stripped off his clothing and took down river, wading across channel whenever it was necessary. He thinks he must have crossed the channel 50 times on the trip. He found grub coche at mouth of river and got some flour to bring back. On his way back he sank waist deep in quick sand in middle of river and got flour wet on outside He says if river had risen 1 foot while he was down stream that he could not have returned to camp.

Rain began to fall at 4 p.m. and continued until 7:30 p.m. We spent time from supper to bed time by small but very warm fire in a hogan.

Sunday, October 2, 1921.

River rose about 2½ feet last night but by 6:30 a.m. it had dropped a foot. Water is dark redfrom mud. Small stream by camp is running a few second feet into river.

Sketch

212 Terrace material here is 20 to 30 feet thick. Terraces in above sketch slope gently toward river. The materials underlying them are variegated shales, landslide boulders and a capping of stream wash. The wash consists largely of material from the canyon to the south; the material from the south includes partly rounded cobbles and boulders of red sandstones (from La Plata group), white hard quartzite and sandstone obviously from the McElmo or Dakota on Navajo Mountain, and cherty limestone from the Chinle. The boulders are as much as 6 to 8 feet in longest dimension. Some well rounded pebbles that have been laid down by San Juan are present.

213 Coarse stream wash.

214 " " " and wind-blown sand. Mainly boulder bars.

215 Small hills; outliers of low terrace. One white quartzite boulder 10 feet long.

Some of the quartzite boulders in the terraces at this locality contain quartz pebbles up to half an inch in diameter. Terrace material is cemented together at places by $CaCo_3$.

216 Sand, gravel, and boulder bars.

217 Landslides on either side of river.

Trimble and rest of surveying party finished canyon south of camp and returned to camp about 10 o'clock. We then carried camp equipment and boats to foot of the 13-foot rapids. We next ate lunch. At 11:25 we started down river with Loper and Blake towing boats while rest of us walked.

218 Stream flowing less than second foot runs north 15° west into river. Rimmed cove.

219 Chinle goes under here.

220 Boulder slope here. There may be some Chinle concealed beneath boulders.

Late in afternoon all used boats to go downstream.

Cloudy in forenoon. Clear in afternoon and at night.

Sketches

Monday, October 3, 1921.

Clear last night and this morning. Temperature 60°.

221 Waterfalls. Wingate goes under here.

222 Todilto forms water falls. Wingate goes under here

223 Spring with flow enough to fill a 1-inch pipe issues from joint in upper part of Wingate sandstone about 60 feet above stream. Although it issues from heavy steeply sloping bare ledges, grasses and bushes have lodged on ledges and grown in water. Stream flows less than a second foot.

224 Navajo sandstone circles head of stream.

225 Navajo ss. forms vertical cliff. Much of surface of cliff is brown. Sandstone breaks off in vertical slabs of even thickness 10 to 20 feet thick. Wingate cliffs show a conchoid alfracture at numerous places.

River yesterday and today very red. River several inches lower today than yesterday.

226 Boat with Blake, Hyde and me in it struck boulder at 1 p.m. The back end struck first; then front end struck. Current tipped boat so some water came over edge on upstream side. We leaned on downstream side. Blake, then Hyde got out and dragged boat off of boulders.

Sketch

227 Chinle formation appears above water in this bend. Here 60 feet of shale at top is exposed above water.

228 Cave with arched roof in Navajo sandstone. Chinle goes under here.

229 About half of Wingate is below level of river.

230 Wingate disappears under water.

We reached Colorado about 5:30 p.m. and went into camp on east side of Colorado and north of mouth of San Juan. Grub coche for one month's supply had been left on boulder near camp for two weeks or more. Some grub, including Irish potatoes, dried peaches, some of the raisins and a part of the cheese, had spoiled.

San Juan rose perhaps a foot later in afternoon but fell several inches at night.

Before we reached Colorado we had gone without sugar for about a week and without coffee for a few days. Our supply of flour was exhausted.

Tuesday, October 4, 1921.

Sketch

231 Wingate disappears both on Colorado and San Juan.
232 Gravel terraces on Navajo, 450 feet above Colorado
233 About 75 feet of Chinle here.
234 Gravel terraces on Todilto.
235 River at Hole-in-the-Rock runs south 20° west. Hold-in-the-Rock is a narrow gulch with an exceedingly steep gradient running south 80° east in Navajo sandstone and Todilto formation. Navajo about 600 feet thick. Todilto about 200 and 20 to 25 feet of top of Wingate shows above water on west side. In winter of 1879-1880 first colony of Mormons to settle Bluff constructed road through Hole-in-the-Rock, crossed river in ferry and wintered small flat on east side of river. They later constructed road to east passing through the Clay Hill Pass. Powder used for blasing in cliff east of Colorado.

