

The Diary of Grove Karl Gilbert

The George M. Wheeler River Expedition of 1871

by George Simmons

When George Simmons presented this manuscript to CPRG we almost fell dead. This is a very significant piece of literature that has, to our knowledge, never been published. The trip occurred in the fall of 1871, before John Wesley Powell's second expedition through the Grand Canyon. This is one of three factors which led to the decision by Powell to abandon the rest of his expedition at Kanab Creek in 1872.

Lt. George M. Wheeler was in charge of the expedition in which Grove K. Gilbert was the geologist. This is the third expedition to reach Diamond Creek; Wheeler rowed, towed and portaged boats upstream from Camp Mojave. The first expedition was by saddle in 1858 with Lt. Joseph C. Ives in charge; John Strong Newberry was the geologist. The second was by boat in 1869 with John Wesley Powell in charge.

This is the document which has the type locality for Redwall Limestone. Grove K. Gilbert is considered by many geologists to be amongst the finest. See *The Confluence Volume 3, Issue 2, Spring 1996*. The document also has many other significant entries which we will allow the reader to discover for himself. Enjoy!

Thursday September 14, 1871 Camp Mohave

Started on horseback to find a quartz mill eight miles below camp and had a delightful ride over the bottom land, the best of which is cultivated by the Indians and made to produce corn, melons, squash, and beans. Cottonwood, true willow, screw bean, muskeet [mesquite] and a similar acacia with constricted pods abound, and a climbing milkweed. The Indians came trooping on their way to sit for their picture. On the west shore the range seems granitic with one or two volcanoes. On the east, hills of granite and metasedimentary rocks are covered by lava (collected) east of Boundary Cone.

The gravel at the edge of the mesa near the Boundary Cone is composed of this lava in large part but shows much quartzite and some gneiss and granite. Near the Post there is very little lava, much quartzite and some altered limestone.

The mesas are terraced in three steps below the Post, the terraces not differing greatly in height and sloping riverward thusly [sketch omitted]

Failed to find the mill.

Friday, September 15, 1871

Camp Mohave all day, making preparations for river trip. Solar observations.

We are to depart tomorrow for the upper Colorado. [tables of river depth and solar observations not included]

Saturday, September 16, 1871

Section [sketch omitted] of the Cañon of the Colorado on the high mesa west of the Little Colorado, from p. 42 [Geology report from the Lt. Joseph C. Ives Expedition of 1857 and 1858].

Turned over to be forwarded from Camp Mohave [presumably to Peach Springs].

saddle and circingle
water bridle
1 picket pin and rope
1 pair spurs
1 pair saddle bags
1 halter and strap
1 blanket and cheval

Saturday, September 16, 1871

We started our boats from Mohave today at 11:35 A.M. after having posed for a stereograph. "The Commodore," Mason has been discharged, and one James hired in place. As I write we approach Hardyville and I doubt not our camp will be made there. Our party consists of

Barge
1 boatmen
2 soldiers
5 Indians including Askut [or Asquit]
8

Boat No. 1
Lt. Wheeler
Loring
Roberts
1 soldier
McGeary
3 Indians
8

Boat No. 3
Hamel
Richardson
Hecox
Gilbert
2 soldiers
3 Indians
9

Boat No. 2
Dr. Hoffmann
O'Sullivan
Pfifer
1 soldier
Salmon
3 Indians
8

[This list totals 33 and omits one of the boatmen either James, who is mentioned above as replacing Mason, or Thomas Hoagland. One of these two men is the boatman listed as being on the "barge"]

Where we touch the south spur of Dead Mountain—Spirit Mountain—it shows a volcanic conglomerate roughly homogenous and showing no lamination. Erodes in grotesque but not bold forms. O'Sullivan photographed these from Mohave. The front line of hills in the picture is laminated coarse sand like that near Desert Springs.

Camped at Hardyville mill. Salmon's boat behind.

Sunday, September 17, 1871

Before breakfast examined a wash from the Black Mountains. The 24 first boulders gave

- 1 white quartzite
- 1 vein quartz (volcanic?)
- 1 (volcanic) tufa
- 1 basalt
- 1 lava like that (collected) below Mohave
- 3 lava (or quartzite) dark gray and homogenous
- 7 other lavas

This showing corroborates my impression of yesterday that the Black Mountain with Rhine (?) Valley Needles and castles is volcanic or rather lava over an axis of metamorphic rock as at Boundary Cone.

Today we pass in Pyramid Cañon through a cut gap in granite—gneissoid and feldspathic.

I think on reconsideration that the spur of Dead Mountain we passed yesterday is granite. Mount Newberry may be set down as granitic. All the rocks adjacent to the river are granite, but the washes from the east bring lavas in some part basalt but mainly the typical Black Mountain lava. Also some quartzite as last night. Pyramid Cañon seems to be named from an obelisk of granite traversed by some whitish veins, said to be auriferous. Seen from the water it has somewhat this phiz [sketch omitted].

Above the cañon we camp. Found a large fragment of olla [Spanish for round earthen pot] or other earthen vessel of the Mukhoves [Mohaves].

Monday, September 18, 1871

From Camp 2 near Mount Newberry [Named after Dr. John Strong Newberry, naturalist of the Ives Expedition; Gilbert had previously worked for Newberry during the Ohio Geological Survey] to Camp 3 above Cottonwood Wash. Camps 1, 2, and 3 are in Arizona all. Mount Newberry and less confidently Dead or Spirit Mountain are of granite. The Black Mountains as every wash on the west side today has demonstrated is volcanic in its chief characters or rather in the chief part of its surface. The pinto surface and battlements are concordant features.

Looking forward toward Painted Cañon I see a number of black volcanic buttes, overlying everything except perhaps the mesas. Mount Davis is one of them.

The mesas rise in terraces as in Mojave Valley. The steps having the greatest height near the foot of the valley. This may be due to the more level character of a deposit from more sluggish water or a mere appearance referable to unequal erosion. The slope riverward would give the appearance if the erosion was regularly arranged in *diminuendo*.

Yesterday and today favorable winds and a deal of sailing. Gulls of small size. Ducks or geese in air.

Camped at dusk with the barge, the others being ahead. After supper and during a swim received orders to follow on and after a smart pull in the dark, reached Mr. Wheeler, etc., and finished the Stars at 11:40.

Tuesday, September 19, 1871

Remained half a day in Camp 3 which is just below Painted Cañon and then moved on. Painted Cañon is not a very startling affair in point or size but well deserves its name. Its variegated lavas are umber, ocher, black, and reddish. Not brilliant colors but in good contrast. Mount Davis just above has a covering and probably a mass of basalt (collected), and several buttes on the opposite side of the river have a similar appearance. They form isolated foot-hills to the mountain range.

