



2026

**SURVEYORS'**

*Conference*

**Frank Brown's**

**Deadly Dream**

**Don Teter, PS**

JANUARY 11-14, 2026 | HERSHEY, PA

# **Frank Brown's Deadly Dream;**

**Robert B. Stanton and the  
Denver, Colorado Cañon & Pacific Railroad Survey**

**1.5 pdh**

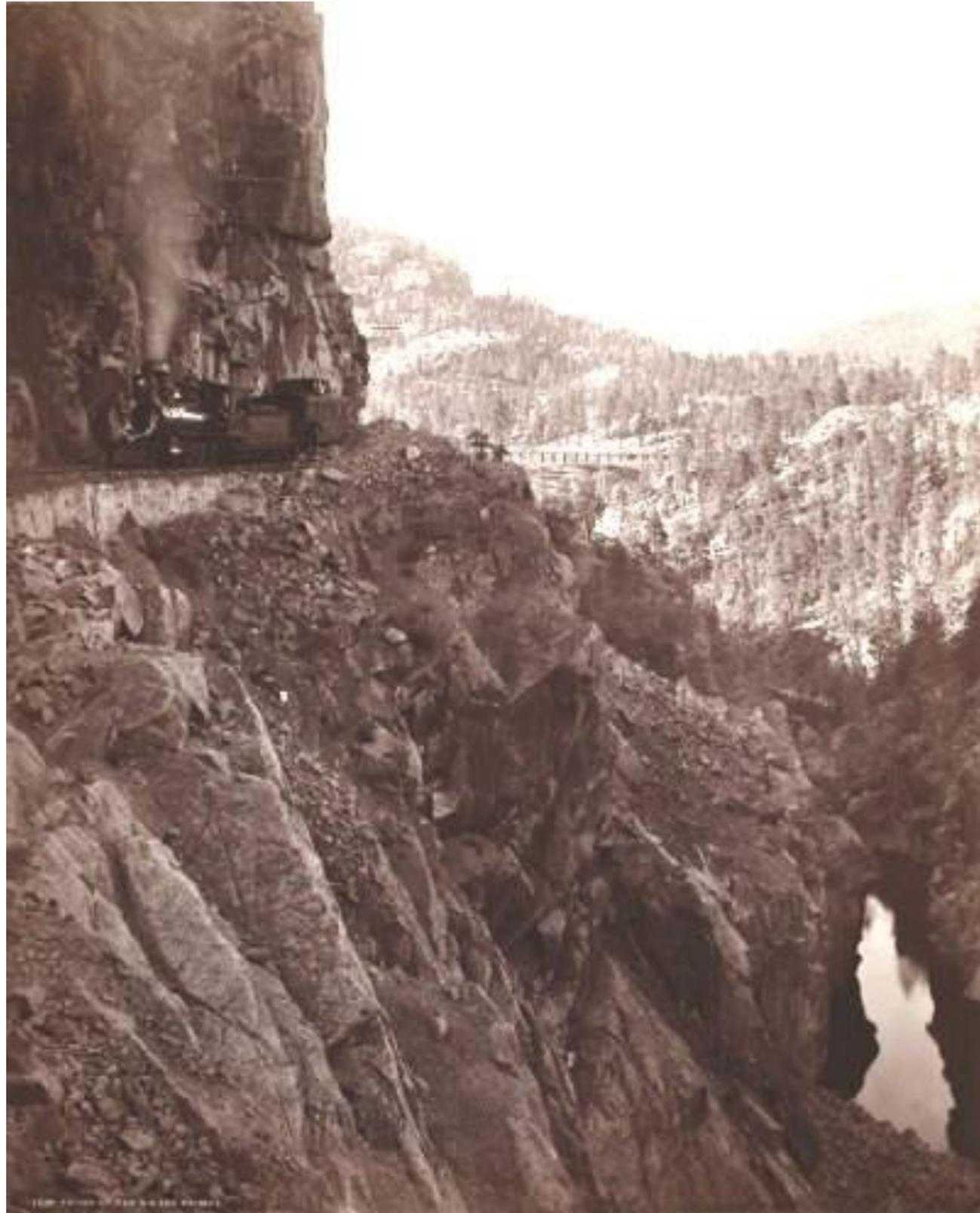
**Presented by Don Teter, PS  
Assistant Professor of Surveying  
Fairmont State University**

# The Mindset

In the mountains of Colorado the surveyors had to “locate routes that would not exceed the grades engines could pull. Often this meant working high up on steep hillsides or under overhanging cliffs. ... Sometimes the surveyors had to work where there was little or no footing. They hung by ropes from canyon walls, plotting courses that could be seen only in an engineer’s imagination.

Trains DID follow these imaginary rights of way, hanging to the sides of steep cliffs, on ledges blasted out of solid rock high above rushing rivers, winding from one side to another on spindly trestles, and sometimes crowding the streams for a foothold at the bottoms of deep canyons.”

*Kelly Choda in Thirty Pound Rails*



William Henry Jackson  
Photo of  
Las Animas Canyon  
1884



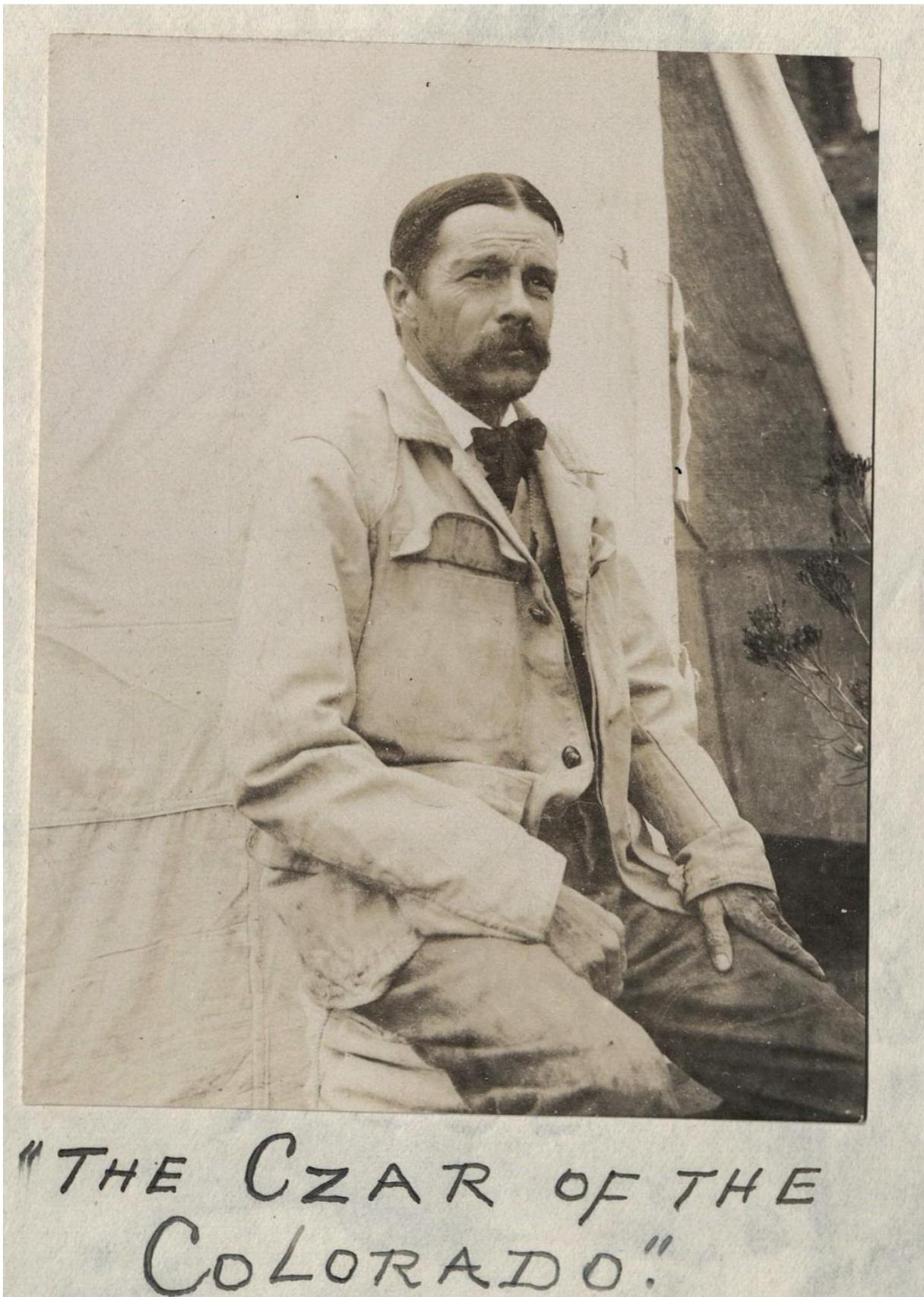


HON. FRANK MASON BROWN.  
PRESIDENT, DENVER COLORADO CAÑON & PACIFIC R.R. CO.  
BORN, JUNE 9<sup>TH</sup>. 1845. Photo taken about 1887-  
DROWNED IN MARBLE CAÑON, JULY 10<sup>TH</sup>. 1889.

1888.

# Robert Brewster Stanton

“Stanton was handicapped by a withered left arm, and this kept him from some of the heaviest labor. Anyone who reads these field notes will agree that the handicap restrained his activity very slightly otherwise.” (Smith and Crampton)



TELEPHONE 738 JOHN  
CABLE ADDRESS: KOTABATU NEW YORK  
CODE: BEDFORD M<sup>c</sup> NEILL

*About 1915*

**ROBERT BREWSTER STANTON**  
CONSULTING  
CIVIL AND MINING ENGINEER

MEM. AM. SOC. C.E. NEW YORK.  
MEM. INST'N C.E. LONDON.  
MEM. AM. INST. M.E. NEW YORK.  
MEM. INST'N MINING & METALLURGY LONDON.

MUTUAL LIFE BUILDING  
32 NASSAU STREET  
NEW YORK

# The First Crew

F.M. Brown, President; J.N. Hughes, Guest (lawyer, boatman);  
John Hislop, Transitman; Ed. Coe, Leveler; C.W. Potter, Front flag;  
H.C, Richards, Steward; E.A. Reynolds, Guest (lawyer, boatman);  
W.H. Bush, Transitman; G. Ed. Howard, Leveler; F.A. Nims, Photographer;  
Geo. A. Sutherland, Rodman; G.W. Gibson, Cook

This group left Denver on May 22, and were joined at Grand Junction, Colorado, by T.P. Rigney, and at Green River, Utah, by Peter Hansbrough and E.W. Terry.

# The River

In 1889, railroad company president Frank M. Brown, Engineer Robert Brewster Stanton, and several workers embarked down the Green River headed to the Colorado River for a railroad survey, intending to go to the Gulf of California in Mexico. This was the first major exploration of Grand Canyon since Major John Wesley Powell's expeditions in 1869 and 1871-72.

**FIELD NOTES OF**

ROBERT BREWSTER STANTON

CIVIL AND MINING ENGINEER

METAL WORKING

32 NASSAU STREET, NEW YORK CITY

**DENVER, COLORADO }  
CANON & PACIFIC }  
R.R. SURVEY. }  
1889 AND 1890. }**

VOL NO 1

FIRST Expedition, May 10 '89  
to July 3 - 89. p. 1-220

SECOND Expedition, Nov. 25  
to Dec. 26. 1889. p. 221-26

N.B. For Notes fr. July 4 -  
to Nov. 25 '89 See  
Vol. No. 2. p. 1st on.

Vol. No. 1 "A"

Private Property of  
**ROBT. B. STANTON.**

Notes of an  
Instrumental  
Examination of the  
Canyons of the Colorado  
River of the West.  
for a Railway Line  
from the Coal Fields  
of Colorado - to the  
Pacific Coast  
By Robt. B. Stanton  
C. E.

MAY 24. ...went over to the railroad to look at our boats. I was awfully disappointed ... They are light brittle cedar hunting and pleasure boats, totally unfit for the work they will have to do down the Colorado River. ...really unsafe. Two of them have very large splits in their bottoms by the handling they have received in the cars.”

(According to Ghiglieri and Myers, *Over the Edge: Death in Grand Canyon*, the five boats provided by Brown were cheap “15-foot-long canoe-type boats only 40 inches wide, a mere 18 inches deep, and built of thin planks of brittle red cedar.”)



Robert Brewster Stanton

THE START - FROM GREEN RIVER - UTAH.

MAY 25<sup>TH</sup>, 1889

MAY 25. Completed repairing boats ... impossible to load all our stores in boats ...with watertight compartments in center. Took these out, made them into a raft, and loaded them full of stores and screwed down tight. All moved off smoothly.'

... Boats all in good order, except *Brown Betty*, old boat, which is leaking all round her top lap. Gibson and Richards quite alarmed as they have the raft in tow ... hauled up on shore and unloaded and carefully caulked ... flour and lard for '*dope*.'"

... first small rapid. ... *Denver* stuck on rocks and stove 3 holes in her bottom. All hands jumped into river and carried rest of fleet over safely."

First 120 miles down the smooth waters of the Green River to junction with the Grand River (now the Colorado) reasonably uneventful. Reached mouth of the Green on May 29, camped on the west bank of the Green in about the same spot where John Wesley Powell had camped in 1869. Picked up survey made earlier from Grand Junction by Frank C. Kendrick.