Party started from camp at mouth of San Juan to Hole-in-the-Rock on the Colorado. Blake and Loper rowed boats upstream, while rest of us walked on left bank. We started out about 8 a.m. expecting to walk only 5 miles, the reported distance. We walked and walked and ate lunch at 11:30. We decided to turn back but we yelled and got an answer from Blake and Loper, so we continued about 2 miles farther. The entire distance from the mouth of the San Juan to Hole-in-the-Rock must be 10 miles (scaled distance of Chenoweth's map is $6\frac{1}{2}$ miles). Walking on Colorado River banks is is bad on account of slipping muddy banks, willow thickets, and steep rocky slopes.

Sketch

On our return to camp from Hole-in-the-Rock we rode in boats. Hyde tried rowing for a while and then I tried my hand.

We put wood in boats to take to camp.

San Juan still muddy (red).

Colorado is slightly milky. Makes no noise except at a few places where boulders occur. Water very smooth and does not flow fast. Water tastes of salt.

Road through Hole-in-the-Rock now impassable for even a horse. Road east of river no longer used for wagons.

Wednesday, October 5, 1921.

3500' (aneroid) elevation of Colorado at mouth of San Juan; also elevation of base of Todilto.

3700 elevation of top of Todilto; thickness of Todilto therefore 200 feet.

Sketch

236 High gravel terrace on top of Todilto.

237 Low gravel terrace on Todilto.

Sketch

238 Stream material here is 30 to 35 feet thick; consists mainly of a sandy yellow loam with a gravel bed several feet thick at base. Fragments of gray limestone like that on the flattopped mesa to southwest are on surface near top of stream filling.

239 Highest part of terrace 3950. Elevation here same as that of terrace west of Colorado.

240 Natural bridge.

Sketch

Crack in roof of alcove back of span 50 feet long and r to 10 feet wide. Width of span at narrowest place is 15 to 20 feet. Bridge in lower part of Navajo. Very small spring with flow enough to fill small pool issues at base of alcove. Trend of span south 30° east (magnetic). Thickness of span 15 feet. All measurements estimated.

241 A few pebbles scattered on surface of Todilto bench

Old stream channel from Colorado to San Juan. This channel is marked by topographic valley partly filled with stream deposits. The location of the deposits is shown in sketch map on preceding page. Material consists of pebbles and cobbles like those along the San Juan. Bed several feet thick. It is overlain by sandy and pebbly loam in which there is some $CaCO_3$ that has been segregated and deposited in bed. Fragments of this gray limestone are scattered over surface at places. Some wind-blown sand on two largest areas. Base of gravel is lowest on outside of bend which is to east. The elevation on the Colorado side is same as that on San Juan side. I could not decide therefore which stream flowed through a band.

Robert N. Allen,
2236 Canyon Drive,
Los Angeles, California.
Don't have pictures trimmed.

Sketches

Left camp at 4:15p.m. for Lees Ferry with Sidney Paige, Kolb, and Mr. La Rue and made above sketch of Colorado in afternoon.

Mr. Trimble's party:

Robert N. Allen, 2236 Canyon Drive, Los Angeles, California ---------- Recorder.
Bert Loper, Torrey, Utah ---------- Boatman.
Heber Christensen, Moab, Utah -------- Cook.
Hugh Hyde, Bluff, Utah, ---------- Rowman.
Ellwyn Blake, Monticello, Utah ------ "
K. F. Trimble, U.S.G.S. Washington, D.C., Chief of party and Engineer.
H. D. Miser ---------- Geologist.

Emery Kolb
Rowe

Thursday, October 6, 1921.
3525 Elevation of river at mouth of Bridge Canyon.
3975 Elevation of base of north pier of Rainbow Bridge.
Mr. Paige's difference in end 480 feet.

Sketch

Rainbow Bridge is formed of what I have been calling Navajo sandstone. Some 600 to 700 feet of this sandstone in this vicinity. Dome of sandstone east of southwest pillar.

Sketches

Dip of Todilto downstream about 1°

Sketch

According to Kolb this is first time party has gone to bridge from river.

At later date he says Spencer took a party from the river.

3960 bottom of creek under bridge.
3600 elevation of river at mouth of Bridge Canyon.
360

Douglass has described Rainbow Bridge in National Geographic.