Mount Davis has for a background the Black Mountains. Not near so black as it and plainly of volcanic surface.

Fine exhibitions of cemented gravel mesa in the vicinity of round island. Bold bluffs facing the stream 50 feet high.

The rocks through which Painted Cañon runs rise little or none above the gravel mesa.

The consolidated gravel was upheaved probably in common with the volcanic activity forming the Painted Cañon range. The shore profile is somewhat thus [sketch omitted].

Wednesday September 20, 1871

At dusk last night we had on our left a bold Basalt hill—one of the Mount Davis suite and from camp we could see another. The Opal Mountains look like granite, but I have not seen the wash yet to ascertain. Much of our way we have on one or other shore a bold, even overhanging bluff of gravel or river deposit standing often 100 feet high.

12 to 2 o'clock we passed a beautiful volcanic mountain in Arizona, a mountain banded with umber or vandyke brown, and orange lavas and piled up in turrets and of symmetrical verticality.

We camp at Eldorado Cañon. A five-stamp mill with 4 pans and 2 settlers and all accessories stands essentially in ruins, that is it is keeping itself and everybody (inclusive) that comes along packs what he fancies.

Rations for 14 Indians

- ½ cup flour morning and night each
- ½ cup coffee morning and evening all
- ½ cup sugar morning and evening all
- 6 lbs. Bacon morning all

Grove Karl Gilbert, 1843 – 1918



Geologist of the U.S. Geological Survey, 1879-1918. Gilbert, who had been a member of both the Wheeler and Powell surveys, was a close friend and advisor to John Wesley Powell. Gilbert served as Chief Geologist from 1889 to 1892. Gilbert was described as "An authority in many fields and yet one who never assumed authority; a leader in science and yet one who never assumed leadership; neither power or glory did he seek, but the satisfaction of contributing his share to the sum of human knowledge."

2 crackers morning all
Dried beef q. s. m. [q. s. m is Latin for *quantum sufficito* or whatever suffices]

Thursday, September 21, 1871

This morning the main party goes ahead and leaves me with a side party consisting of

T. H. O'Sullivan
Frank Hecox
[George] Salmon
[Johnathan] W. Grinnel
Arthur Keegan
3 Indians

Rations for 7 days; to connect above Callville.

The mail carrier from Mohave to Salt Lake via Callville weekly passes Eldorado Cañon and we left letters conspicuous on his trail.

Table Mountain the flattest of the flat volcanic mountains. Everything looks volcanic ahead—red and brown and black over a purplish gray.

We make camp several miles up the cañon but don't know whether we have passed Roaring Rapid. Cool water and clear in a pool separated from the river. But the river is of the color of red clay and thicker than the Missouri itself.

Our photos today are Cabinet—

Gibraltar from below. The gate of the Black Cañon.
Gibraltar from above, looking toward Cottonwood Valley

Stereo—

Gibraltar from below gate of the Black Cañon.

The wind was of great service today carrying us along gaily except at three or four rapids. Contra, it interfered with photography and kept O'Sullivan in a perpetual state of profanity.

I am a little disappointed in the Black Cañon as I had based my ideas on Ives' view of the entrance [drawing by F. W. Egloffstein from sketch by Lt. Ives, Part I General Report, Plate V facing p. 80] of which I cannot find the original. Gibraltar affords data for half of that picture but the other side is wanting. The points are comparatively few where it is impossible to land a boat on one side or the other of the river. As a rule one side is accessible and the other not. There is no mile in which the cliff cannot be scaled on both sides.

Geologically the cañon is an eroded channel through lava umbrous red and brown or burnt umber and burnt Sienna in surface color, but gray on fracture. In a few places near the foot of the cañon there is interstratified ochre-yellow volcanic conglomerate (conspicuous at the left view of the gate). The lavas too are conglomerate in structure.

Friday, September 22, 1871

Had a glimpse of 2 [desert] sheep while at breakfast. We all rushed for our guns, though they were far beyond range, and they disappeared. Two Indians started out and obtained a shot that did the sheep no harm [four pages of sketches omitted].

Dead Mountain	S 13° E
Davis Mountain	S 33° E
Table Mountain	S 65° E
distance 5 miles to	N 55° E
Gibraltar	S 22° E
Camp Big Horn	N 20° W
½ mile distant	
A Table Mountain highest	N 10° W
point 15 miles	
Acute point	N 16° W
in range 25 miles	
Acute point in range	
12 miles	N 60° E

These are magnetic bearings from a peak near Camp Big Horn.

Everything appears volcanic except distant mountains at the north and perhaps the Opal Mountains. The lava I start on bears many boulders of granite and gneiss.

Cistern (barometer) at Camp	29.330 in.
Aneroid at Camp	29.120 in.
Aneroid on hill	27.900 in.
	1.220 in.

Corresponding to 1,325 feet the height of the hill above camp.

This gives Gibraltar about 700 feet. Table Mountain must rise above camp 2250 feet and a few other points 1750 feet, but the buttes will not average higher than the one climbed and the general height of the visible walls of the cañon is but little over 1000 feet. The butte opposite camp is about 900 feet. Above camp the walls are low for a space.

Below high water mark the surface of the rock is blackened.

Above Camp Bighorn and thence to Camp 2 the immediate walls are low and the view from the river is more extended. Looking ahead from Camp 2 we see walls closing in again and the portal is so impressive that we camp so as to photograph it in the morning.

Approaching this camp and for two miles below, the walls are of a peculiar old lava or young plutonic rock, highly feldspathic and with the feldspar in large crystals. It is divided by parallel curved joints into sub-vertical strata a few inches thick and decomposed on the surface. Fragments of this imbedded in later lava I have alluded to above as granite and gneiss but the identification now seems doubtful and the case requires examination.

Rapids are caused on this river chiefly by washes; not entirely however. A notable example is afforded by Roaring Rapid. A wash here comes from the Nevada shore and carries a great amount of large boulders

athwart the current. At some time these have been so far removed as to carve a deep channel above so that slack water prevails above the present dam. Other rapids are at narrow points in the gorge where the walls are falling in and so obstructing its water.

Saturday, September 23, 1871

From Camp 2 to Camp Keg (3) of the Black Cañon Series.