## *The Troubles Begin*

May 31. “Learn of narrow escape of Richards and Gibson and loss of our ‘float’ and about one third of all our provisions ... I instructed if they got into swift water and could not manage ...to pull to shore as quick as possible. ... had tied up the ‘float’ and their boat in eddy above rapid, when Brown ordered them to take boat and bring float across the river, above the rapid where he had made camp ... were caught in the swift water when they both jumped out into the river and struggled hard to save the ‘float’; but finding that they and their boat were about to be carried over the rapid they cut loose the ‘float’ and let her go, and saved themselves and their boat. *No* blame whatever can be attached to the boys.”

## *Loosing Supplies and Equipment*

June 1. “two portages and run and let down by ropes [over] three rapids. The hardest day’s work I’ve known for years.”

June 3. ... “Boat No. 5 ... run against a rock and sunk ...Reynolds swam out and saved the boat, but almost everything was lost, all of **Potter’s and Sutherland’s bedding and clothes**. ...One other boat.....stove in.

“Nims’ **photo camera blew over the cliff** and smashed up. We have two more.”

June 4. ...“Brown, Hughes, and Reynolds start off ...to run the rapid. ... capsized in heaviest rapid ...clung on (to boat) ... scrambled out and stayed on rocks, all day, drying out clothes, etc., ...

“...cook boat the *Brown Betty*, ... swung ...against a huge rock. She did not break at once but soon filled with water.

...saved a part of the cook’s outfit, but lost all but seven of our plates, all spoons, pans and two camp kettles, ...**Lost nearly all our grub in cook’s boat**. Tried ... to save the boat but she broke all up and was a total loss.

## *The Losses Continue*

“... everything was wet ...spread out our supplies to dry and found many of them *spoilt* ...”

June 5. ...”Two boats slightly damaged and *Mary*, No. 3, had end completely knocked off.

Repaired ...after reaching camp.

...still left about 4 weeks’ ... flour; 3 weeks’ ... bacon; 1 weeks’ ... sugar; 6 weeks’ ... dried fruit; and 6 to 8 weeks’ ...coffee. ...

... started with 75 days’ supplies of everything, this looks rather serious.”

June 10. “... repaired boats with rosin Hansbrough got from pines on top yesterday.

... Boat No. 1 ...went down. **A total loss, including \$250.00 transit**, 2 sacks flour, 1 keg vinegar, 3 sacks fruit, 1 sack beans, etc., etc.

... followed Boat No. 1 for 3 miles, ... found *one* of *five* floats ... lost June 1<sup>st</sup>. ... contained 2 sacks flour, 2 cans tomatoes, soap, 2 sacks fruit, 1 sack meal, and some tobacco ... are about where we were before Boat No. 1 was lost.”

## *More Losses and Fearing Starvation*

June 12. ... *Mary*, No. 3, ... against a rock and smashed her up pretty badly, losing our last coffee pot, all but nine cups, all our dried peaches, and one sack of beans. ... loaded up all rest of stuff in our two remaining boats and pushed on.

Boat 5 ... swamped just above camp. ...blankets wet, but saved. ... All bacon, beans, and fruit on No. 5 lost and my level box with medicines, etc., etc. Rather a bad disaster to wind up the day with.

... found two more 'floats' intact and one broken up. ... 2 sacks flour, coffee, syrup, 2 kegs pickles, 12 cans condensed milk. A good find."

June 13. ... "took stock of all provisions and found [it] pretty slim for sixteen men and will not last even with *short* allowances for six days. **Mr. Brown does not seem to grasp the situation in the least, but goes on as if we had two months' supplies in camp.**"

June 16. ... "saw ...bags, blankets, etc. floating down river, ... lost the boat *Denver* ... **In its load was Bush's transit**, and all sorts of other things including one sack flour."

... had torn up the *Mary* in order to get material to repair the other boats. This affected Brown very much as the boat was named for his wife and he cried before the whole party. The men went over river and got boat *Ward*, No. 1. Found it little damaged."

## *Resupply of Chow*

June 17. “Brown will go ahead for grub this morning with one boat and send us back supplies as quick as possible.”

June 20. “... come down the hill and meet Howard, who with Coe and Hansbrough have come back from Dandy Crossing ... with plenty of supplies. Howard is in great glee over plenty of ‘grub’ ... **Potter stuffs himself and is sick.**”

June 24. “We went across river to Hite City ... Found all the rest of the men and mail from home.”

Smith and Crampton : “The instrumental railroad survey through Cataract and Narrow Canyons ... was a remarkable achievement. ... Railroad had hired an engineer capable of dealing with man and ...and with enough determination and fortitude to carry the job through to the end.”

From Dandy Crossing (Hite), the party split with Brown and Stanton going ahead with a crew to “eye-survey” a route through Glen Canyon, while the other group was to continue with the instrumental survey.



CANYON  
ONE OF THE LITTLE CEDAR BOATS, IN CATARACT CANYON.  
LOOKING UP <sup>STREAM</sup> ~~STREAM~~ FROM THE <sup>FOOT</sup> ~~FOOT~~ OF  
A RAPID. (Used on the first part  
of the expedition)

Photo. By F.A. Nims 1889.

D. C. C. & P. R. R. Survey No 46.



A TUNNEL SITE IN GLEN CAÑON.  
"Even cameras, like figures, may be made to  
misrepresent facts, when in the hands of a good manipulator" ~~see page~~  
Photo By F.A. Nims 1889. D.C.C. & PRR Survey No 2416242  
241-242

# *They Can Build It!*

River through Glen Canyon much easier ...“precipitous walls ... and sweeping curves ...(caused) Stanton little doubt (regarding) ...feasibility ... his notes ... (speak of) ... **tunnels and bridges** over side canyons. Long sections ... to be **blasted in solid rock** and ... cliffs ...dropped into the river ... blithely proposes ...a 200-foot span over the mouth of the San Juan”

Stanton “was a child of his time. .... had ...participated in the spectacular railroad building era in Colorado. **Railroads could be built anywhere**, even through the canyons of the Colorado.”

The “eye survey” crew reached Lee’s Ferry on June 2.)

June 2. “From the San Juan River to Lee’s Ferry the river is *very* tortuous and will require at least 15 tunnels. They will generally be short, from 200 to 500 feet, but one or two will be one to 1 ½ miles.”

Lee’s Ferry, Arizona, July 4, 1889. “In camp waiting for supplies, before going on down the river. **Of course it is the hottest day of the year, 132° in sun, and 105° in shade.**”

(After enjoying of few days of fresh meat, milk, eggs and vegetables, they resumed their journey downriver on July 9.)

## *President Brown Drowns*

July 10. “Just as we got into the swiftest part at head of rapid I looked up and saw McDonald bareheaded on left bank running towards us with his hands in the air. ... We realized in a moment that their boat had upset. I turned quickly and looked over the water. Saw nothing and then shouted to men to pull hard for shore, and just as we turned I saw Brown’s notebook shoot up out of the water and float with the eddy. ...I jumped over Richards to shore with line and immediately looked over the whole eddy and rapid could see not other trace of him, Brown. **The whole of this did not take ¼ of a minute**, even much less. ... This has been a day of terrible experience. ... **In the depth of this lonely canyon and beside the roaring waters, which leaped and lashed and foamed without ceasing, we sat for hours utterly paralyzed.** We watched eddy and whirl and then searched the banks for a mile and a half on either side in hopes of at least finding his body and giving it an honored burial place on top of some high cliff, but all in vain.”



283.

Lower end of Soap Creek Rapid, Marble Ganyon.

Note book says photo. 283 shows where President Brown was drowned.

x-Camp No.33, July 9th, 1889.

Photo by F.A.Nims.

(The waves smoothed out by the long-time exposure.)

## *Two More Die*

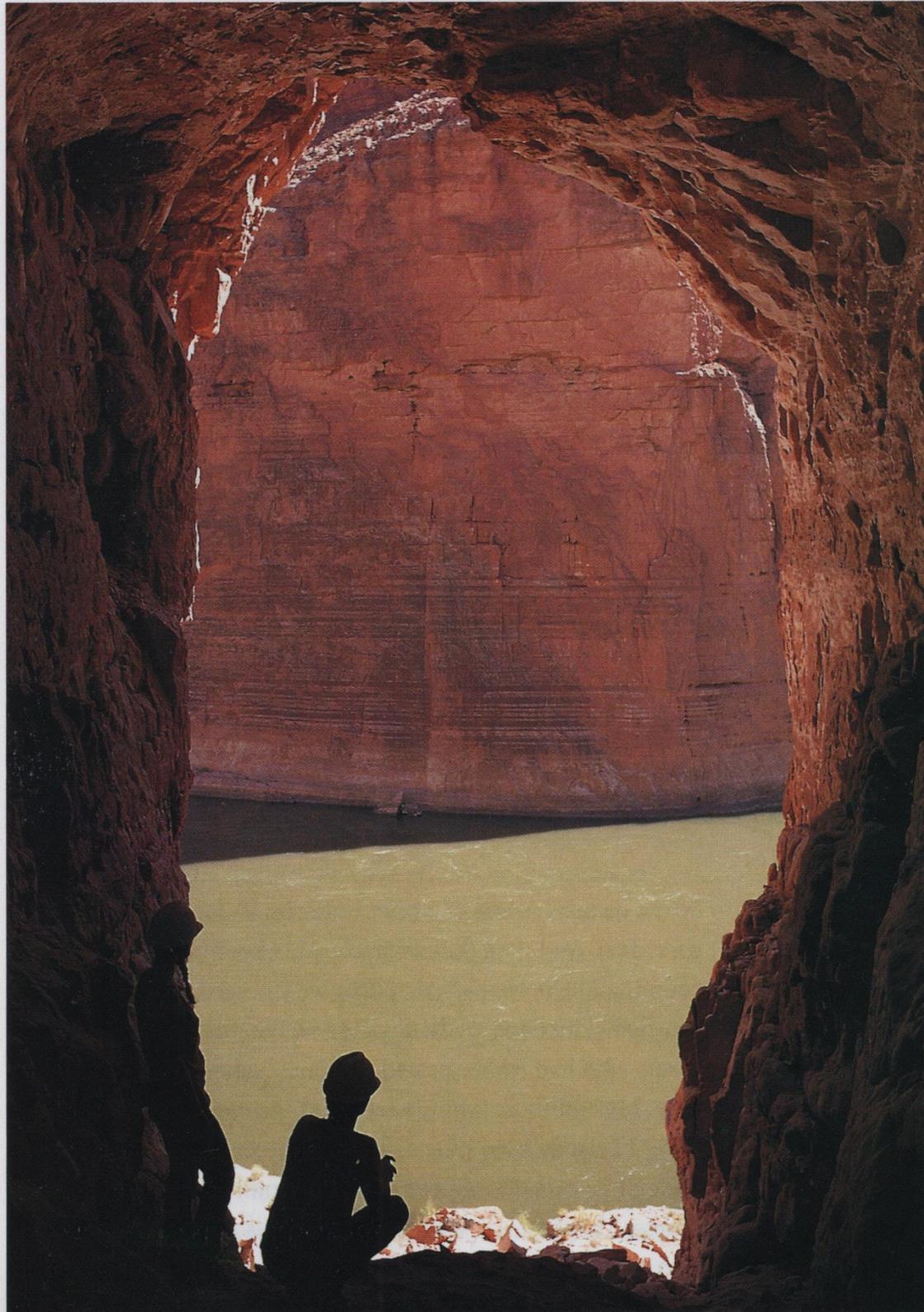
July 15. “...all of a sudden we saw them turn towards the cliff at a point with an overhanging shelf of about 3 feet. ... as I watched them I saw Richards get his end out from the rocks clear into the stream and Hansbrough had his head out from under the shelf. I remarked ... ‘They are all right now,’ ...when all of a sudden their boat turned over, and both went into the water. **Hansbrough was never seen to rise** by any of us. ...McDonald and Gibson who were below ...rushed out into the stream with their boat towards **Richards** ...but he **sank before they could reach him**. ...Hislop and I ran over the cliff but by the time we got there all was quiet and both men gone forever.”

**July 16. “After breakfast ...we ... came to the conclusion it was best to try to go out ...”**

## *Heading Out and Watching Brown's Body Go By*

July 17. "About ¼ mile below we notice beautiful green vines, ferns, and bushes ... There is quite a spring coming out of the cliff and there are several patches of rich soil lodged on a bench of the marble and watered by these springs ... We gather bunches of ferns and flowers to take home to remember this place which is Powell's 'Vasey's Paradise,' ... *I name this Point Retreat.* ... will require a tunnel about 1 mile long and it has a splendid approach on upper side; and as well as I can see there is an easy exit on lower side."

