

# YOSEMITE NATURE NOTES



WATERFALL NUMBER  
HIGH WATERFALLS OF THE WORLD

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# Yosemite Nature Notes

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## Which is the World's Highest Waterfall?

By RANGER NATURALIST REYNOLD E. CARLSON  
and RUTH CARLSON

"Is Yosemite Falls really the highest in the world?"

Twice a day during the course of the summer season, auto caravans, bringing tourists from all over the world, pause for a view of the famed Yosemite Falls. The naturalist points out various interesting features near the cataract and attempts to give his hearers some conception of the great height from which the water falls. He usually points out that the upper fall, 1,430 feet high, is probably the highest sheer fall of water for a stream of its size in the world.

"But they say there is a fall in Labrador 2,000 feet high;" or a New Zealander may interpose, "Are not the Sutherland Falls of New Zealand higher?" Or perhaps a student of South Africa may inquire, "What about the falls in Natal?"

In the hope that these questions could be answered with authentic information, the writer has explor-

ed available sources of information on the subject of the world's highest waterfalls. Several difficulties, however, were immediately encountered in comparing one fall with another. The tall, thin Yosemite obviously is a completely different type of fall from the low but powerful Niagara or Victoria Nyanza; the two types are not to be compared. But even if we confine comparisons to the high, small-volume falls of the world, it must be recognized that no two of them present the same features. Each fall has its own individuality, its own profile, its own changes in volume from season to season. In one feature, however, there may be some definite basis of accurate comparison—in the total extent of free-falling water. From the lip of the upper Yosemite to the valley floor there is a total drop of 2,565 feet. The upper Yosemite, however, has a total drop of 1,430 feet, the free

fall in that distance, as computed by Matthes, being seventy feet less, or 1,360 feet.

Is there, then, anywhere else in the world a waterfall with a greater sheer fall than 1,360 feet, the sheer drop of the upper Yosemite?

Much as we Yosemite enthusiasts should like to be able to say definitely, "No," we must admit that in other parts of the world there are great mountain regions only partially explored that may yet bring to light higher cataracts. In the Himalaya Mountains, for example are streams which descend several thousand feet per mile; and the Kali Gandak, rising on Mt. Dhaulagiri, at an elevation of 26,795 feet, shows an average drop of over 5,000 feet per mile for a distance of about four miles. No great falls have been reported in this region in spite of the steep gradient of some of these streams, but it is not impossible that in this region there may be sheer drops surpassing those of Yosemite. From Africa and from South America come unverified rumors of great falls, most of them in regions not yet thoroughly explored.

Explorers in out-of-the-way places are prone to exaggerate. Even John Muir probably let his enthusiasm carry him away when he told that in Sum Dum Bay in Alaska there were falls surpassing those of Yosemite. Later investigation has not borne out this contention, although there are some beautiful cascades in the deep

fjords of Alaska. In justice to Muir it must be added that in his own written accounts of the trip, he makes no such extravagant claims although he does state that "others (presumably cascades) are upwards of 3,000 feet high."

From Labrador come reports that the Grand Falls are over 2,000 feet in height, this belief creeping even into modern encyclopedias of high repute. Reports of the geological survey of Canada indicate, on the contrary, that the Hamilton river descends only about 760 feet in 12 miles with one free fall of only 302 feet, instead of 2,000. From Norway, too, come stories of great falls, but positive evidence has as yet placed none of them in the class of Yosemite.

Another striking illustration of careless exaggeration is contained in a December, 1934, article in the Sunday supplement of a large Los Angeles newspaper, which I had sought out because a friend said it contained a picture of the world's highest waterfall, for which I was seeking. Under a picture of a waterfall was this caption: "Five times the height of the Niagara Falls are the Kaieteur Falls in the interior of British Guiana. They are the highest in the world." Of the photograph, taken by the William La Varre Brazilian Guiana Expedition, was the statement that the "world's highest waterfall was seen for perhaps the first time by Anglo-Saxons." The Kaieteur Falls are undoubtedly among the most beau-

tiful in the world, but they have been known since 1870, have been visited many times, and have a total fall of 822 feet. Because of its large volume of water, it may hold the title of the highest waterfall in the world for such a large stream, but by no stretch of the imagination can it be considered the highest waterfall in the world.