Most of the day was spent in photographing but we managed to get a few miles ahead toward night. The cañon in this part is in better accord with the idea I had conceived. The walls are not so steep as fancy (and Ives) had pictured them nor are they so high but they are for considerable distances unclimbable and we found camping ground so scarce that our search for it was prolonged into the darkness. While supper was cooking a mysterious object appeared floating down the stream. Opinion was divided as to whether it was an Indian or a box and it was hailed and shot at in the division of sentiment. Finally after a brisk excitement of ten minutes it was overhauled and found to be an empty barrel of bacon discarded by the Main Party above us. Thus ends the second Battle of the Kegs.

The general section along here is [sketch omitted].

1. Gneissoid lava (?) described above
2. Red lava
3. Brown lava

Sunday, September 24, 1871

In the deepest and blackest part of the Black Cañon from Camp Keg (3) to Camp Snug (4) a distance of not over 3 or 4 miles. O'Sullivan took photos at Camp Keg and again further up at a point where a side cañon gives the impression that the main cañon is narrower than it is. Here we found a large pool that we made use of for reflections. Took a ghost picture.

Rock all volcanic in the walls but the washes from Arizona bring pale granite and the bars show limestone.

Overtook the larger party and let—them go ahead again today.

Monday, September 25, 1871

From Camp Snug (4) to Camp 5 at the head of Black Cañon, passing two camp fires of the other boat parties at different places. On the way we took some views including one looking up. At the head of the cañon [we took] photos of the entrance, of a table mountain and of camp.

The cañon holds its features to the end, but is higher than below. For today's march it is all lava of the beds 2 and 3 [red and brown lava]. The Table Mountain has several hundred feet of basalt above, the talus of which lies against yellow and red soft beds, probably of volcanic ashes.

Hecox climbed the mountain back of camp today and observed with large Aneroid

Hill	27.320
Camp	28.920
	950/ 1.600

This gives 1725 feet as the height of the wall at the entrance of Black Cañon. The Table Mountain is 200 feet higher and the mountain climbed is overlooked by higher [Mountain?] at the south. The highest wall in the cañon is not over 2000 feet and probably not so much.

Sand worn rocks. This afternoon I examined the best exhibition I have seen of rock worn by blown sand—on the talus of the cañon wall near camp. The rock is sub-homogenous lava and lava breccia, and is worn in such manner as to give an appearance of solution influenced by grain in the stone. The surfaces all bear relation however to the position in which the boulders lie, being deepest on the windward side and diverging where the air currents divide.

The foreground of the Table Mountain view has red and yellow soft crumbling lavas.

Names of Indians in the Boat Picture

- Eul - l - taw
- Tah - wáh - gah
- It'z - l - quáh - rah
- Eelítá
- Taw'aga
- Itsíquara

older than No. 3 and probably synchronous with No. 2 [the red and brown lavas].

Tuesday, September 26, 1871

	Magnetic [bearing]	
Acute peak in range, 10 miles		S 75° E
Acute peak in range, 15 miles		N 8° W
Spring Mountain Peak		N 60° W
Table Mountain		E N E

The gravel that underlies Fortification Rock and Table Mountain, is newer than Black Cañon lavas and older than the basalt of those peaks. The river bluffs above are of more recent gravels. Think the lower (red) bed of Table Mountain is lava—the yellow above gravel. The same beds north of the river bear the same relation to the basalt that forms the Table Mountain there.

At Fortification Rock were pictured the Butte itself the sculptured gravel opposite and some sand-worn rocks. We left the spot at about 1 P.M. and to Vegas Wash—2 or 3 miles—had to tow up a steep hill made by the debris from the wash. The slack water above this dam gave us easy work nearly to Callville, a distance of ten miles(?). All the way the banks show gravel bluffs of coarse and fine material, half consolidated so as to give rough semi-castellated forms.

Wednesday, September 27, 1871

Our camp last night was at Callville, a deserted city of a dozen houses, all roofless. Two are squarely built with mortar, the rest of loose stone. Lots are fenced in with

stone.

Left letters for mail riders who meet here.

O'Sullivan's hand so sore that we make no pictures here.

Just above Callville is the head of the valley we spent yesterday in. Here is the greatest exhibition of gravel we have seen not less than 700 feet high and, lying north of the river principally. A mile above Callville carries us up a very steep rift and, brings us in still water to Camp Layover at another mile.

Layover Camp (11) is in Boulder Cañon a mile from its mouth where the sides are steep but not high. Hamel rehearses his woes and exhibits his sores and I help him make a section of the river at a point where it can be little broader in high water [section measurements omitted].

Thursday, September 28, 1871

From Layover Camp (11) to the head of Boulder Cañon. Boulder Cañon is identical in style with Black Cañon but much shorter. Gneiss and other metamorphic rocks are distinctly developed in it. Rock salt and incrusting salt occur in its banks. The section next page expresses my present view of the sequence of rocks:

1. is granite or at least ancient plutonic rock upheaving.
2. a series of metamorphic rocks chiefly gneiss [sketch omitted].
3. and 4 are unconformable with 2 and are red and brown lavas gray to purple in fracture.
5. is a later volcanic (3) product showing at the head of the cañon and in the valley above soft and pale yellow and capped near the Cañon Range by
6. a red basalt

All the rocks within the cañon are pale ocher in sheltered places and black to umber on projecting surfaces. This remark refers to the appearance at a distance and cannot be applied to the details of the surface.

Friday, September 29, 1871

From Camp Dust at head of Boulder Cañon to Camp one mile below mouth of Virgin River. At Camp Dust we were overwhelmed with fine and coarse sand all evening until late at night. In the morning I found some sand worn rocks as at the head of Black Cañon.

On further examination it looks as though 6 [above] might be identical with 4. A still more recent sediment is a red water laid conglomerate seen only near the mountain where it dips west toward it. This bed may be equivalent to other beds in the open valley and separated by convulsion from them. Leaving the mountain slope we strike on the north bank an amygdaloidal basalt not rising to any height near the river and probably coeval with the low butte that rises a mile and a half northwest from our evening camp. In the evening I visit with Lt. Wheeler a salt well near the butte and a [sketch map omitted] mile from camp. The sand worn pebbles on the mesa are very interesting and serve to account for markings that have

puzzled me heretofore because I could only suppose them due to peculiar atmospheric conditions. The effect could hardly be produced when meteoric decomposition was rapid or rain frequent.

Notes on well [sketch and part of description omitted].

The upper surface of this gravel is covered by pebbles curiously wrought by blown sand. Carnellians too are common.

The strata at the sides were evidently formed continuously with water at a high level and have been undermined by a subterranean current induced by the subsequent drainage. The walls are of undisturbed gravel and as steep as it will lie.