... I looked up the river and saw something large and white like a large bundle floating down. As it came a little nearer we all saw it was Mr. Brown's body. McDonald and Hislop ... at the risk of their lives attempted to get it; but it was impossible as it was so near the head of the rapid. They came near going over the rapid ... It was very sad. I had so hoped ... we could give it burial in the pretty little spot called 'Vasey's Paradise.' ... "We have **cached all our surplus supplies** in a cave ... **Except ... boats which are useless.**"



Looking out from mouth of Stanton's Cave (Paul Long photo, from *The Grand Canyon, intimate views*; Robert Euler and Frank Tikalsky, Univ. of Arizona Press, 1992, p. 106

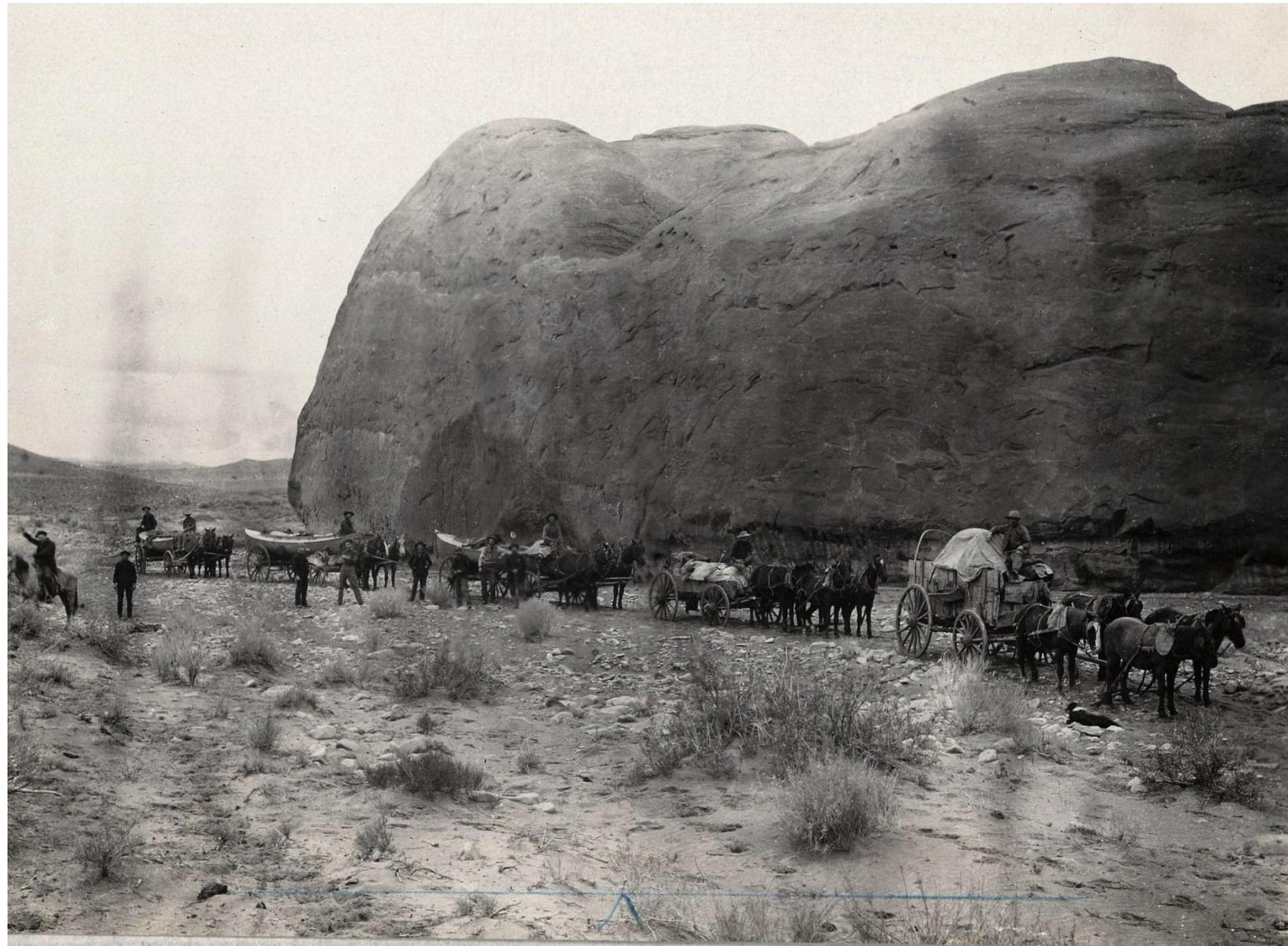
They spent a stormy night sheltered in the cave, and Stanton wrote: "I have seen the lightning play and heard the thunder roll among the summit peaks of the Rocky Mountains, as I have stood on some rocky point far above the clouds, but nowhere has the awful grandeur equaled that night in the lonesome depths of what to us was death's canon."

From Todd R. Berger, *It Happened at Grand Canyon*, p. 42 (Two Dot; Guilford, CT; Helena, MT, Second Ed., 2016

## *Giving it Another Shot*

Smith and Crampton: “Stanton now emerges as the prime mover in the operations ... New boats and safety equipment were built to his specifications. ... second expedition made up of four river veterans and eight new men. To save time and avoid the hazards of Cataract Canyon, ... traveled overland from the railhead at Green River, Utah, to the head of Glen Canyon. On the run through Glen Canyon, the new equipment was tested, gold mining claims were staked, and the last thirty-four miles of the instrumental survey was completed.”

“The equipment ...was far superior ... Stanton designed and had built, three boats made of oak, twenty-two feet long, four and one-half feet beam, and twenty-two inches deep. Each ...with ten separate air-tight compartments, and a lifeline ...entirely around the gunwales. Each boat carried a cork life buoy and line. Cork life preservers ... for each man. All stores and provisions were packed in water-tight rubber bags ...Photographic equipment included three cameras and 2000 rolls of film.”



78%

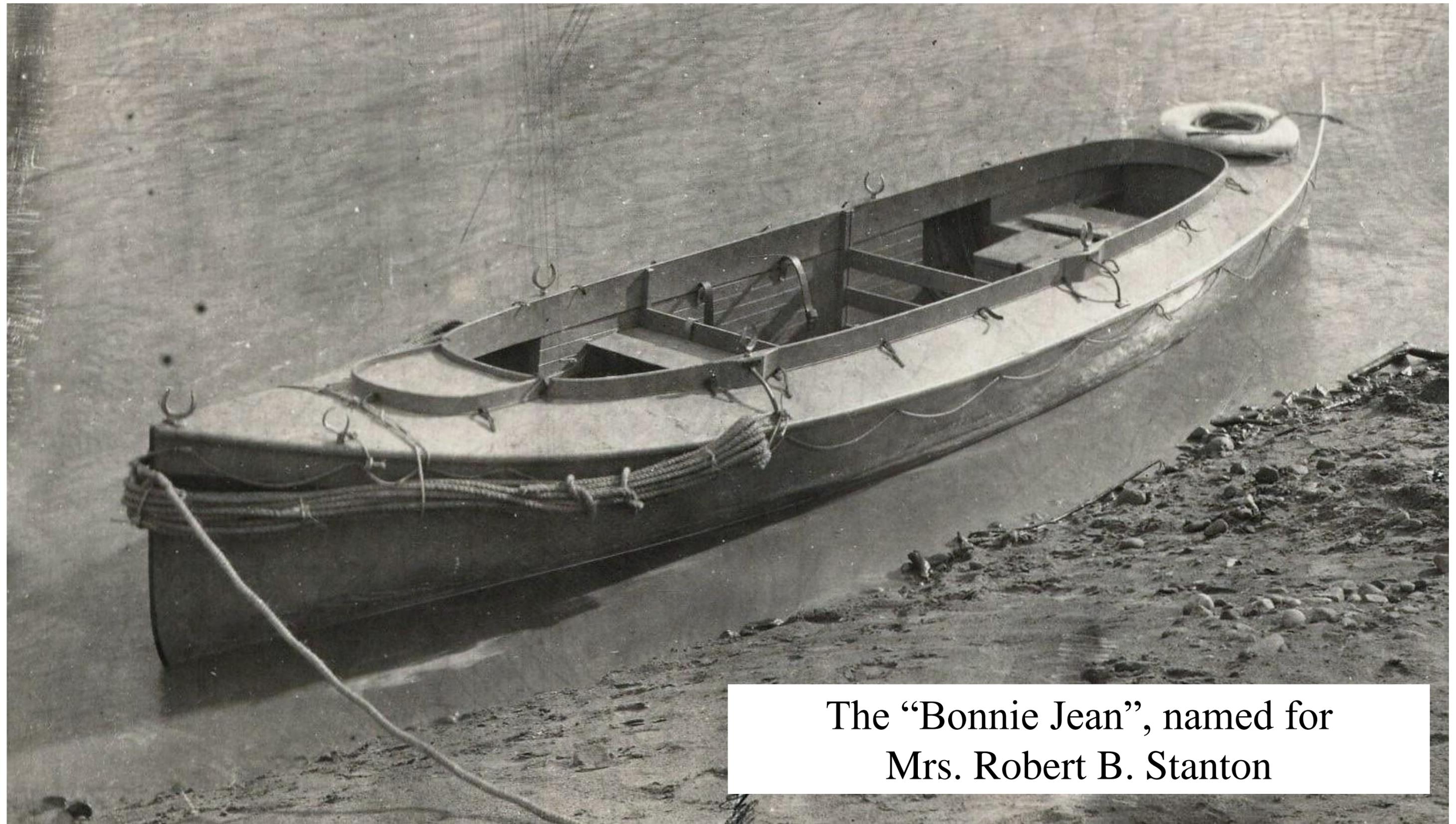
THE OUTFIT AT HEAD OF CRESCENT CAÑON.

DEC. 5<sup>th</sup> 1889, 2<sup>nd</sup> party.





**At the mouth of Crescent Creek, 12/10/1889**



The “Bonnie Jean”, named for  
Mrs. Robert B. Stanton

## *Much Better Boats*

December 9, 1889. “The boats leak almost none at all even after their 120 mile wagon ride.

December 10. “We had not gone more than 200 feet when we commenced bumping on the rocks, and ... were stranded on the head of an island. Our boat behaved splendidly. Would not be upset, and withstood all bumps without a leak.

Boats 2 and 3 were close behind us and went bumping over the rocks but did not stick. ...

All the boats show their strength by the rough usage they had today.”

December 19. “Our boats run this rough water in grand style. Obey their helm easily; and although they dance over the heavy waves ... they ride so steadily that I stand up in the bow of No. 1 all the way through this long run.”

## *Busted-Up Photographer*

January 1, 1890. “Nims ...went up on rocks to take a photo ... fell 22 feet. ...We got to him in a moment, found him bleeding at the nose and right ear, ...his right leg broken just above his ankle. ...

“Nims has been semiconscious all afternoon. Has thrown up several times with blotches of blood”

January 2. “We put his leg in a box made by Mac, and bandaged it in the best way we can. We have made a stretcher of two oars and a canvas bed cover, and leveled down the load in No. 2 boat. ... we strap him in ... smooth but swift water ... Nims is asleep and does not know anything of it. ... decided to take him out ...to Lee’s Ferry and leave him with the Johnsons.”

(Smith and Crampton note: “The rescue of Franklin Nims was a labor of the heaviest sort. He had to be lifted ... up over the rim ... a vertical distance of about 1500 feet; this within a horizontal distance of about four miles. ... [he] eventually recovered enough to return to Denver without assistance.”)

# *Hansbrough's Body*

January 8. "The first *snowstorm* we have experienced this winter. It was certainly very dismal as the clouds gathered over the canyon and hung down almost to the river; and the narrow canyon became almost dark with the blinding snow blowing up the river."

January 17. "... we took the remains of P.M Hansbrough and buried them in a mesquite grove under the marble cliff ... offered a short prayer, not for our poor Peter but a petition that we might be spared his fate ... We covered his grave with marble slabs "

Smith and Crampton note that Hansbrough's body was found near camp and "A pair of peculiar shoes, still on his feet, made identification positive."



"To honor his memory we named a magnificent point  
opposite Point Hansbrough  
in Marble Canyon.

## *New Boats Tougher, But Not Unbreakable*

January 29. “In letting down Boat No. 3 ... the current caught her and swung her around crossways of the rocks, with her bow over the little fall we were trying to get by. **She turned ¼ way over and filled at once.** ... we had to give up for the night.

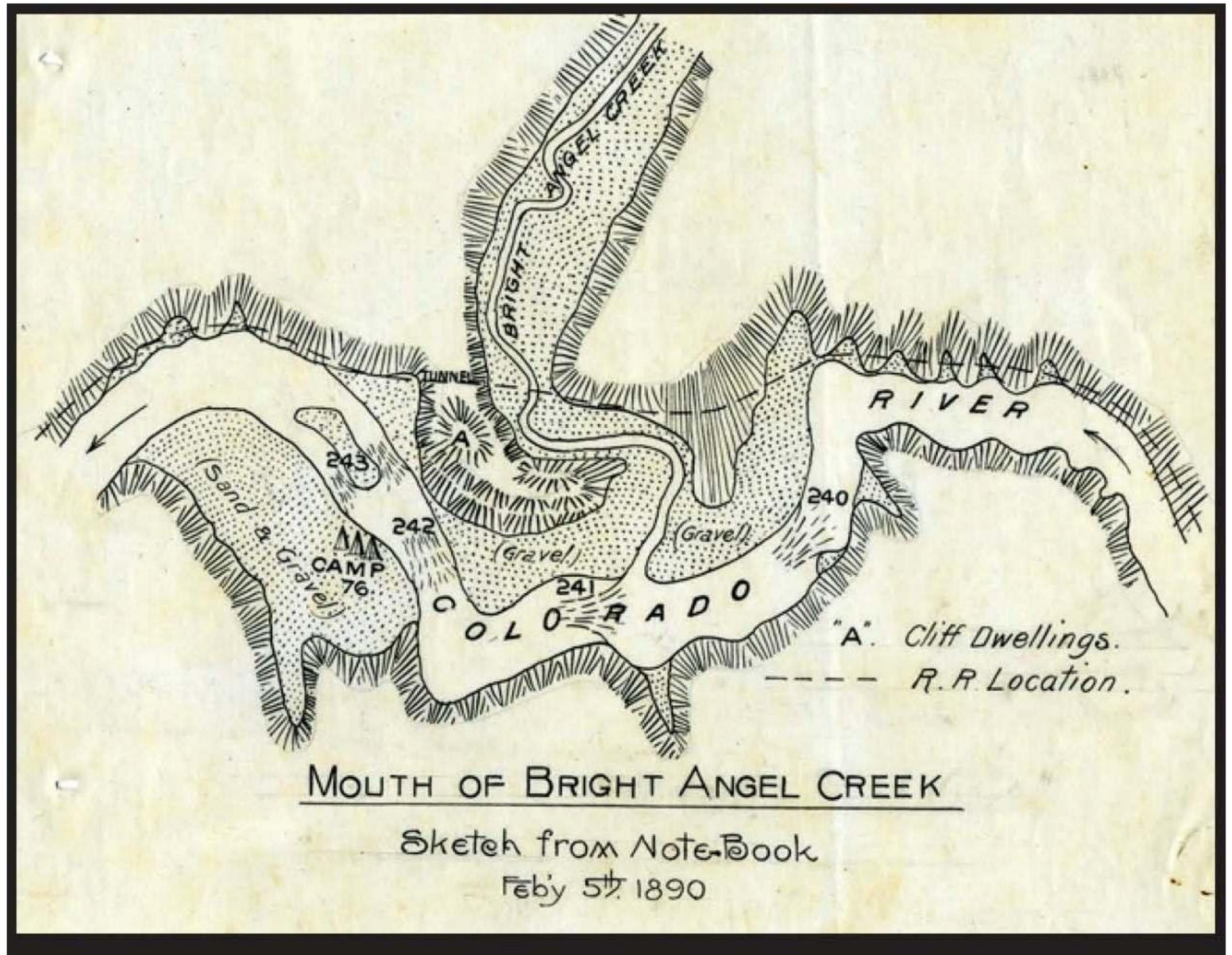
About 8:00 p.m. we heard her move and found that the river was rising and the boat had moved off the rocks .... We worked at her for about an hour but ... gave up till morning, **not expecting to see a piece of her there next day.**”

January 30. “After about two hours work, we succeeded in getting her out, badly smashed on one side. ... not beyond repair ... Have concluded to cut her down to 18’2” ... “

February 3. “**Four men, 38 hours work** to cut this boat in two, **take out 3’10”**, put her together with nothing but the old stuff, caulk her, and complete her ready for the water.”