The elusiveness of material regarding waterfalls is again illustrated by the writer's search for information regarding the Oroco Falls in the region of Monte Rosa, referred to in a well-known encyclopedia as a fall of 2400 feet. I could find no other references to such a fall and, in desperation, wrote the editor of the encyclopedia. The reply is worthy of quotation: "As to the Oroco Falls located in the region of Monte Rosa by the writer of the article to which you refer, we can give you no information as the writer is dead and the editor who had charge of the work done, died as the result of an operation in 1825. No book on Switzerland available to us bears out the height noted and we conclude that only the altitude of the fall rather than the water-drop depth was intended." Thus, to all appearances, faded another of Yosemite's rivals.

From various other parts of the world come reports of great falls. On the Tugela river in Natal, Africa, there is said to be a fall over 2,000 feet. No authentic evidence

has, however, been presented, and one authority suggests that the drop may be a series of cascades.

From British Guiana comes the report of two falls, Kukuenaam and Roraima, that are rumored to fall over a precipice of some 2,000 feet. Mt. Roraima has a total elevation of only 8,625 feet, and the surrounding country has an elevation of some 3,600 feet, making it rather improbable that there would be such precipices. Mrs. Cecil Clementi visited this region with a party in 1915 and 1916 and reports that after heavy rains, cascades and waterfalls come down the sides of the mountains, but she mentions no free leaping falls of great height.

The following paragraphs describe some of the highest waterfalls in the world. It must be understood that the list is by no means complete, and in some cases the heights given may be estimates rather than accurate measurements. I have attempted, so far as possible, to list the falls in order of height.

1. Yosemite Falls, California, 2,565 feet. Composed of an upper fall 1,430 feet high and an intermediate chain of cascades, and a lower fall 320 feet high. The clear leap of the upper fall equals about 1,360 feet, perhaps the highest sheer fall in the world. The combined drop of the upper, middle and lower falls is, as far as we know, unequalled elsewhere in the world.

2. Kukuenaam Falls, British Guiana, 2,000 feet. References to this

fall are scanty and vague, and it is exceedingly doubtful if such a fall of such height exists in that country. The same is true for the reputed "Roraima Falls" in the same region.

3. Suitherland Falls, New Zealand, 1,904 feet. This fall, situated on the Arthur river, is sometimes called "The Yosemite of New Zealand." Discovered in 1879 by a prospector whose name the falls bear, the falls are seldom visited, lying off the beaten track. The falls resemble Yosemite in that they are divided into three sections of 815, 751 and 333 feet, respectively.

4. Tugela Falls, Natal, Africa, 1,800 feet. According to one reference, the Tugela river "hurls itself through a series of falls 2,800 feet high, to traverse a wooded gorge of unsurpassed beauty . . ." According to another edition of the same work, the falls are about 2,050 feet high. Another authority gives the height as 1,500 feet. Nowhere have I found any information as to the height of unbroken drops on the falls. More accurate description of the fall is necessary before we can say with certainty how high it is.

5. Ribbon Falls, Yosemite, 1612 ft. This high, thin fall, being constrained in a narrow gorge, does not make a clear leap of its entire distance.

6. Gavarnie Falls, Southern France, 1,385 feet. Gavarnie is reputed to be the loftiest cataract in Europe. The volume of water is

small, however, so that the leap does not clear the rock face. In summer it is said to descend in two leaps, of 958 and 427 feet respectively. The fall is located in the Pyrenees.

7. Takakkaw Falls, British Columbia, 1,346 feet. Matthes gives the height of this fall as 1,346 feet, including a partly free leap of about nine hundred feet.

8. Kalambo Falls, Rhodesia and Tanganyika, Africa, 1,200 feet. This fall, located on the boundary between Rhodesia and Tanganyika territory, has been estimated at from 740 to 1400 feet, of which 1200 feet are described as composing a sheer drop. The fall is believed to be of quite recent discovery.