Water salt almost as the ocean. Felt but did not taste alkali. It is possibly derived from the Virgin River but not, probably. Water with a free outlet does not force its way through sand beds. Some water we saw trickling through gravel on the river bank probably comes from this stream, and it is probably merely a course along bedrock of water accumulated in the gravel mesa. The salt is derived from all of the sand of the region.

Saturday, September 30, 1871

This morning paid another visit (from Camp Virgin River) to the Salt Well with Richardson to sketch and Hecox to read barometer (stupidly). Whatever may be his result I record it as evident from inspection that the water of the well is not lower nor much higher than that of the river and that the depth of the open hole is not far from 45 feet at the low (river) side.

Mojaves and Piutes last night talked, laughed and gambled with each other in our camp. Today after we were well under way Eelitaw announced that he had overheard the Piutes planning the shooting of the Mojaves from ambush up the river. So we had a mild panic (chiefly our invalid) and concluded to make camp with the other boats tonight though it cost us two hours of fair wind to wait for them to overtake us.

At intervals all day we have been in sight of the Virgin Range, not near enough to see more than that the rocks are obscurely stratified and contorted, whence metamorphic is inferred. Tomorrow we shall see some rocks that have the same distant aspect as these, q. v.

At night we approach the Cathedral of the Colorado and it is resolved to wait and photograph it tomorrow.

Sunday, October 19, 1871

A mile of travel early and then a delay until 1 P.M., photographing the Cathedral. We waited for a favorable light.

The Cathedral I guess to be 600 – 700 feet high, a mass of half-cemented gravel and sand with one belt of basalt at the base of the principal tower. The whole is a remnant of a gravel formation that has filled the valley formerly. The absence of marine deposits on the west flanks of the Black Mountains leads me to suppose that the retaining wall for this gravel-spreading was of rock, the cañons, Black and Boulder not having been cut through. This gravel era was interrupted or interspersed

George Montague Wheeler, 1842 – 1905



In 1869, Wheeler, 27 years old and three years out of West Point, began a reconnaissance south and east of White Pine, Nevada, to obtain data for a military map and revived the interest of the Army Engineers in mapping. From an article by William Rideing in *Harper's New Monthly Magazine*, May 1876, p. 807.

by basalt. The eruptions forming hard beds that form frequently the crests, tables and combs of residuary gravel buttes and mesas near the head of this valley.

Three or four miles above the Cathedral we start into a cañon through a metamorphic range (the Virgin Range) the general dip of the rock is anticlinal and its character gneiss and gneissic quartzite. Navigation occupied so much attention that I had little for the rock. Through the first half we sailed and through the second rowed. Finally at the head we overtook the other boats at a long stiff rapid that we did not attempt on account of darkness. The superiority of management of the barge as compared with No. 1 was conspicuous as they went up this rapid where everyone put his best foot foremost. Richardson steered No. 3 up by moonlight.

Monday, October 2, 1871

This morning we put on a heavy line and towed up our boat.

Palisade Rocks

Day before yesterday at the point where we stopped to wait for the other boats we passed under a low palisade on the south bank composed of massive breccia of gneissoid (?) rock (collected). From the massive character of the face of the bluff I infer doubtfully a volcanic origin of this formation. The stone itself will bear study.

Coming up the long rapid (the first long and swift rapid of our trip) we emerged from the metamorphic cañon and entered a small valley bounded west, north, and south by metamorphic or at least highly inclined sedimentary rocks, and east (visibly) by a high gravel mesa. Adjacent to the river are gravel mesas of two distinct epochs, the lower being red. These are in one sense unconformable. The red was eroded deeply before the deposition of the other [sketch omitted].

General Ideal Section

1. Red gravel
2. Gray gravel and sand
3. Red rock

[sketch omitted]

In places the gray overlies the red after erosion and in general we may say that the red was succeeded by a low water system, succeeded in turn by a higher.

At several points the upper gravels are seen to be interstratified with basalt flows, or rather, at several points I saw the same intercalated flow 10 – 20 feet thick.

We camp (in advance of the others where we command a view for morning photography) I set a goose to stewing, a goose that was shot by Hecox 99% and O'Sullivan 1%.

Tuesday, October 3, 1871

Yesterday Halitauwa had a talk with some Piutes on the shore, and obtained from them a melon and doubtless information that he did not divulge.

Photographs this morning: 1st Cabinet and stereo of highly inclined sedimentary rocks through which the Colorado flows in a monoclinical valley of erosion.

2d. A dry wash seen across the river [sketch omitted].

General section of photo

a, a series (200 feet) of various rocks but chiefly sandstone, consolidated red sandstone.

b, a series (500 feet) of various rocks thick-bedded. Includes chiefly limestone secondly quartzite.

c, a bed of soft gray shale.

The strike of these beds is very straight and N 20° E, their dip 45° to 60° E.

Two miles north the river channel turns obliquely to the right, cutting across the b beds while the monoclinical valley continues to the north as the channel of a wash that pours down detritus to dam the river very seriously.

Turning into this oblique channel I get a continuation of my section of rocks drawn on page 37 [omitted].

a thin-bedded sandstone, etc. = a of page 34 [previous column], 200+ feet.

b = b of page 34. Heavy limestone beds, blue gray within and gray, snuff, vandyke brown, etc. within 600 feet.

c thin-bedded sandstone, etc. of many colors, at top chiefly yellow sandstone 600 feet.

d Red sandstone, friable equal in quality that of Cottonwood, massive and changing to 800 feet.

e yellow sandstone like the Cottonwood 800 feet.

f must be described tomorrow.

We encamped at a rapid and photograph it trying unsuccessfully to catch a boat in its passage.

Our lunch—rather late—was under a bluff [sketches omitted, including Beaver Rapid and Grand Wash] of yellow and red sandstone and our supper not a mile away and in plain sight of it [sketch omitted] [spelling of two Indian names omitted].

Back of our camp was a low bluff or basalt—detached masses of columns falling down from the undermining of the supposed sand beds. Above them on the same side is a large wash (see map) the largest we have yet seen. Its grade is low and its bed broad. From it comes percolating water that rises in a series of springs along the Grand Wash [sketch omitted] river bank. A great mass of gravel from it blocks the river and makes three rapids. On the upper the barge stuck at night and had to be relieved of her cargo. Ryan and an Indian were hurt in the mêlée. From our camp 40 rods below we went up to their assistance.

Beavers tracks plentiful and Hecox saw one by twilight. I watched for them in vain.

At our morning camp the limestone (framing this foreground of vertical strata view) is finely sculptured by blown sand as well as bored by potholes. The stone takes a beautiful polish and I secured a number of splendid specimens.