February 4. “...quite a triumph of our boat building skill ...new boat is almost without a leak and rides the waves like a duck. She is **easier to steer** as she is only about 18 feet long and has 4’10” beam.”

February 5. "From point 1/2 mile above Bright Angel the line would not follow river around left bend past mouth of creek, but would cut across, bridge the creek 150 feet, and tunnel point."



## *Destroying the Rebuilt Boat*

February 6. “decide to adopt Powell’s plan ... and **turn the boats loose at head of rapid and catch them below.** ... No. 3 boat was pushed off. She entered the wave in good shape just in the line No. 1 followed. ... a wave struck her stern sideways and turned her under the worst fall in the rapid. She dove under but came up all right, was forced upstream by the rebounding wave and then driven back by the fall. This time she went clear of the rebounding wave ... a shot up of the edge of the wave turned her over. She rolled once and came up ½ full of water. ... floated with the current and sideways to the cliff where the full strength of the current was beating ... rolled over face to the cliff and struck ... **tore her to pieces in a few minutes.** Thus our first real disaster and second mishap to No. 3.” (Smith and Crampton note that the boat “was **reduced to a mass of floating splinters,**” and Powell likely never used such a “harum-scarum” method.)

February 7. “had to make our loads lighter ... 5 in one boat and 6 in the other ...”

(One of the men left the group and climbed out on February 10, and three more left when they reached Diamond Creek on March 6.)

March 13. "The water fills the whole channel. A portage of boats or dropping by lines is impossible. ...a torrent of *slashing, curling, jumping* waves broken into one mass of yellow dirty foam such as our boats never went into before."

(Stanton's Rapid 465 is "Separation Rapid", where three members left the Powell Expedition in 1869 to climb out of the Canyon, then were killed by "Indians", or perhaps Mormons fearing Federal spies.)

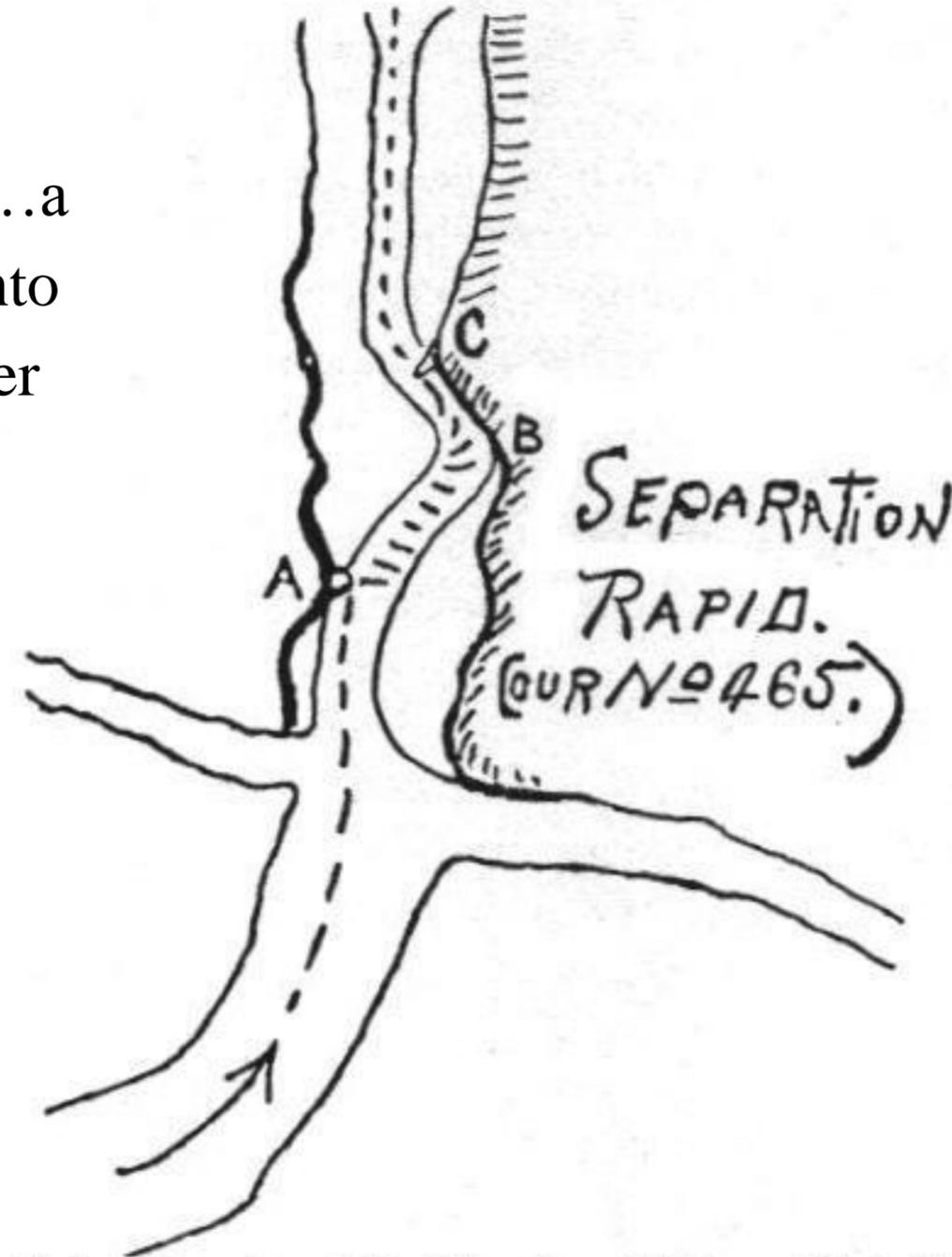


FIG. 49. Stanton's sketch of the historic rapid. The first fall is at "A." Then the current rushes to "B" and thence along the cliff to "C" where there is a sharp projecting rock. Miami University Library.

**Black Canyon,  
approximately  
at site  
of Hoover Dam**



*D. C. C. + P. R. R. Survey 1890*

*Photo. No 787, By The Author.*

# *End of the Journey*



April 26<sup>th</sup> 1890. We reached tide water  
at the head of the Gulf of California.  
D.C.C. + P.R.R. Survey. Photo. no 810. Looking up river.  
By Robt. B. Stanton.

# The Survey

## You Want It When!?

### From Stanton's Journal

Tuesday May 28: ... Mr. Brown took me off one side...then said that he was very anxious to push this survey through as fast as possible. That he thought it could be made to the A&PRR crossing in 60 days; and that if I would push it through to that point in that time he would give me \$10,000 of stock ... I thanked him for his offer ... but to accomplish it in 60 days was *utterly impossible*. **I do not think Mr. Brown has the least idea of the difficulties before us**, in getting our outfit over the rapids or the time it will take.

# How to Survey in Grand Canyon

(From *Availability of the Cañons of the Colorado River of the West for Railway Purposes*, by Robert B. Stanton, American Society of Civil Engineers, *Transactions*, April 1892)

“The maps of the Government Geological Survey gave the general course and length of the river, its fall by section, and all the general information required. What was needed ... was detailed information upon the alignment and fall of the river, the nature and material of which its banks were formed, and the careful inspection of the lower 100 or 200 feet of the canon walls.

... a continuous transit line was run for the first 355 miles. Over 600 miles of transit line was run altogether. Such work was done at all points where there was any question as to possible difficulty of curvature.”

“*All measurements were made by stadia, and triangulation.* (emphasis not in original). On all transit lines run contour topography was sketched. Levels were only taken at points where excessive fall in the river required a settlement of the question of grade, or at points where the line would require sharper grades to cross long bends or rise from one ledge to another. ...

For a very large proportion of the whole distance there was no difficulty in the way of running a line along the shore in the usual way without the use of boats. ... At other points the work could only be accomplished with the help of the boats.

# *Leapfrogging And Collecting Information*

... where the rapids were heavy and thick, it was the usual method to take the boats ahead, make camp, and return along the shore for the line, which was carried ahead of the camp. In the smooth portions of the river, ... the first boat carried the front flagman ahead, the second boat brought the transitman and photographer up to the next station, and the third boat assisted the topographer and did other special work. Permanent backsights were set up at all turning points. ...when ... only one boat could be used many devices by triangulation ... were employed to carry on an accurate line.

Careful readings of the barometer and thermometer were taken three times each day. In addition to the usual notes kept by the transitman, leveler and topographer, the writer kept an extensive series of notes, ... covered a careful description of each section of the shore line (connected by numbers with each of the photographs as taken) ... with numerous sketches showing cross-sections and peculiar forms, requiring special work, careful classification of all material in each section, a record of every waterway required, from 10 feet opening up, with a general description of the whole country, and its bearing upon a railroad line as to its grade, alignment, methods of construction, nature of the roadbed, and requirements for maintaining the permanent way. These notes cover nearly two thousand pages. ...

## *Pictures of the Route*

Photographs were taken ...to show almost a complete panorama of the river banks and the walls of the canons ... Through the most difficult portions these pictures were taken so as to overlap each other ... This continuous panorama was not carried out in full over the whole distance ... During the stampede of the first expedition, only a few photographs were taken in the lower Cataract and Narrow canons ... being so uniform ... the pictures taken fully illustrated the work ...On the lower river, where, for miles at a time, the line would run over identically the same formation, pictures were taken less frequently.

About **2200 negatives** were taken in all ... **Nearly 1000 views** were secured that illustrated the route. These views ... connected by numbers with all notes, are of such value as not only to convince the most incredulous of the entire practicability of the route, but also cover the line so in detail that ... will enable engineers anywhere ... to make as correct an approximate estimate of the cost of such a road as can those who accompanied the expedition.

## *People Suffered, But We Got Good Pictures*

...while the President of the Company and two boatmen were drowned, provisions, instruments and boats destroyed, not a single negative was lost in the river. ...the photographer, Mr. Nims, who did all such work down to the middle of Marble Canon, fell January 1<sup>st</sup> and broke his leg. No other man in the party had ever taken a photograph. It was with much anxiety and misgiving, on account of the importance of securing pictures of the Grand Canon, which was still below, and the most important section of the river, and the utter impossibility of securing in time another professional operator, that the writer undertook the work; for he had never before as much as focused a camera.”

“It may not be out of place to note here, that while exposing his first negative, and while in the act of dashing his hat upon the ground and tearing his hair in his excitement and perhaps rage at his complicated situation, the cook took a snap shot at him with the “detective” and preserved for his future contemplation the absurd picture he was making of himself. **Twelve hundred exposures** were made **without his being able to see a single developed negative**, as all such work was done afterward in Denver, but it is gratifying to state that out of the whole number taken **only about 10 per cent** were not clear pictures, and this 10 per cent were sufficiently clear to be used to illustrate the survey.