Also look up Cummings' articles.
" " " Roosevelt's article in Outlook.

Kolb has published

Discovered August 14, 1909 by Cummings and Douglass.

Sketches

Large areas of dark red sandstone and McElmo on both sides of river.

Friday, October 7, 1921.

Sketches

242 Wingate forms benches here and elsewhere along river above this point.

243 Some 300 to 400 feet of Wingate above river.

Section on mesa at 244	600 +	McElmo	
	300 +	Navajo	
	150	Todilto	Estimated by Miser and Paige.
	300	Wingate	
		River	

245 Dip downstream of $\frac{1}{2}$ to 1° Bench of Wingate gets lower down stream.

246 Gravel terrace on Wingate.

247 Gravel terraces on Wingate.

248 Wingate rises 150 to 200 feet above river and forms wide terraces on either side of river.

249 Wingate rises 150.

250

			Adjusted in office.
	150-200	McElmo	- 200
	400-500	Navajo	- 300
75(Miser)	150 (Paige)	Red clay and ss.	- 100
	300'	Wingate	- 300

249 Wingate generally forms vertical cliffs on either side with sand bars with willows on them.

251 High plateau carved by canyons as seen from 252.

253 Gravels on two hills of Wingate.

254 Large mesa with chert points and remnants.

255 Wingate about 200 feet above water. Dip about 1° to west.

256 Gravels on bench about 50 feet above stream. Panorama from 256. Two pits in gravel. Probably made in prospecting for gold.

256

Sketch

257 Highest gravel terrace about 3700.
258 Level floored valley cut by canyons and has cliffs of Navajo and McElmo on either side.

Sketch.

250 Vertical joints on circular vertical south side.

Sketch

259 Wingate some higher than to west.
260 Gravels on Wingate bench 75 feet above the river.
261 Gravels on low benches of Wingate.
262 High water mark on south cliff 20 feet above water today. Indicated in places by wet horizontal streak Cliff of Wingate 450 feet.
263 Navajo here light brown like Wingate ss. Farther upstream it is dark red.
264 Navajo with no McElmo.
265 High water level marked by damp streak.
266 Wingate about 250 ft. above water.
267 Gravels on Wingate terraces.
The Crossing of the Fathers.
268 3430 elevation of river.

Sketch

Looking south 70° west from 268

Sketch

269

Todilto under part of Wingate terraces on both sides of river.
268 Dip of Wingate less than $\frac{1}{2}^{0}$ to west.
270 Wingate terrace partly underlain by Todilto.
271 A thin bed of red ss. (10-20' thick) within 75 ft. of top of Wingate. Caves in this and other soft ss. beds

on west side of river above the Crossing of the Fathers.
272 Circular vertical cliff. Has conchoidal fracture.
273 Gravels on the Todilto.
274 Dark red beds of sandstone in upper part of Wingate

Sketch

275 Todilto caps tops of cliffs.
276 Gravels capping highest part of bend at edge of cliff. Some parts of high bench for a mile to southwest are capped by gravels. Wingate vertical cliffs stained dark brown at places like basal massive bed of Wingate. Some of gravel areas are on Todilto.
277 Nearly level bench 50' ± above river of Wingate capped by veneer of gravel.
278 Mesa of Navajo capped by McElmo. Kolb thinks 200 people have seen Rainbow Bridge.
279 Mesas of Navajo and McElmo poorly located.
280 Cliff of Wingate.
281 Gravel veneer on terrace of Wingate 60'+ above river.
282 Two hills of Wingate capped by veneer of gravel.
279 What appears to be upper half of Navajo has red light gray beds of ss. all cross-bedded, apparently grading into each other.
283 Conchoidal concentric rings convex downward.
284 Sketch At this locality which is some 200' N. of river, the vertical-walled canyon bends very sharply and in well on outer bend there is an excellent example of an arch. Sand bar in mouth of canyon.
285 Wingate in approximately horizontal position between this locality and Crossing of the Fathers. Talus and wind-blown sand at places at base of cliffs.

Camped at night on sand bar at mouth of Warm Creek. When a gold mining camp was located here a hole was blasted through thin canyon wall below level of camp to

Sketch

Sketch

prevent flood water of Worm Creek from rising into camp. No trace of Fowler could be found. Spencer built steam boat here for his gold camp.

Saturday, October 8, 1921.