Wednesday, October 4, 1871

Sent help again this morning to the barge who reciprocated. While this was transpiring O'Sullivan made two views of basalt columns, one of fish-hook cactus, and one of muskeet [mesquite] and Nitchiquava whom I persuaded to sit for his portrait.

At the head of the difficult rapid we enter a cañon at first across and soon with the strike of the strata. I am disposed to believe a fault exists at this point so that the limestone and sandstone of the bluff we cross are the repetition of b, c, and d

(Section Page 37)

b' massive limestone, gray blue within; variegated without, but umbrous in the distance, 500+ feet, +

c' yellow sandstone, crossbedded, 150 - 200 feet.

d' red sandstone, crossbedded, 500 + feet.

e' yellow sand, 100 feet.

On the upturned d' beds rest gravel beds that continue all the way to the Crossing and to the Great Mesa front.

Reached camp about 1 P.M. and found letters from Emma, Grace, Howell, and Bill.

A trip to the mesa back of camp:

1st. I see no distinctive great wash here in this north/south valley, but think the wash of last night must be the one known as great wash.

2nd. The edge of the Great Carboniferous Mesa is not due to erosion, but to a dislocation with a north/south trend [sketch omitted].

This is the section of rock for yesterday's, today's, and the next day's travel.

The wall has the right to all the adjectives (except numerical) that have been given to it.

The gravel that forms the valley mesas has been formed and reformed in a manner indicating something besides a gradial drainage. It is not however highly inclined and perhaps not at all disturbed. The lower gravels are redder, perhaps because more of the sandstone then contributed to the formation (poor guess).

The barge reached camp at 3 P.M. and so the entire water party got in to the crossing rendezvous in time.

Flour
Yeast Powder
Hard bread
Bacon
Beans
Rice
Sugar
Coffee
Cans
Vinegar
Pickles
Pepper
Salt
Soap
Matches

	Pilots	Keegan	Pfifer	
Plates	5	1	2	8
Knives	7		1	8
Forks	5	1	1	7
Spoons, large	3		1	4
Saucepan cups	(overboard) 5	1		6
Kettle	1			
Pail, small	1			
Frypan	1			

Oven for Sgt. Eisenbise
[two Indian names omitted]
Flour 1 cup a day each
Sugar Coffee Salt
Bacon [?] each
Cracker each per day

Thursday, October 5, 1871

In camp at the crossing of the Colorado. In the course of the afternoon the land parties arrived and were ferried over.

Had a long talk with Marvin and Ogden. [A. R. Marvine, a geologist with the Wheeler Survey in 1871, but not on the Colorado River trip.]

Packed a box for Truxton Springs's

Hence the River party takes but three boats, each with 15 days' rations for its 9 men; Lieutenant Wheeler, Mr. O'Sullivan and I command the boats. My party to start in the a.m. consists of

G. K. Gilbert, Geologist
E. M. Richardson, Artist
Frank Hecox, Meteorologist
Richard W. James, Cockswain
Thomas Hoagland, Cook
Private Arthur Keegan
Mojave
Mojave
Mojave

[omitted; barometer reading for section at mouth of Grand Canyon, small sketch and description page mostly blank, description of section at mouth of Grand Canyon. Section published in Wheeler report, Vol. 3, Geology p. 162-163, Section VII]

The general dip of the rocks is northeast. The mesa rises a little toward the south and drops off to the north. The hard lime that caps it is smooth and bare of soil though as well covered by vegetation as the most of the country.

"Rat-tail" Cactus [Ocotillo] is a bush branching at the base and sending upward a dozen shoots [sketch omitted] all armed with strong spines as frequent as those of the osage orange. The leaves are obovate lanceolate and shorter than the spines. The branches rarely divide.

Friday, October 6, 1871

I propose to call our boat (No. 3) the *Trilobite*. We managed to get off from Camp Crossing at about 10 a.m., just in time to miss the swimming of the mules. Mr. Marvine accompanies us so far as to get a glimpse of the mouth of the Cañon and then returns. We camp outside the Cañon and Hecox and I start to climb the wall. Hecox sickens (morally) at the first third of the climb, and returns. I do not reach the top until after sunset though I started at about 1 P.M. It is the hardest climb I ever undertook.

Saturday, October 7, 1871

Last night I spent alone on the mountain at the foot of the Big Cañon. Having no blankets I built a little fire in a sheltered spot among the rocks and hugged it all night, getting little sleep.

The first thing that day light shows me is that I am on only the first terrace and the second rises 5 miles to the east and trends a little south of east. I cannot yet tell whether the Colorado cuts it. There can be no doubt that it consists of yellow and red sandstone thus: [sketch showing yellow overlying red omitted] and the best guess I can make at its feet is

Yellow	600
Red	1200
Total	1800

There is a dip of this mesa toward its base so that it does not tower more than 1500 feet above this point which seems to be 4000 feet above the water. The magnetic bearing of a profile of it that may be 20 miles distant is S 71° E of a very distant profile, S 67° E.

The wash opposite the camp of the land parties last night comes from this mesa a few miles from here. It is not easy to be sure from this point, but it looks as though the great wash made into the Colorado at beaver Rapid.

The Wash Valley lies between the Virgin Range and this mesa front, and is very broad. There are many basalt flows on its western side none to be seen on its eastern. Here is the limit of disturbance. I will redraw my section p. 41 with trifling amendment thus:

The ridge terminates a little north of the river and runs not very far south. The ridge is not conspicuous [sketch omitted].

The gravel accumulations in the Wash Valley are immense and prove that a high barrier has once contained the waters of the valley. The rise in going south in the valley is rapid and a point cannot be distant whence the drainage is southward. [continuation of geologic section at Grand Wash Cliffs omitted].

Reached Camp at about 1 P.M. with a big fire on. Whiskey coffee and rest brought me around however. The south shore is festooned and covered by calcareous tufa, in places still moist. A great deal of water is now flowing from springs along the shore.

Broke camp about 2 P.M. and worked up the river a few miles, passing springs.

The granite that we had at the mouth and which I neglected to collect disappeared on today's march and the strata descended so as to bury No. 2 [Tapeats Sandstone] below water. I feathered out my collection to represent the great section but still left the representation meagre.

Sunday, October 8, 1871

This morning we got ready early and I walked back to meet Lt. Wheeler who with O'Sullivan had camped a mile below. With him I revisited the springs on the north shore and we named them.

A large one of the crater style with flowers we called Tufa Spring and Tufa Springs would be a good name for the group. Another larger one with a fantastic canopy of tufa is Grotto Spring.

A third is Baptismal Fountain.