*March 7. "I am greatly pleased to get telegram from W.H. Jackson & Co., Denver, saying my 'negatives all right.'*



## *Control and Completeness*

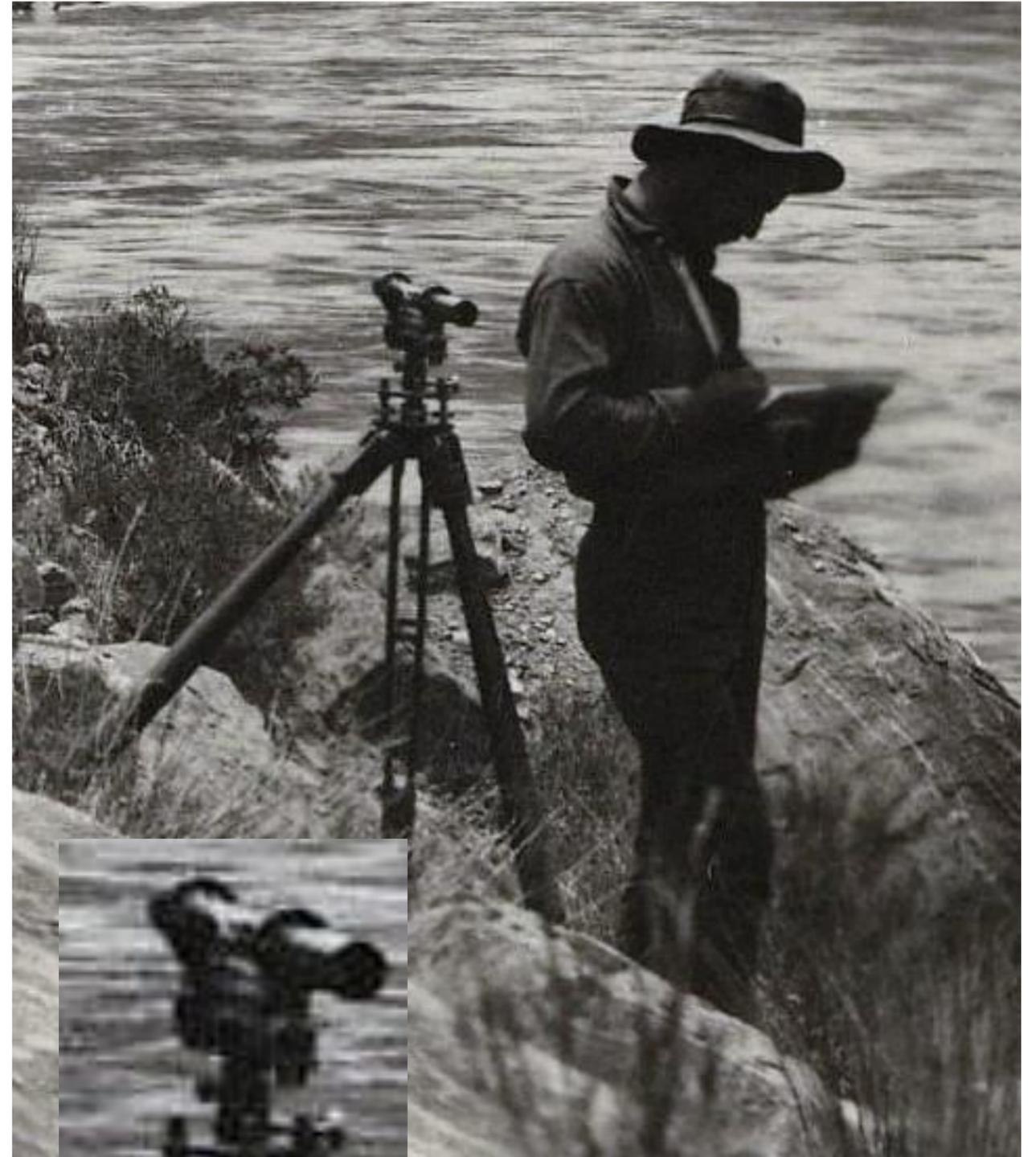
The first work done ... was to **establish a true meridian**. This was done **at various points** for the purpose of checking the instrumental work. The results were very satisfactory, and reflect much credit upon Mr. John Hislop and Mr. W.H. Bush, for the accuracy with which they handled their instruments under so many trying circumstances.

It may not be out of place to record one experience of the writer's peculiar to the depths of these wild gorges. It was the burden of anxiety ever pressing upon him that a mile might be passed over and important features not be sufficiently observed and noted at the time, for the reason that while in his many experiences in exploration in the Rocky Mountains, if an item or two were forgotten, it was but a matter of a day and some hard climbing to correct the error, yet here in these awful canons, with death staring the party in the face at almost every rapid, it was impossible to return. And especially was this the case in the winter, when, while the wild flowers were in bloom in the valley below, the plateau above was covered with from 3 to 6 feet of snow, and in case of loss of provisions, worse than death was in store for those who attempted to retreat.”



WHY WE DID NOT CROSS THE RIVER IN CATARACT ~~CANYON~~.  
 "We were driving stakes every two hundred <sup>CANYON</sup> feet and taking levels upon them"; for a Railroad line on one bank of the river.  
 Photo. By F.A. Nims 1889.

D. C. C. & P. R. R. Survey - No 37.





33.

*IN THE FIRST SIX MILES OF CATARACT CAÑON.*

*"We continued down the River bank with our survey, when, although we could have run a mile or two further, we turned back to find our boats."*

*D. C. C. & P. R. R. Survey. Photo No 33.*

*By F. A. NIMS. 1889.*

## *The Beginning*

May 30, 1889. “Commenced survey of line down Colorado River this A.M. by taking true meridian from Polaris at 3:15 A.M. ... adjusted all instruments, triangulated the positions and courses of the three rivers during A.M. P.M. corrected lines with true meridian and started real railway survey on left bank of Colorado opposite Kendrick’s Station 8489+50.”

June 16. ... “this morning we make another attempt to get along the cliff to a point where the transitman can see us, but after working hard for two hours we give it up as impossible without a boat.”

June 17. ... About noon we reach the cliff. We have one boat. ... Triangulate around cliff ... turning angles to various points on the cliff so as to fix its position.

## *Long-Range Stadia*

.June 19. ... “All went smooth till we got to Station 10090+ when the river filled the canyon from side to side; and on our side the bottom part of the cliff about 100 feet high overhung the river. The only way to get our line run was by triangulation. This we did for one sight, 1333 feet; but on getting to that point we found it impossible to get any point further on, except to cross the river. At this point it would have been very dangerous with our load, instruments, five men, etc. So I determined not to do it, and went on down past the small rapid we were at, saying to the boys, ‘This ends the Survey.’ Everyone seemed quite sad ... rounding a sharp point we saw what seemed to be open country ahead with the setting sun on the cliffs beyond. It was such a glorious sight after being shut up so long in the narrow canyon, and it seemed to inspire everyone; and Potter and the boys spoke up at once and said, ‘We will go back in morning and bring the line down’.”

June 20. ... “**set up a pole with stadia marks on it 28 feet high**, and left it to take sight on ...”

June 22. “We should have made 7 or 8 miles today except that Hislop made mistake on one angle and we had to go back; and in P.M. Potter got rattled on account of signals. So in all we lost about 2 ½ hours.”

December 21. “recommenced survey of railroad line, where Bush left off at Station 18112+44.”

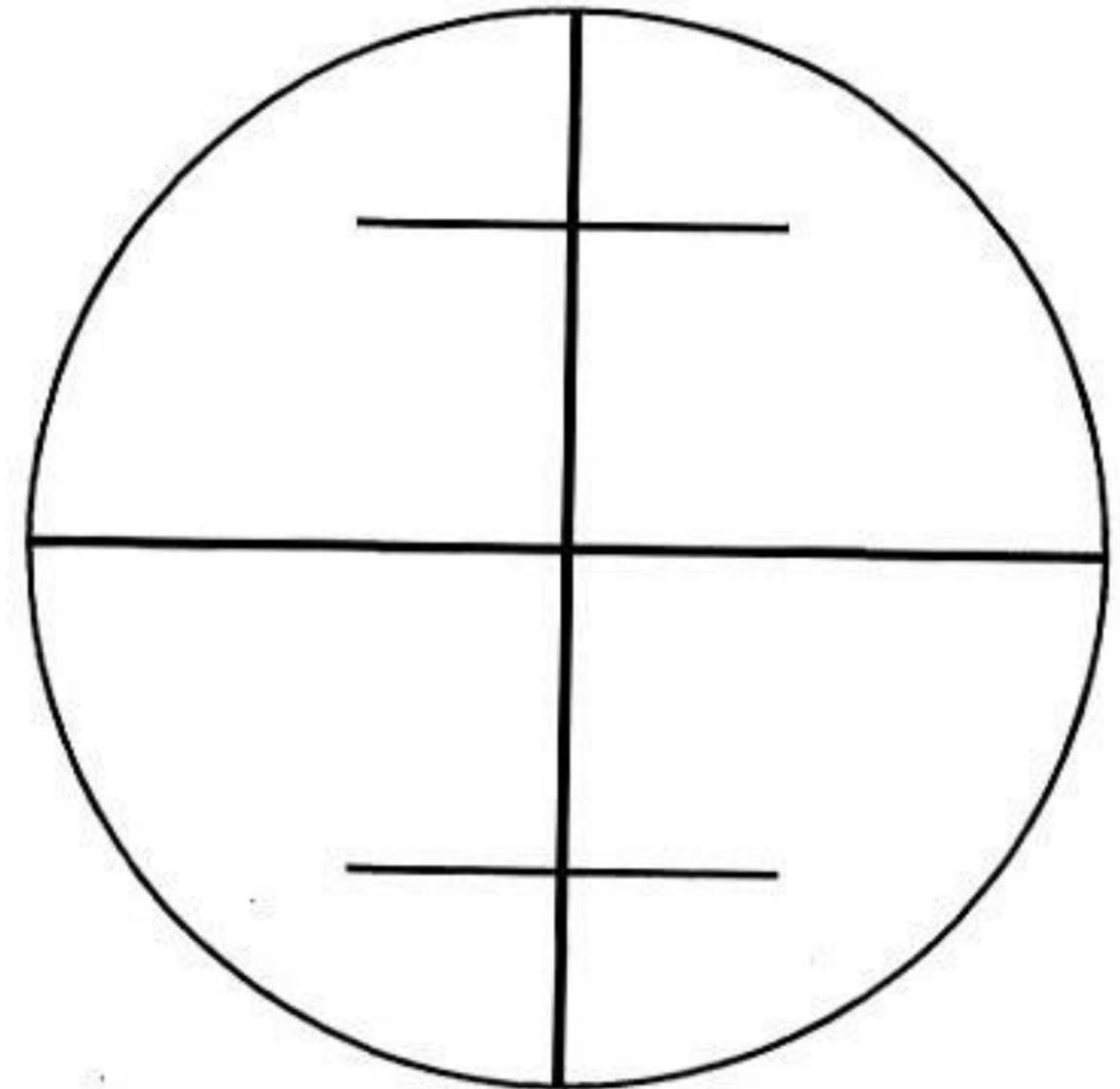
# Stadia Surveying

From **Surveying Theory and Practice**,  
by Raymond E. Davis and Francis S. Foote  
McGraw-Hill, New York, 1940 (1928)

“the stadia method ... is employed extensively on topographic, hydrographic, and other surveys [and] is far more rapid than chaining and under certain conditions is as accurate. It is a useful means of checking more precise measurements.”

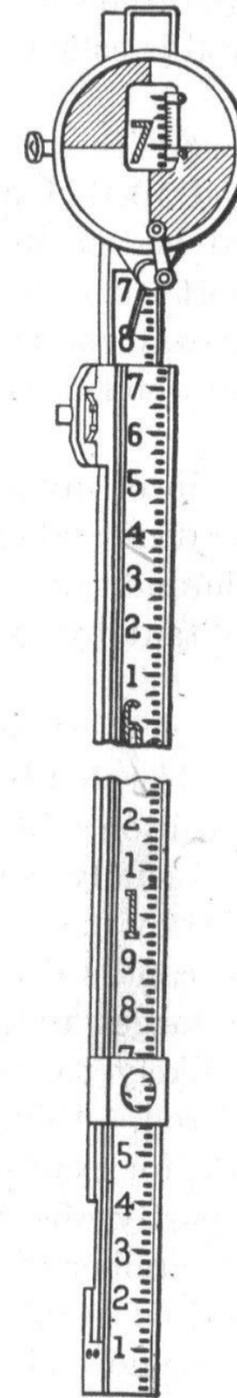
## Stadia Hairs

“The telescopes of most transits, all plane-table alidades, and many levels are furnished with stadia hairs in addition to the regular cross-hairs, one stadia hair being above and the other being an equal distance below the horizontal cross-hair. Stadia hairs are usually mounted on the same ring and in the same plane as the horizontal and vertical cross-hairs.”



## Stadia Rods

“The rod is usually graduated in decimals of a foot but may be graduated in decimals of a meter or a yard. Any leveling rod of the self-reading type may be used as a stadia rod, but the common leveling rod graduated in hundredths of feet ... is suitable only for short sights, say less than 400 feet.”



Note: - Cross-hatched portions indicate red

FIG. 146a.—Philadelphia rod.

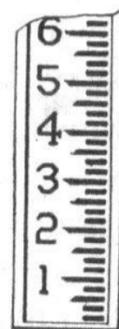
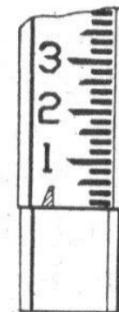


FIG. 146b.—Chicago rod.

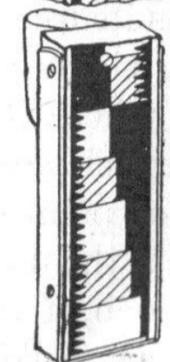
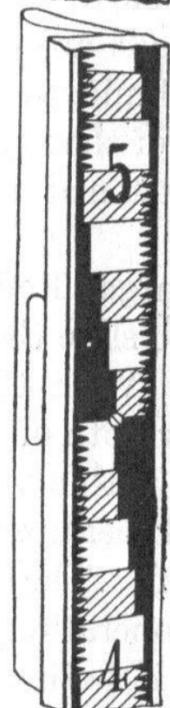
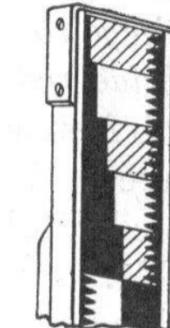


FIG. 146c.—Florida rod.