286 Worm Creek runs several second feet. Water muddy. Greenish, yellowish gray in color.

Sketch

287 Wingate cliff cut by numerous joints running in different directions. Cliffs are gradually getting higher south of mouth of Navajo Creek. Talus at places.

288 Low bench of Wingate.

289

Well-rounded slope with soft red beds probably include red shale and shaly ss. May be Todilto

Sketch

Massive light-brown crossbedded ss.

290 Sentinel Rock at mouth of Sentinel Rock Creek. Height some 200 feet, width 50 ft. length 120 to 200 ft.

Sketches

291 Wingate and its cliff are gradually rising above river below mouth of Navajo Creek.

292 Wingate has many joints running in different directions. Canyon walls in such places are not smooth but ragged. Joint surfaces are dark brown.

293 Canyons walls between 800 and 1,000 feet high.

294 Wingate jointed and extends to tops of cliffs that are visible from river in this vicinity.

295 End profile of dome-shaped point.

296 Thin deposit of gravel on Wingate bench 100 feet above river. Spring at camp on east side of river has flow of perhaps $\frac{1}{2}$ second foot. Middle member of Wingate may be near surface.

297 Wingate jointed. Debris at base of cliffs at places. Some arches.

298 Cliffs of Wingate are 1,100 feet high on outside bend. All sandstone here is massive light brown. A break occurs a little above middle; sandstone above and below is of same character. Break has even surface.

Interbedded brown sandstone and brown shales 150 to 200 feet thick between massive Wingate and Chinle. This may be uppermost division (Gregory) of Chinel.

Reached Lee's Ferry about 3 p. m.

Sketches

Sunday, October 9, 1921.
Stayed at Lees Ferry entire day. Did washing, sharpened axe and did other small things and rested.

Monday, October 10, 1921.

Elevation U.S.C.& G.S. near cabin 3149.023 at Lees Ferry.
3480 " (aneroid) " " 3380 " " "
top of ridge N.of Lees Ferry 4975
1,595 Vermillion Cliffs.

Sketch

Mr. Paige and I climbed to top of back bone ridge running S 10° E past Lees Ferry. The Colorado cuts through Ridge at Ferry. A broad plateau of Wingate ss. is east and north of this ridge. The plateau rises to south and east. It is cut by canyon (Glen) of Colorado and smaller canyons The canyon areas are fairly level, being cut by small gulches. Most of the plateau surface has a thin cover of sage brush. There are very few domes like those north and northwest of Navajo Mtn. and north of San Juan River. Mesa to west of Paria has small traces on it, probably of cedar and pinon.

p

Sketch

Tuesday, October 11, 1921.

Elevation of river 3115.67 ' as determined by leveling from U.S.B.M. 3148.023 at Lees Ferry.

Shinarump conglomerate is 40 to 60 feet thick. It is a massive, cross-bedded, coarse-grained gray sandstone stained brown and brownish black at places. Well rounded pebbles up to 2 inches in longest dimension of quartz and quartzite are abundant at places. The pebbles have a thin coating of secondary silica that sparkles in sunlight. This feature is characteristic of pebbles in Shinarump on San Juan River.

North of San Juan at Piute Farms

Sketch

Mr. Paige and I walked down right bank of Colorado to a point about 1 mile below mouth of Paria and studied the variegated shales, the Shinarump, the Moencopi and the Kaibab.

The Kaibab forms the walls of Marble Canyon which begins here. We saw as much as 150 feet of beds at its top. These beds are predominantly sandy and calcareous and contain nodular rough gray to dark chert and some fossils, especially gastropods. They would be termed cherty calcareous sandstone or sandy limestone. Drusy quartz present in some beds. The beds have a uniform thickness.

Some features of the Kaibab are the same as those of the Goodridge formation of the San Juan oil region and I believe the two formations are roughly equivalent.

The Shinarump of the Lees Ferry region is the same as the Nokai sandstone on Nokai and Copper creeks and near Gable Camp.

Sketch

Impossible from lithologic character of the shales in field to decide which correlation is correct.

Look up Longwell in Amer. Jur. Sci.

Persons at Lees Ferry night of October 11.

Mr. Ward a vice-president of Edison Co.
Dennis " " "
Schenck " " "
Ducker " " "
Paige of U. S. G. S.
La Rue
Miser " "
Spencer
Sid Johnson
Cockroth
Sid Wilson
Henry Rauch, Grand Canyon
Ed Kolb " "
Emery Kolb " "
Gerdine U. S. G. S.
4 or 5 or more others.

Wednesday, October 12, 1921.