A fourth (now dry) and hanging against a larger one is the Holy Water Fountain.

A dripping spring where tufa a foot from the water projects far over it. Starting our boat along we find yet other springs on both shores. Many of them voluminous. At one are some scrubby trees a foot or two in diameter but with the habit of the water willow. The leaf is small and unequally cordate [sketch omitted] the leaves on sprouts being rounder than those on old stems.

Verdure is to be seen at many points on the bank and referable to springs. It is confined however to the sandstone doubtless because the limestone is not so pervious [barometric readings omitted].

In the afternoon Lt. Wheeler and I came to a rapid where we deemed it advisable to wait for the *Picture*.

I climbed the bluff to Old Snuffy [one of the brown dolomite tongues in the Bright Angel Shale]. Near the water line are rocks with scolithus, loosely aggregated sandstone, Potsdam sandstone? It must be 75 feet thick on the granite [sketch and description of geologic section omitted].

Copy of Order, Camp No. 20, October 8

Plan from crossing of Colorado to mouth of Diamond River, 65 miles. Have reached a point 60 miles from Diamond River on the eve of the 8th. Diamond River should be reached eve of the 16th. Number of days (9, 10, 11, 12, 13, 14, 15) = 7 — average per day = 8 ½ miles.

The boats should be within short communication from this point until a distance of 15 miles when it will be expected if nothing remarkable happens that there will be no physical obstacle to the reaching of Diamond River.

This point must be reached on the evening of the 10th inst [in nomine Sanctae Trinitatus, in the name of the Holy Trinity].

The boats may each run independent—

Mr. Gilbert should camp with Lt. Wheeler at two points between this and Diamond River—1—evening of 10th; 2 about midway.

If it is considered advisable one boat—light will be sent ahead to be some 48 or 72 hours from mouth of Diamond River and this will complete the time allotted for river

exploration.

It therefore becomes necessary to lose no time that can be devoted to the collection of details.

finis

Monday, October 9, 1871

Last night all three boats camped together and this morning started in inverse order of numbers. The *Trilobite* did not however keep her lead, but was passed by the *Picture*.

Last night observed the stars and this morning found a quantity of sand on bed clothes and in eyes, ears, and mouth. Plenty more tufa springs this morning, all on the north side. Afternoon we see more of the subadjacent granite, now a flesh colored variety. For a mile it shows in both banks and it rises in places 30 feet above water. It is beautifully wrought in potholes and resists the erosive forces better than the sandstone though not much better than the superposed sandstone that up to the scolithes beds is 100 feet thick (guess) and coarse, purple red; cross-laminated, and black below high water line.

Tuesday, October 10, 1871

Our Camp (21) last night was on the debris from a large wash from the north—the largest wash we have seen in the cañon. The gravel is piled up 40 - 50 feet above the water though it is covered by high water. Along the whole length of it is a rapid with a fierce one (that we dubbed the Cascade) at the head. In attempting these rapids last night by No. 1 boat a failure and Roberts hurt—it is feared seriously. This morning Panambona was hurt near the same place, striking his chest against a rock. When we finally got up the cascade it was about 11 A.M. solar time.

A low arch of granite was visible near Cascade Rapid and not far above it began to be continuously visible. Through the day it has risen higher and higher until now (5 P.M.) I think it is 200 - 300 feet above the water. Rapids today have been fewer and higher than yesterday when 15 were counted. The granite stands up at 45°, the sandstone (Potsdam?) above it is nearly as steep, in fact steeper at base and the shales make a base for the limestone wall that averages about 45° [sketch omitted].

This is the profile or something like a true scale so far as the angles of slope are concerned.

The tufa has not formed a wall anywhere today but I see a small line of it ahead. Neither have I seen any springs along shore. The washes I have entered so far all have running water in them though not very much. At the middle of the day's march is a basaltic lava flow occupying an old channel cut in the sandstone.

The section on next page is almost a sketch of the view given by a side canon of the arrangement of [sketch omitted] the different beds. The base of the lava is about 200 feet above river and 50 - 75 feet thick, and flows (according to O'Sullivan) from the north shore though the sketch is made on the south. I could see (certainly) no remnant of basalt indicating that it flowed from the south. The arrangement of the columns is noteworthy. It seems

as though they had been [sketch omitted] formed normal to the cooling surface.

Encamped on the granite (Camp 22) because night left no time to pass a rapid and reach sand as usual.

Wednesday, October 11, 1871

Direction of great joints of the red wall limestone (approximately) N. 30° W. and N 75° E. There are no well marked systems of joints in the stratified rocks. These bearings are along pretty continuous walls of the "red wall limestone" as I may as well designate the heavy mass that it troubled me so to climb.

A mile from the sandstone cliff opposite our camp where Messers. Wheeler and Hamel and I have climbed for a view, etc., my principal point of interest is a black vein in the granite that proves to be basaltic lava. It is about 6 feet thick where visible and apparently tapers upward, though this could not be definitely ascertained as it is lost in the debris.

The granite adjoining the lava is unaltered. The lava seems homogeneous throughout and neither close nor distant inspection revealed any prismatic structure.

We find as we proceed two long stretches of rowing water when granite walls hold the river narrow with very little debris at the foot.

A sharp rapid intervenes and at the head, of the upper a rousing rapid that gave us one too many.

The leading boat, McGeary at the helm, Hoagland at the pole, wrecked or rather swamped and upset scattering its freight along the bottom and top of the river. I started at once with Hecox, Salmon, and Keegan and Drew as oarsmen to save the floating debris. We managed to pick up the oars and some blankets, baggage and others were saved along shore, but 3 or 4 beds, 3 pairs of saddlebags, and a considerable amount—nearly all the rations were lost. The most serious losses were those (continues after tables below)

P.M.

1 ½ cups flour
1 ½ cups coffee
1 ½ cups sugar
beans

A.M.

1 ½ cups flour
1 ½ cups coffee
1/12 cups sugar
1 ¾ lbs. bacon
2 crackers each
dried beef

of the Record of Astronomical Observations of Party 1 and of Lt. Wheeler's basket of papers and notebooks. My only loss is of the Macomb Expedition Map that Dr. Newberry gave me.

Some of the men are demoralized a little by the rapid and tomorrow I have volunteered to steer a boat up.

The granite continues to grow higher and is beautifully

sculptured by potholes and sand action on. Much of the surface is smooth and glazed.

Thursday, October 12, 1871

This book opens under a cloud at Camp 23 in the Big Cañon, for last night occurred the accident that lost valuable books and papers and this morning all hands are at work repairing and searching. As the sextant books are lost I have given observations a place here [observations omitted].