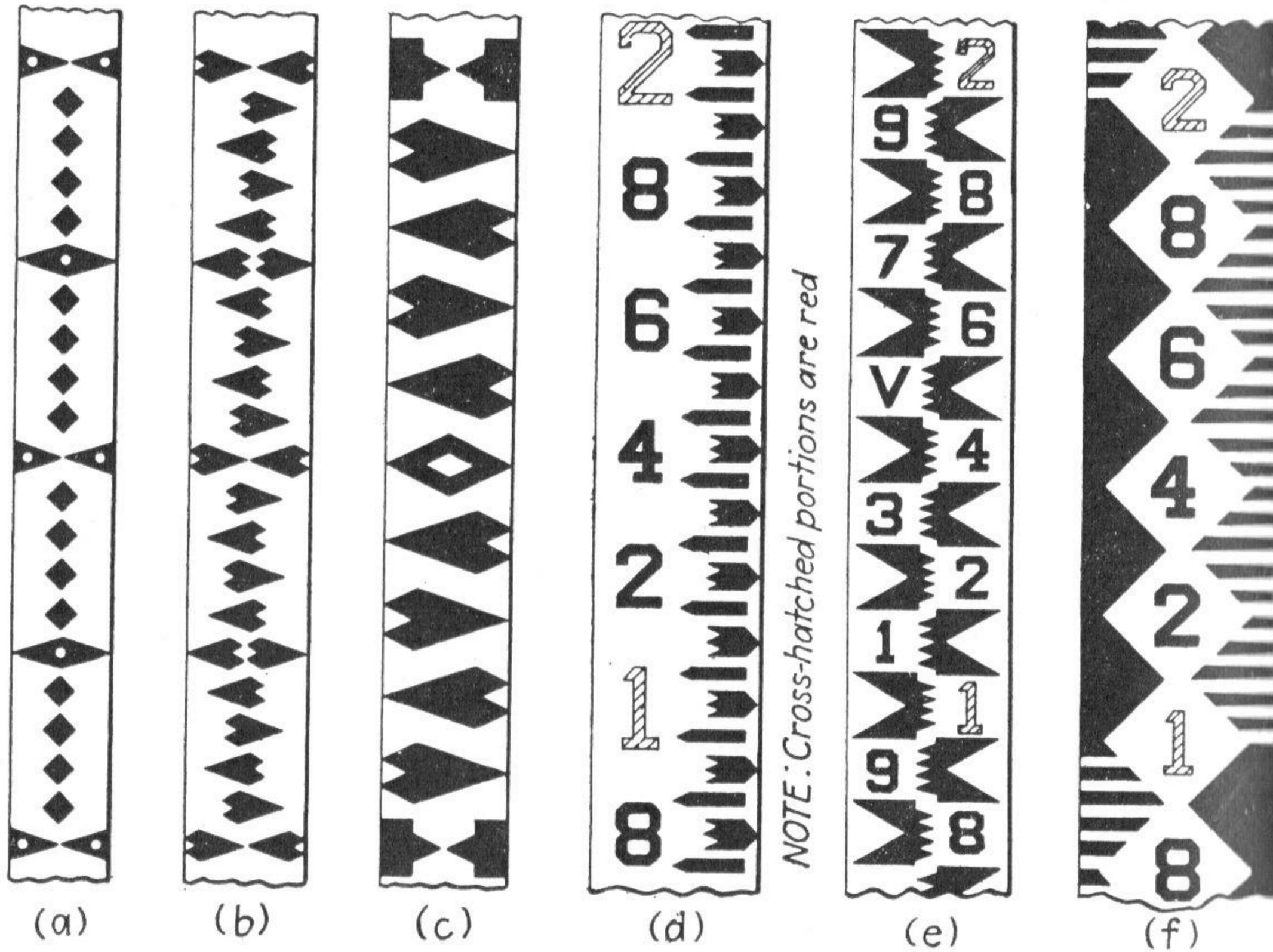


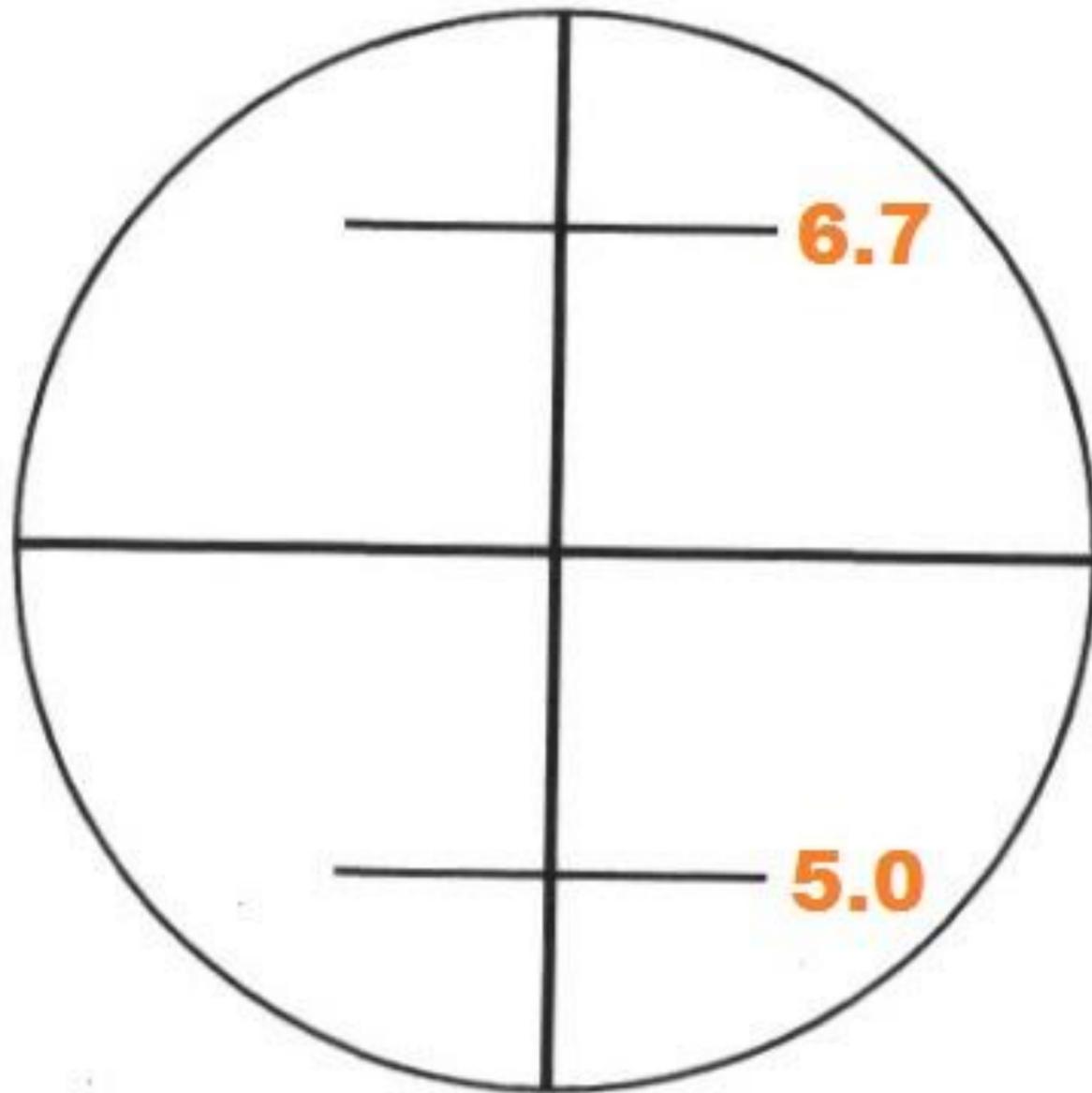
FIG. 293a-f.—Stadia rods.

## **Observation of Stadia Interval**

“... the stadia interval is determined by setting the lower hair on a foot mark and reading the position of the upper hair. The stadia interval is then mentally computed more easily, and with less chance of mistake ...

## **Stadia Interval Factor**

“... the nominal value of the stadia interval factor ... is usually 100.”



$$6.7 - 5.0 = 1.7 \times 100 = 170 \text{ feet}$$



In the first six miles of Cataract Cañon.  
"Our survey work had been all day  
on a broad, almost level talus flat".

D. C. C. + P. R. R. Survey, Photo No 39  
By F. A. Nims, 1889.



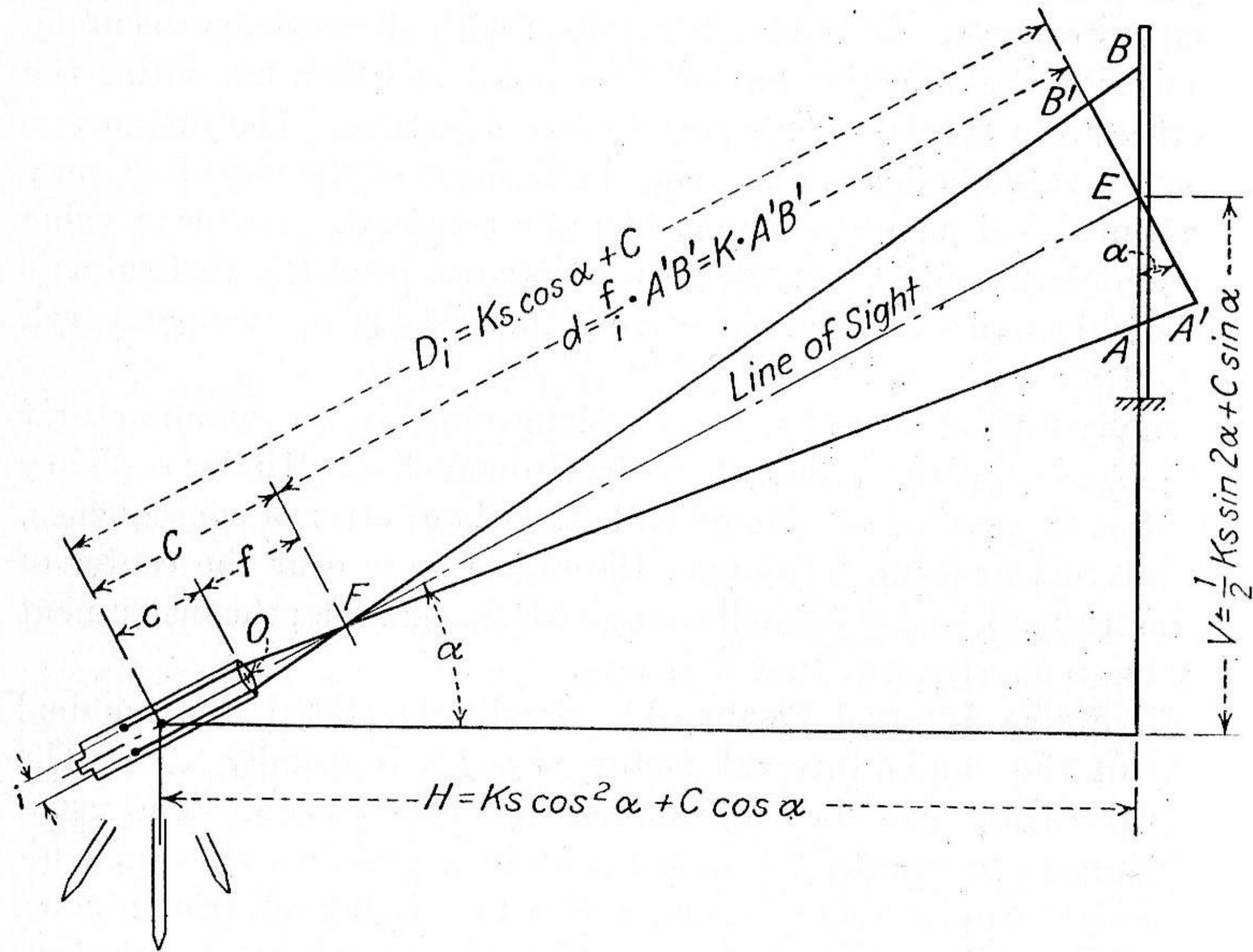


FIG. 298.

## Stadia inclined sights

# Stadia Reductions

“Ordinarily, in practice the horizontal distances and the differences in elevation are not computed by actually solving the stadia formulas, but are obtained by the use of a table, diagram, stadia slide rule, or stadia arc ... “

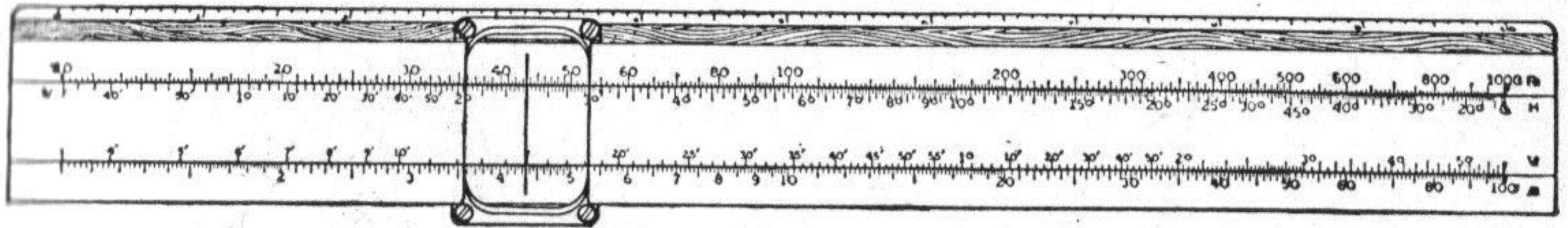


FIG. 300.—Stadia slide rule.