Started with party from Lees Ferry for Flagstaff.

Saw pebble beds (lenticular) at and near base of Shinarump and also saw a fossil log near base.

The Moencopi shale near Lees Ferry is a brick red but assumes a chocolate brownish coat toward top. Much of Moencopi - even at top weathers with fluted surfaces like the shale of Organ Rock. Thin seams and veins of gypsum.

Lees Ferry to Flagstaff 146 miles.

Ducker, Paige, Miser, Ellsworth Kolb, Emery Kolb, Henry Rauch, La Rue in party on truck from Lees Ferry to Flagstaff.

Bought blankets from I. N. Duff, Cameron, Arizona.

Party reached Flagstaff 11 p. m. without mishap of any king. Ate lunch at The Gap, where we bought blankets from a Babbitt Trading post. Stopped a little after sundown at the Bridge, Cameron Post Office, where there is a

store with a fine assortment of blankets and other things. Party spent about $150 or more for blankets, silverware and pottery.

After we ate late supper at Flagstaff we went to bed. My mattress felt fine. It was the first for me to sleep on since I left Green River, Utah, July 16.

Thursday, October 13, 1921.

In forenoon finished writing letters, got grips out of storage, expressed one bundle of blankets to Mrs. Miser, mailed one blanket to Mother, purchased heavy clothing and did other things.

Ducker and La Rue left at 11 a.m. for California, first for Los Angeles, second for Pasadena.

Paige left at 8 p. m. for Washington, D. C.

At 1:30 p. m. Henry Rauch, the Kolbs and I left in Ford truck for Grand Canyon. Made 12 miles per hour until we reached point about 30 miles from canyon at sundown. Car stopped and could not be started although three of the party corked on it for more than 2 hours by the light of a pinon fire. We, therefore, camped on desert. Bedding was divided to give me some. I put on the new woolen underwear and then put trousers, sweater and coat on to go to bed. Rain threatened early in night.

In afternoon and also in evening of October 12 we passed through San Francisco Mountains, a scattered group of volcanic peaks with wide rolling valleys between them. The mountains and valleys are forrested with large yellow pines and some quocken aspen. Timber mostly pine and forms basis for important lumber industry. Grass thick in valleys. Good grazing.

Friday, October 14, 1921.

At 10 a. m. first car going to Grand Canyon arrived. Emery Kolb hailed it. Driver of car took Emery and me in his car to point 16 miles toward Grand Canyon where Emery's wife met us in car. He went with his wife back to truck to tow it into Grand Canyon. I continued in auto and reached destination about 12. Driver and wife, Mr. and Mrs. McCause, of Providence, R. I.

After lunch at Bright Angel Hotel I walked to Powell Memorial, two miles to northwest.

Inscription on Powell Memorial.

1869	1872
John Sumner	A. H. Thompsons
Walter H. Powell	F. S. Delleybough
G. Y. Bradley	John K. Hillers
William R. Hawkins	Stephen V. Jones
Andrew Hall	W. Clement Powell
	Andrew J. Hallan

Erected by the Congress of the United States to Major John Wesley Powell, first explorer of the Grand Canyon, who descended the river with his party in row-boat traversing the gorge beneath this point August 17, 1869, and again September 1, 1872.

Saturday, October 15, 1921.

Sketch

About 7,000 second feet.

Ellsworth Kolb and I left rim between 9:30 and 10 a.m. for descent down Bright Angel Trail. After passing the Indian Farden we took left hand trail for Plateau Point. From that place we got an excellent view of the lower inner gorge or canyon of the river. At this place I saw the following section to northwest of point.

Sketch

We reached base of Trail about 12:45. Ate lunch on small sand bar on left bank of Colorado and east of the mouth of Pipe Creek. Kolb had pointed high water mark reached during spring of this year. He says it is higher than at any time since By hand leveling I found rock to be 37.5 feet above present water surface. Flow of stream as measured at Lees Ferry on days we were there was 7000 second feet or a little more. Stream narrower here than in lower Glen Canyon. Rapids formed by boulder bars at mouths of gulches and by bed rock and boulders. Bed rock apparently extends 1/3 distance or more across stream from left bank at the mouth of Pipe Creek.

We started on the return trip at 1:30 - later than the two mounted parties. Near top of the trail we passed both parties and reached rim at 4:40.

Bottom of canyon fairly warm. Rim fairly cool. Difference very marked in climbing trail.

Beauty of canyon shows best from rim or 1000 to 1500 feet below rim. Proportion of things is not revealed by views from lower part of the canyon.