Did I forget to record that on the 9th inst [in nomine Sanctae Trinitatus] we passed a monument of stone built by white hands, .5 feet high by 2 feet square. Lifting the top stone I found under it a box and a piece of paper. On the paper is written:

Sevintz Cañon
Sevinta Mountains
May 5 186(4)

This point was reached by party of men with (P) [?]. We believe that we are the first and only party who have explored the cañon this high.

() following () [?]

and on reverse side:

James Ferry	La Paz
Chas. Fisher	Mohave
C (W) Stoddard	Eldorado Cañon
() D Gass	Eldorado Cañon

[Lt. Wheeler had met O. D. Gass in 1869, Grand Canyon].

In the afternoon after astronomical observations and caulking we take all things up again to the rapids and with Mr. Wheeler for bowsman I take boat *Picture* up the rapid. We ship water where McGearry did but the large force on the rope pulled us through safely. Our camp at the head of the rapids.

Friday, October 13, 1871

From this point of time the boat party is divided. One boat goes down stream with dispatches and exhausted and demoralized men. The *Picture* and *Trilobite* go on up with 10 men (7 white and black; 3 red) each. Salmon being sick and James demoralized I take the tiller in strong rapids and Hecox is my efficient assistant. During the day we make some lively transits. One involved a run out with the line on the thole-pin and then a jerk ahead after throwing it off. The boat was often so highly inclined on a fall that to go forward one must climb as though up stairs.

The rock character continues unchanged. A little basalt at two points of old river bed high (200 - 300 feet) above the river. The carving (pothole wise) of the granite is most beautiful and very many potholes are shown in section 1 and 2 are type forms, 3 and 4 are [sketch

omitted] oddities. Very commonly the bottom is worn out (5) probably after the falling off that left the section a knob or ridge in the bottom. (2) is exceedingly common and suggests a cutting on the principle of the annular drill.

Saturday, October 14, 1871

This morning visited a creek opposite Camp (25) and saw Indian gardens. Left a paper. Gneissoid rocks are commonly mingled with the granite (collected specimen). Here too a little basalt on the cliff on the south side.

At noon we encounter again the worst rapid we have met and this time are compelled to make a portage of boats as well as freight. Above the rapid the current for a few rods being too swift to row and the cliff perpendicular so that towing is out of the question, we have "crept" in the old Genesee style and laid a rope to warp up by with loaded boats.

Picked up a dead duck today and saw a flock of live ones, the first in the cañon I believe.

At the last mentioned rapid more gneiss and more basalt.

The principal birds in the cañon are bats! and they can be seen at all hours of the day and night. The steep walls do really shorten the day in such manner as to delay us somewhat. Not only the granite, but even the limestone is steeper. The lower sandstone has increased in thickness.

The shales are invisible owing to the greater comparative steepness of the granite. Some granite here has a very peculiar aspect too large in pattern to be represented by a specimen we can afford to carry: [sketch omitted]

Some whitish (concretionary?) spots are suffused by mica with approximately all in the same plane, but in their general distribution presents a stellate-dendritic appearance is represented. These occur at intervals through a great mass of granite.

Camp after dark on some sand. Astronomical Observations. Camp 25.

Sunday, October 15, 1871

Inventory of provisions on hand

	White	Red	Total
Flour lbs	20-5	25	45-60
Bacon lbs.	0	1½	1½
Hard Bread lbs.	1½	6½	8
Coffee lbs	2¼	2	4¼
Sugar lbs.	3	½	3½
Rice lbs.	2½		2½
Pears cans	1		1
Beans lbs.	0	1½	1½
undivided coffee	8		

This is for the *Trilobite* only. The *Picture* is much better provisioned, but it is doubtful whether we can fully ration both for five days. The ration matter may yet turn us back.

No geological points of novelty. I collected some rounded pebbles from potholes today.

Our progress is but four miles over a series of rapids. Toward night we reach a double rapid, two rapids with a short interval of water that can be crossed.

On the lower half the rope broke and let Hecox and me drift own stream. We did not discover that we had our line dragging until it anchored us in comparatively slack water below. Then we pulled in the rope and made for the nearest accessible shore. We had shipped some water and put the cargo ashore to save wetting. Made coffee and beds.

Monday, October 16, 1871

Hecox and I were out of camp [27] last night on account of boat accident, and the camp missed us for we had food and beds, and our boat crew went without either. They had however some bread in the morning when we came up and some of them made up all deficiencies by a good hearty grumble lasting through the day. Tonight Lt. Wheeler puts us on short allowance of flour—four pounds a day for seven men (the full ration is 7 lbs. 12 oz.). Our bacon is gone, and beans and rice are scant, but coffee is in plenty and will outlast every other item. Our flour will hold out at this rate six days and those must bring us to the Diamond River or back to the crossing, the former if possible. I make out from Ives map and Newberry's section that we are not to expect any great change in the character of the cañon at Diamond River, but merely a retirement of the Red Wall from the immediate cliff. It is now far enough back to be out of sight except through canon vistas.

The granite cliff continues to show much schistose rock gneiss, chlorite slate, etc.

Basalt veins (as I can only suppose them to be for I have no time to examine them) have appeared along the cliff at many (3 or 4) points today though we have come but 1½ miles.

Our work of today was the completion of the passage of Double Rapid. On the upper half Salmon and Hecox broke loose in a boat and brought up in an eddy between the two falls and on the wrong side. Indians had to swim the river and climb around to them (a work of 2 hours) to row them over when they succeeded in getting them up. Once above the rapid we found deep slow running water (with slight interruption) for 1½ miles when we encamped and drew our daily ration or half ration. Drew the *Picture* up for repairs.

The force of the current in high water is here so great that no small gravel remains on the surface of the bottom—only large boulders. These give the rapids quite different character as regards navigation. Standing ground is generally convenient for men on the tow line. Sunken rocks are likewise abundant and the water is much tossed. The towing force does not have to wade, but pulls hand-over-hand. The steersman and bowman have to be on the alert.

Astronomical Observations tonight: Camp 28.

Tuesday, October 17, 1871

My half ration for breakfast proved quite satisfactory

and I recognize the fact that I have been eating less than the full ration in time past.

Today the same routine of rapids and rowing, and 3¼ miles progress. No change in the features of landscape or geological formations.

Wednesday, October 18, 1871

Another day of the same sort. At night a dull green schist (chlorite?) forms the whole face.

Two accidents and I in each of them.

1st. As my boat the *Trilobite* was taking in her cargo her fastenings gave way and she fell backwards over the rapid, bumping her stern severely over the rocks and starting a rapid leakage. Richardson, Hoagland and I had the ride down and I did not enjoy it.