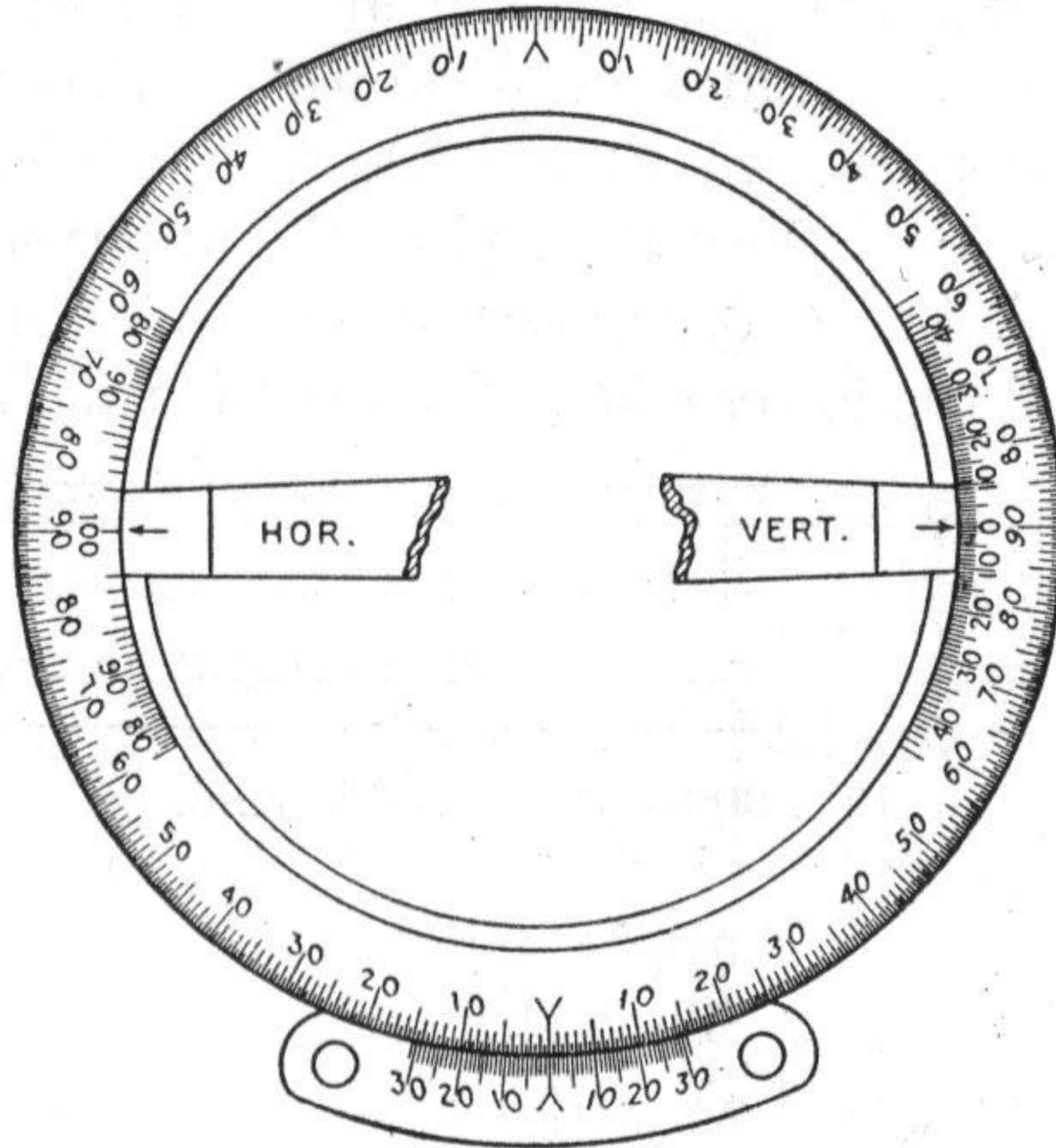


FIG. 301.—Stadia circle.

### STADIA TRAVERSE

For Horizontal Control

Sta.	Obj.	Az.	Mag. B.	Rod Int.	Vert. Ang.	Hor. Dist.
B	A	279°00'	N81°W	9.09	+2°40'	908
	C	356°14'	N4°W	8.94		
C	B	176°14'	S3°30'E	8.98		899
	D	296°56'	N63°W	13.45		
D	C	116°56'	S63°E	13.50		1351
	E	221°49'	S42°W	8.49	+4°40'	
E	D	41°49'	N41°E	8.47	-4°40'	845
	A	127°57'	S52°E	11.90		
A	E	307°57'	N52°W	12.00		1199
	B	98°58'	S81°E	9.05	-2°40'	

### OF GREEN ESTATE

31

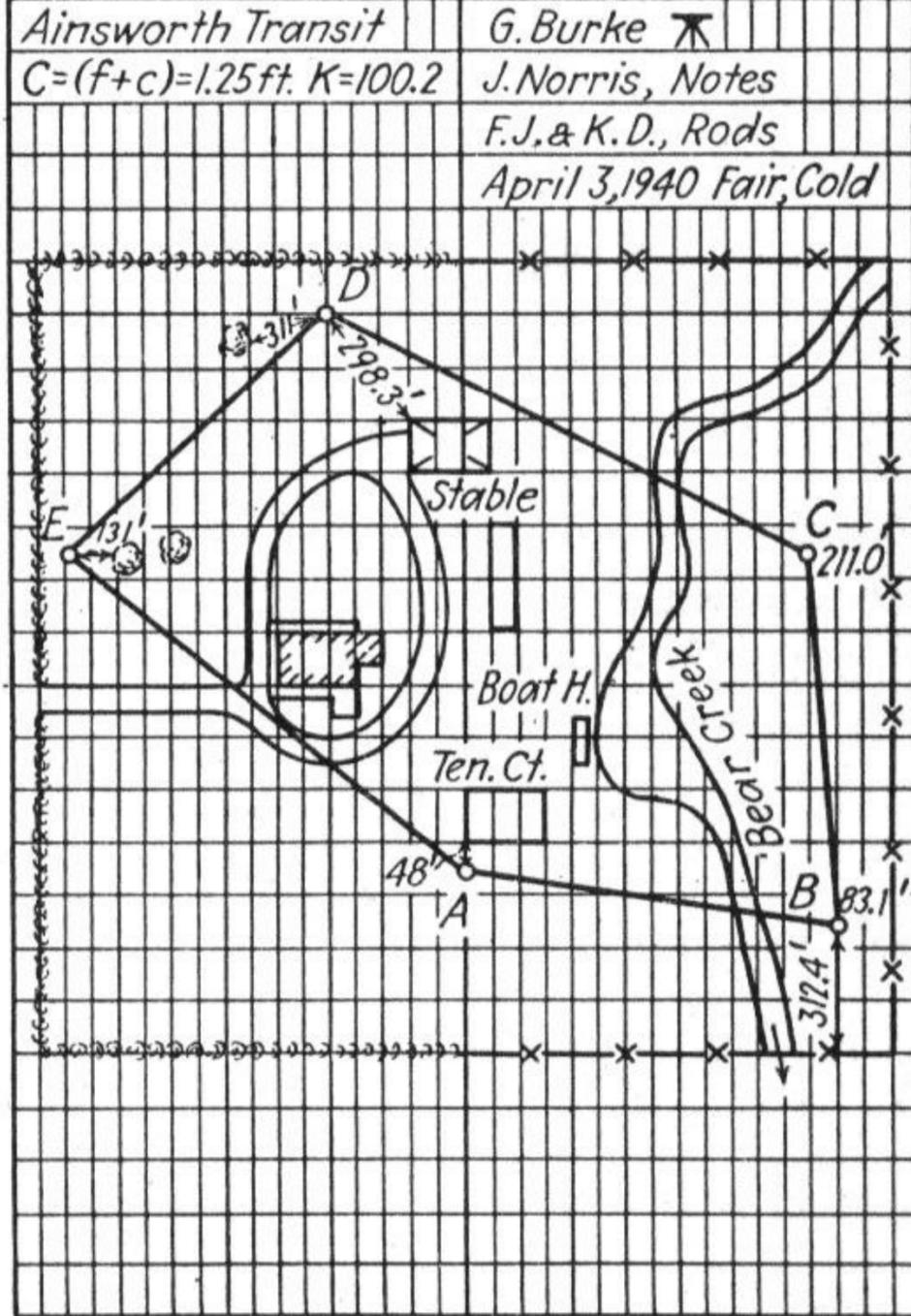


FIG. 304.—Stadia traverse notes.

TOPOGRAPHIC						32	
	Inst. at C; El. 423.9; H.I. = 4.4					Wisconsin Transit	
Obj.	Az.	Rod Int.	Vert. Ang.	Hor. Dist.	Diff. El.	(f+c) = 1.25; K = 100.2	
B	176°14'					G. Burke, M.D. Rand, Notes	
1	10°21'	7.23	-3°11'	723	-40.2	Elev. F.J. & K.D. Rods	
2	3°14'	7.02	-3°17'	702	-40.2	Apr. 4, 1940	
3	352°45'	5.64	-4°11'	563	-40.9	383.7 Water's Edge-Corner Cloudy, Cold	
4	7°18'	5.76	-4°04'	575	-40.9	383.7 " " -On Line	
5	349°10'	-(7.14x4) on 7.7		714	-31.9	383.0 " " Swamp	
6	16°55'	5.50	-2°50'	551	-27.3	383.0 " " Cedar	
7	315°20'	-(7.86x5) on 1.9		786	-36.8	392.0 Line (Intervals) Grass	
8	349°15'	4.13	-5°46'	410	-41.4	396.6 " " 15' 13' 12' 11' 10' 9' 8' 7' 6' 5' 4' 3' 2' 1'	
9	339°30'	5.40	-4°22'	539	-41.1	387.1 " " 15' 13' 12' 11' 10' 9' 8' 7' 6' 5' 4' 3' 2' 1'	
10	0°05'	3.71	-4°12'	371	-27.2	382.5 Water's Edge	
11	344°40'	4.85	-4°54'	484	-41.4	382.8 Bank Brook 6' wide 15' 20' 19' 18' 17' 16' 15' 14' 13' 12' 11' 10' 9' 8' 7' 6' 5' 4' 3' 2' 1'	
12	25°00'	2.86	0° on 3.2	288	+1.2	396.7 " " 15' 20' 19' 18' 17' 16' 15' 14' 13' 12' 11' 10' 9' 8' 7' 6' 5' 4' 3' 2' 1'	
13	307°45'	4.88	-4°56'	487	-42.0	382.5 " " 15' 20' 19' 18' 17' 16' 15' 14' 13' 12' 11' 10' 9' 8' 7' 6' 5' 4' 3' 2' 1'	
14	319°10'	4.02	-5°56'	400	-41.6	425.1 Direct Levels	
15	309°45'	5.80	-3°00'	581	-30.7	381.9 Water's Edge	
16	318°25'	3.27	-4°36'	327	-26.3	382.3 " " N	
B	176°15'	ck.				393.2	
17	340°00'	6.34	-3°08'	635	-34.7	397.6	
18	278°35'	2.51	-5°43'	250	-25.0	389.2	
19	276°20'	3.07	-7°56'	303	-42.3	398.9	
20	277°40'	4.24	-5°40'	422	-41.9	381.6 Water's Edge	
						382.0 " " TO B	

FIG. 305a.—Stadia notes for location of details, with elevations.

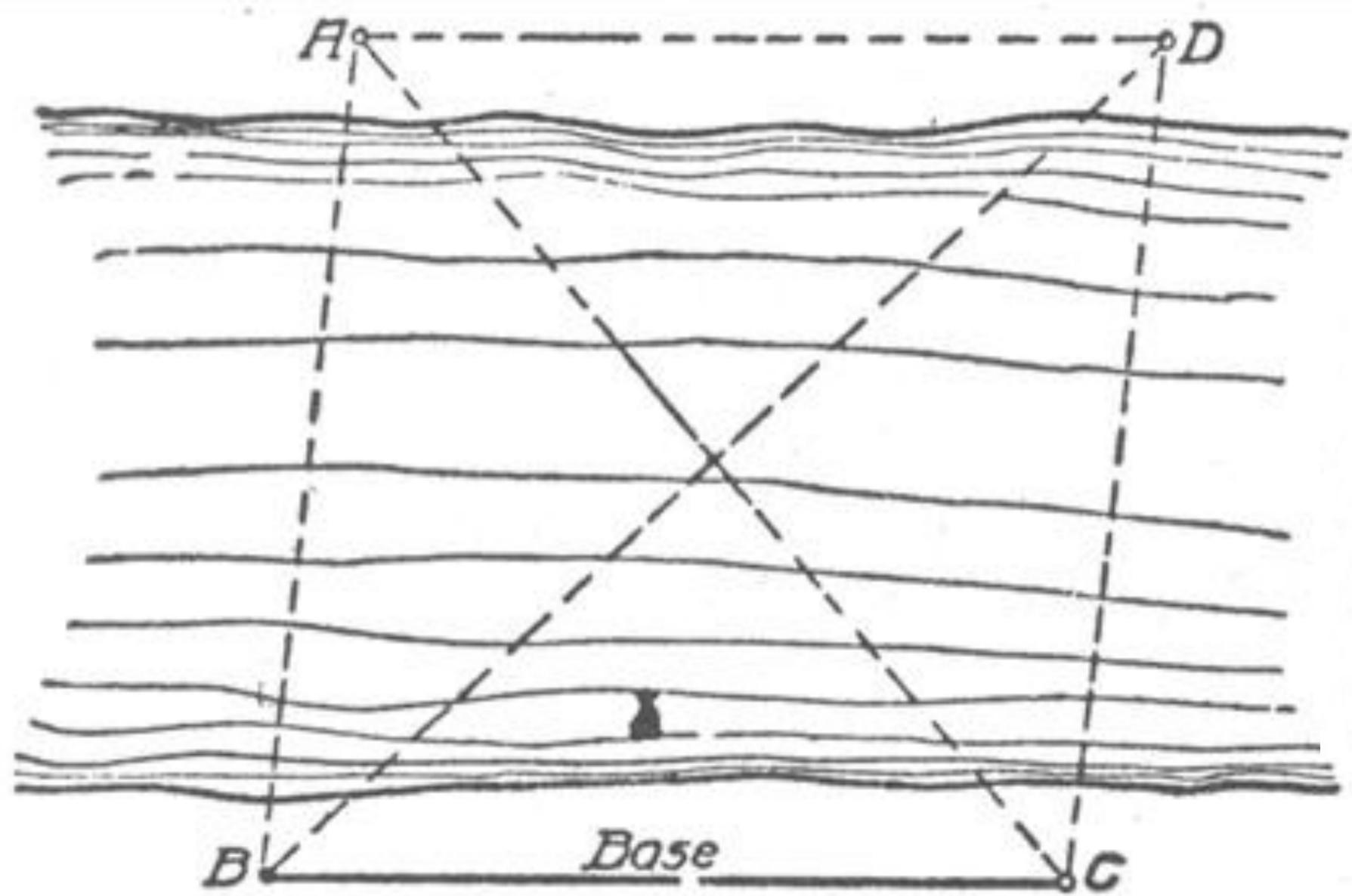
# Triangulation

From **Plane Surveying**, by J.K. Finch, C.E., A.M.,  
American Technical Society, Chicago, 1926

Measuring all the angles and one side of a triangle,  
and computing the other side.