Trees on the plateau include yellow pine, pinon, juniper.

Trees on slope along trail include fir, balsom, juniper, and cottonwoods.

Left canyon at 7:25 p. m. for Los Angeles.

Sunday, October 16, 1921.

Arrived in Los Angeles at 2:45 p. m. Then took street car to Hollywood, a residence suburb northwest of the city, to call on Mrs. Robert N. Allen.

Monday, October 17, 1921.

In forenoon made trip in sightseeing auto from Los Angeles to Pasadena and return. Stopped at Busch Gardens and Ostrick farm.

In afternoon went by trolley to Long Beach. Took swim in ocean. Waves high. Called to see Mrs. Hunt but found that she and her husband were out of the city. Returned late in afternoon to Los Angeles.

Took So. Pacific train at 7:30 p. m. for El Portal, Yosemite Valley R R Merced-El Portal.

Tuesday, October 18, 1921.

Reached El Portal at noon. From there went by auto 15 miles to Yosemite Lodge, near village of Yosemite. In afternoon took sightseeing car through valley. Saw El Capitar, Half Dome, Bridal Veil Fall, and many other points of great interest. Valley with forested floor and vertical gray granite walls and waterfalls is the most beautiful spot I have ever seen.

Stayed over night at Yosemite Lodge.

Wednesday, October 19, 1921.

Walked in forest before breakfast and saw 8 deer

Left Yosemite Lodge at 8 a.m. in sightseeing auto. Went to Mariposa grove of big trees where we ate lunch.

Grizzly Giant, largest tree, 31 feet in diameter several feet from the ground. Oldest trees 4,000 years old. In the afternoon went by auto to Glacier Point where party stayed over night in hotel annex. Saw several deer and a coyote along the road during the day.

Thursday, October 20, 1921.

Left Glacier Point 7:30 a.m. in auto for Yosemite Lodge. Reached Lodge at 10 a.m. Left Lodge at 10:45 a.m. by auto for El Portal. Left El Portal at 1 p. m. on train. Reached San Francisco at 10:45 p.m. Stopped at Antlers Hotel.

Friday, October 21, 1921.

After breakfast bought Railroad ticket. Then went to Survey offices in Custom House Building. Found Miss Gaylord and J. M. Hill. Hill took the day off and accompanied me for most of the day. We went to Cliff House and near-by points and then through China town.

Left San Francisco at 7:15 p.m. over Western Pacific for Salt Lake City.

Saturday, October 22, 1921.

Was on train all day passing through eastern California and Nevada.

Sunday, October 23, 1922.

Reached Salt Lake City at 5:30 a.m. Pacific time. In forenoon got mail, met Calkins at New Grand Hotel and took sightseeing car to see city.

At 2 p. m. attended meeting in Mormon tabernacle. At 3:15 p. m. I had heard several songs and two speeches. Other speeches appeared to be in store. I therefore got up and left the

Tabernacle as I was not interested in the speeches especially as they dwelt very largely on the "Church of Christ of the Latter Day Saints," and on the "prophet Joseph Smith".

At about 6 p.m. took D. and R. W. train for Denver.

Monday, October 24, 1921.

Passed through treeless desert of eastern Utah during the night. For this I was thankful as I had already seen enough of this sort of country for one season.

Traveled during daylight from Grand Junction to Canon City. Mountain scenery beautiful, especially Canyon of Eagle River and Royal Gorge of Arkansas River. Snow storm greeted us at Tennessee Pass at elevation of 10,240 feet.

Reached Denver about 11 p.m. Stayed all night there.

Tuesday, October 25, 1921.

Spent forenoon in shopping and resting. Took Union Pacific train at 12:50 p. m. for Kansas City, Missouri.

Leave Flagstaff	8:15 p.m.	23)		
Arrive La Junta	9:50 p.m.	24)	1 day	
Leave "	12:05 a.m.	25	)	
Arrive Denver	7:00 a.m.	25	(	1 day
Leave "	12:50 p.m.	Oct. 25	)	
Arrive Kansas City	9:15 a.m.	26	)	
Leave " "	10 a.m.	26	(	1 day
Arrive St. Louis	6:15 p.m.	26	)	

Want discussion of geology with reference to possible sites from 3945-3995 on San Juan.

Also want pictures.

Discuss accessibility

3875-3915

3735-3760

Clay Hill Crossing to Mouth of Moonlight

3470-3515

3380-3405 below Piute

From mouth of San Juan to 3305