2d. At a very lively rapid an attempt was made to drag up an otherwise empty boat with Salmon and me aboard and we were swamped and upset. Shore was near at hand and we swam to it and hung our clothes on the rocks to dry. Here I found the inconvenience of having no change of raiment (McGeary responsible).

In the first accident three carbines were lost and one of them mine. I do not feel very sorry unless I am called on to pay for it, which would be highly unjust. The care of it was onerous and not compensated by any present nor probable use.

This forenoon we saw a star (probably Venus) [Seymour Dubendorff wrote a similar diary entry for the Julius Stone trip in 1909] by day, probably at 10 or 11 A.M. It appeared just above a 1000 foot cliff that occulted the sun and was plain to be seen. This will go well with the bat matter in describing the gloom of the cañon.

Tomorrow morning Roberts and Hecox are to start ahead for Diamond River following the first bench above the river. They carry a demand for grub.

This afternoon we saw after an interval of many miles some tufa cascades. They are at several points and quite picturesque. The great drawback to their beauty is in the slimy appearance of many of their faces. They seem to head at the shale line.

The roar of the rapids is echoed by the cliffs and in the still of the night has the seeming of a mingling of many voices. As I write it is somewhat musical and reminds of church-bells in the distance (where alone they are musical).

Astronomical Observations tonight. Camp 30.

Thursday, October 19, 1871

Roberts and Hecox started this morning on foot for Diamond River and Lt. Wheeler accompanied them to the lower (Potsdam) mesa which they are to use. We hauled up the boats on the rocks last night and overhauled their bottoms (sadly in need of it) this morning.

Writing at 10 A.M. I can see but one bit of the red wall, the view on all other sides being limited by the Potsdam (?) Sandstone or the underlying granite and metamorphic rocks. Here for the first time I see an Indian (Mitawava) dress his hair. The hair is cut square across in front so as to just shade the eyes. Behind it hangs to the middle

of the back and is loosely trussed in a dozen ringlets. To dress it, he covers it all with soft mud—parts it behind so that the long part hangs forward over his bowed head in two ropes. These he [sketches omitted] twists slightly and wraps turbanwise around his head. The front lock is then brushed up and adheres to the turban, giving a Ciceronian appearance, if I remember rightly the bust of Cicero. It is said (I know not how truly) that this is done to kill lice. Our boatmen practiced it every two or three days. When the mud had dried it was rubbed out [sketch omitted].

The ordinary wearing of the hair is in a loose queue behind with a band near the end while the front hair hangs straight to the eyebrows.

We did not start today until 10 A.M. our delay being for O'Sullivan to dry things. At noon we found a salmon attached to a line and pole and hooks and two pieces of bacon—all of which gave us assurance that we had not far to go. A little later we found a float from Hecox announcing Diamond River 6 miles from our last night's camp.

By pushing we made Diamond River by night fall.

The character of the cañon immediately on the river has changed in great measure. The plutonic and metamorphic cliff has become less steep and softer. The shore of the river can be traveled on foot if one is willing to climb 50 or 75 feet occasionally. Potholes are seen no more for the rock is not firm enough to retain them. The water surface is broader and the rapids shallower. Just below Diamond River is a long rapid of course. The slack water above is not of great extent. The current has been so swift today that we have had to tow the boats most of the way.

Arriving at Diamond River we found notes from Dr. H [W. J. Huffman] announcing his departure at 10 A.M. the same day, and from Hecox and Roberts announcement that they had arrived at 1 P.M. and started on after the train hoping to catch them at Peach Springs.

It afterward transpired that the two pedestrians traveled till 10 P.M. and stopped exhausted. At dawn tomorrow morning they started on and found the train at Peach Spring, but not before they had been met by a party that Loring's message had started back from Truxton Spring.

Friday, October 20, 1871

Lay in camp at Diamond River all day resting or trying to. The river trip has proved very exhausting and after 24 hours of nothing to do (heavier than solar observations) I still feel as though just out of a threshing machine. The mule train came in at about 3 or 2 P.M. Our supper was a full-ration one, but we were not very ravenous as last night we had $\frac{3}{4}$ ration of flour and a can of pears and a salmon extra.

Four home letters and 1 each from Lucius Williams and Howell [probably E. E. Howell, a geologist with the Wheeler Survey] all via Camp Hualapais.

Saturday, October 21, 1871

I was photographed this morning as a member of the *Triobite* crew. Started mountain climbing with Hamel and lost him in the first 100 feet.

Sitting on the Potsdam step opposite Diamond River I note--

There is a fault near here of a trend N. 25° or thereabouts [sketch omitted]. It passes a mile or two east of where I stand and I think determines the wash we are to follow tomorrow. East of it this horizon is lifted 500-1000 feet above its height at this point and the other beds to match. It evidently occurred after the deposition of all these beds. Near it they are inclined somewhat. Along the Colorado the inclination is thus: [sketch omitted]

along the Diamond River thus: [sketch omitted]

My travel today is an aggravation because a sore toe prevents me from going to the top of the Hill. Mr. Hamel has made the trip however and his report of the high mesa confirms my idea so far as it goes. He estimates the height of the high mesa above the low at 1000 feet.

[omitted: barometric readings for geologic section at the mouth of Diamond River].

Mr. Hamel says we have come 222 miles from Mojave in 30 days traveling time and have passed 208 rapids [names of Indians omitted].

Sunday, October 22, 1871

Some doubt was thrown yesterday on my discovery of basalt veins by an examination of a black or green-black vein a foot wide that looked plutonic.

This morning I wrote some letters and packed my box.

I gave Panambona and Mitiwara some tobacco to pose for their picture. Bought of the latter for \$.20 an ear ring that proves to be pottery. Panambona has a scar under his left nipple given in the late battle by a Pahute arrow.

Said good bye to the boat party at about 1 P.M. and they shot the rapid.

I have saddled *Ruth* and am waiting to start away from the Colorado. Someone has just discovered that we have not enough transportation for our stuff and so we are feeding the grain to our mules.

Starting up Diamond River we quickly turn to the right with a wash for which I propose the name Straight Wash. This wash as I surmised yesterday is due to a fault [description of geologic section omitted].

Monday, October 23, 1871

Peach Springs for breakfast.

End of Transcript

Probably the only known photo of George M. Wheeler, the man in black hat. This photo was taken by Timothy O'Sullivan at the mouth of Diamond Creek in 1871. The man standing behind Wheeler is probably Gilbert. The names of the other men are uncertain.