Used to determine distances that cannot be measured directly,  
e.g., the distance across a river.

A series of triangulation stations  
is used as a basis for extended topographic and other surveys.



$$AB = \frac{BC \times \sin ACB}{\sin BAC}$$

Fig. 137 Diagram Showing Determination of Distance across River by Triangulation

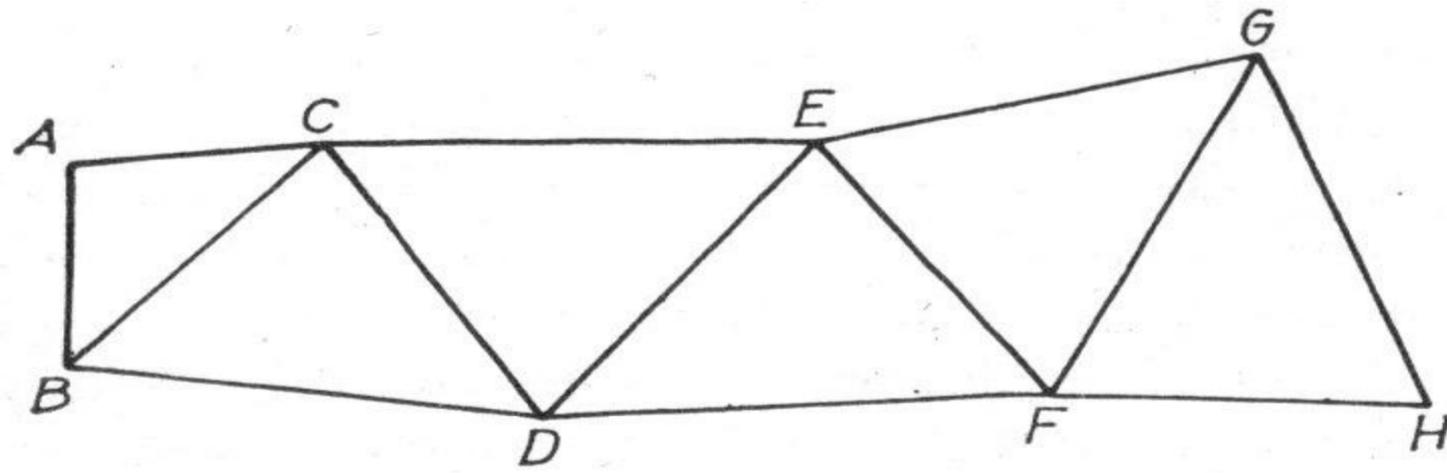


FIG. 313a.—Chain of single triangles.

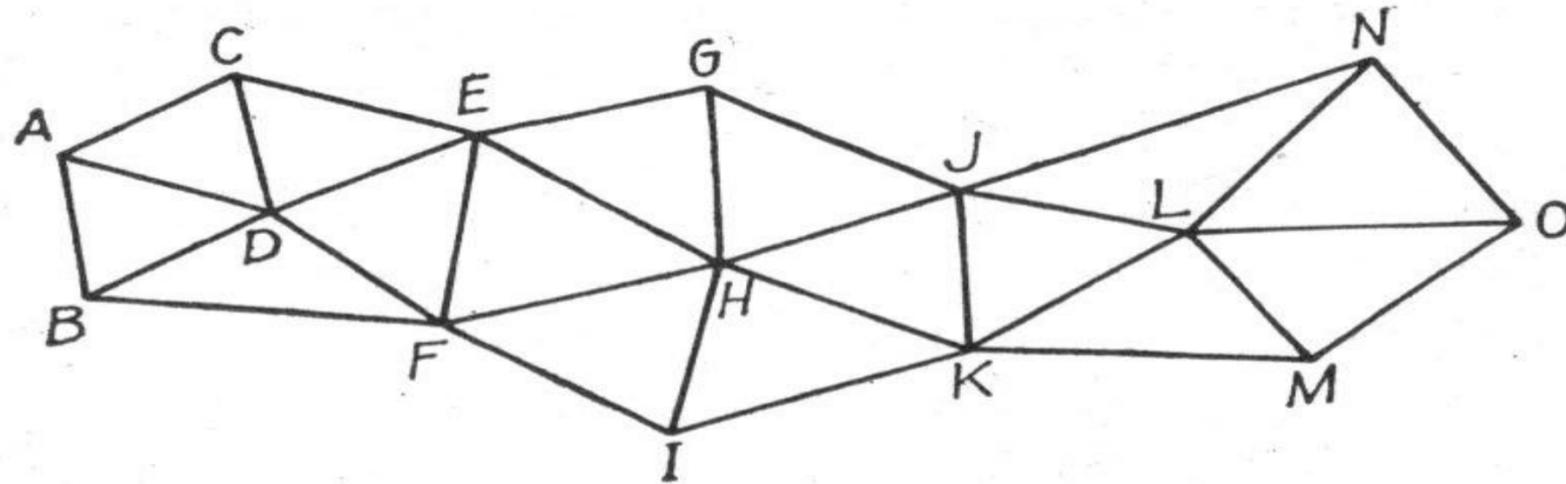


FIG. 313b.—Chain of polygons.

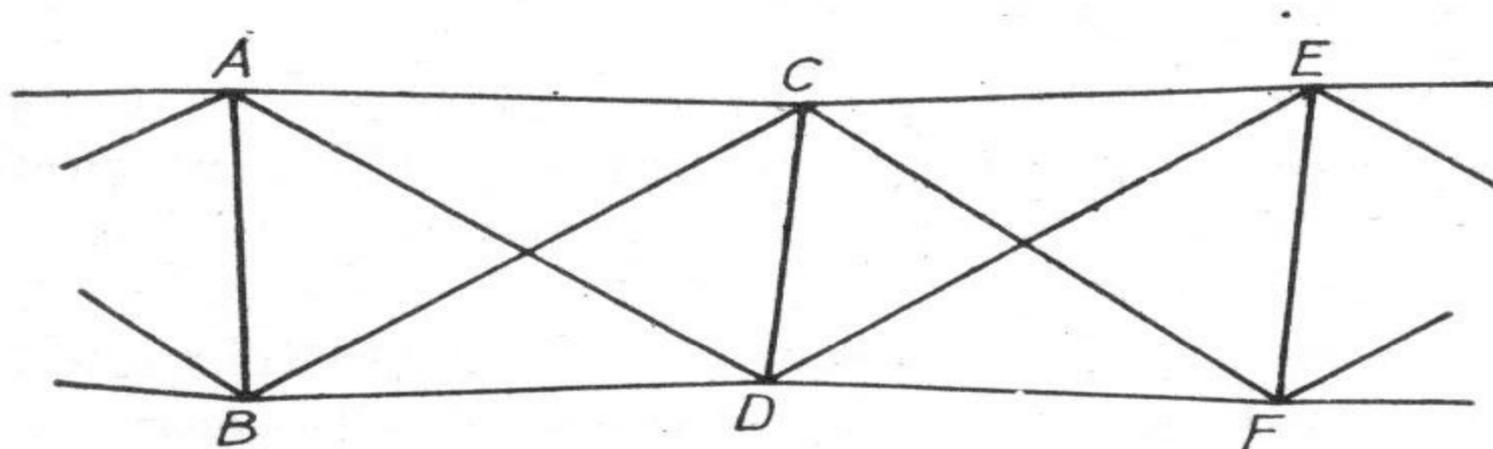


FIG. 313c.—Chain of quadrilaterals.

# Following the Footsteps



FIG. 27. Franklin A. Nims, expedition photographer, at Lee's Ferry. Miami University Library.



2019

# Following the Footsteps



FIG. 39. Elmer Kane, Stanton's strong righthand man and companion on hikes away from the river. Photo at Lee's Ferry Christmas, 1889. *F. A. Nims*. Miami University Library.



2019

# Following the Footsteps

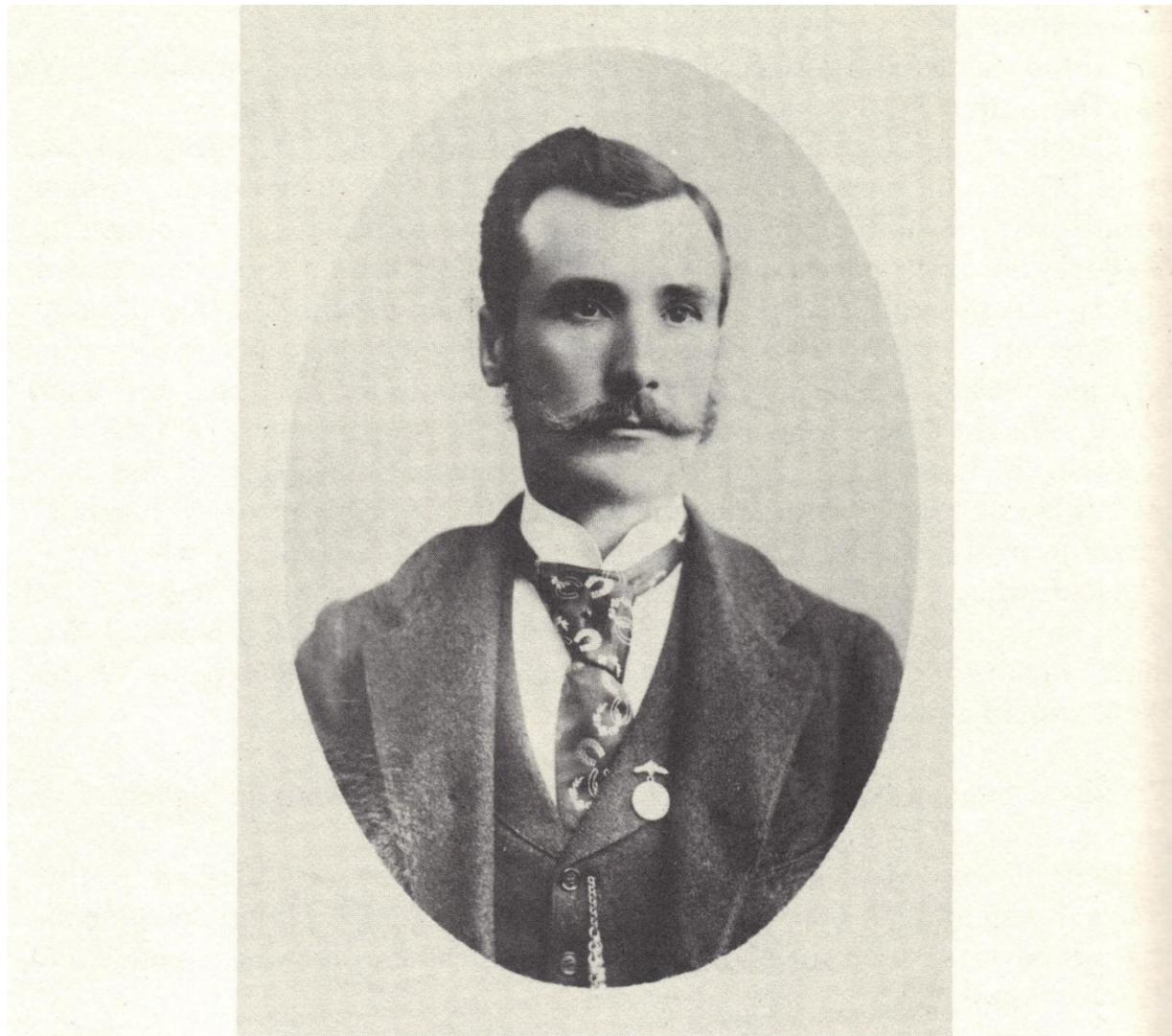


FIG. 38. John Hislop, C.E., McGill University, 1884. Stanton wrote that he owed the most to Hislop, his first assistant, for the final success of the railroad survey. Miami University Library.



2019

# SESSION EVALUATION