9. Widow's Tears, Yosemite, 1,170 feet. This tall, thin fall is not forceful enough to leap clear of the cliff wall. It usually dries up in summer.

10. Vaur Fos, Norway, 1,150 feet. This irregularly shaped fall is one of many beautiful and famous Norwegian waterfalls. Du Chaillu reported. Norwegian waterfalls 2,000 feet high, but I have so far found no verification of his statement.

11. Staubbach Falls, Switzerland, 950 feet. Though small, this fall drops straight from a jutting precipice. It is located near Lauterbrunnen. Matthes gives the height of this fall as about 600 feet.

12. Woolloomumbi Falls, New South Wales, 900 feet. According

to Matthes, this fall not only leaps clear, but shoots far out from the cliff because of its momentum.

13. Basaseachic Falls, Mexico, estimated variously at 827 to 986 feet. This cataract is found in the Sierra Tarahumara of Chihuahua.

14. Vettis Fos, Norway, 853 feet. Another of Norway's many falls. This one leaps practically clear.

15. Gersoppa Falls, South India, 830 feet. The Sharavati river divides into four separate cascades to form these scenic falls. The four divisions are called the Raja, the Roarer, the Rocket and La Dame Blanche, the first making the clearest leap.

16. Falls of the Bella Coola Valley, British Columbia, 800 to 1,000 feet high. This fall, mentioned by Matthes, is comparatively little known.

17. Kaieteur Falls, British Guiana, 800 to 822 feet. It is fitting to close a list of the world's high falls with Kaieteur, for these famous falls are perhaps the highest

in the world for a large river. No mere trickle is this, for the Potaro river, on which the falls occur, may at times be 400 feet wide. Far from human habitation, reached by an arduous trip, the symmetry of the falls, the waters dashing into foam, the rising mist clouds striped with shadows, form an awe-inspiring sight.

Some time in the near future it is hoped that the countries in which these falls are located will provide the world with authentic information concerning the heights of the sheer drop and the volume of water, or some wealthy philanthropist might provide the funds for the study. There is romance and beauty in the contemplation of these waterfalls, but we would also like to know the facts.

Until definite facts to the contrary are presented, it is not too much for us to say, as we have been saying, that the upper Yosemite Fall is, to the best of our knowledge, the highest sheer fall for a stream of its size in the world.

## The Ice Cone of Yosemite Falls

By C. A. Harwell, Park Naturalist

The past winter one of the largest ice cones ever seen by present residents of Yosemite was formed under the upper Yosemite Fall. Continued cold weather coupled with a good volume of water brought the cone to its maximum

height for the year about March 24. As usual, speculation was rife as to its height and guesses ran from 200 to 500 feet. March 28 Park Photographer Ralph H. Anderson, William Kat and the writer made an expedition to the cone equipped

with clinometer, compass, tape and cameras, to measure and record this phenomenon.

#### It's Size:

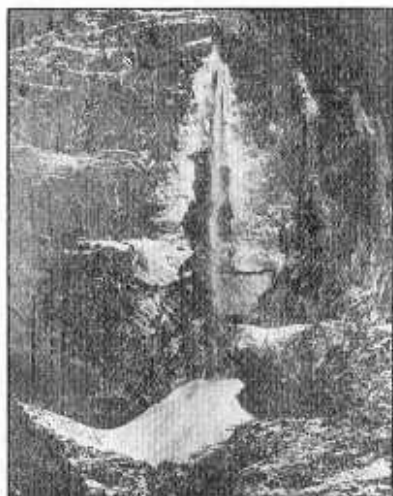
Though we were badly drenched by wind-blown spray, we succeeded in setting up a base line and taking measurements which later computed showed the cone to be 171 feet above our base line, or an estimated total height of 220 feet, allowing some fifty feet from our line to the bottom of the basin. We will measure this accurately this September when the fall is dry, and then in future years the size of these cones can easily and accurately be determined from our known markers. The cone measured 500 feet in greatest diameter, so contained some six million cubic feet of ice or 263,000 tons.

Mr. Kat and I climbed half way up it against the tremendous pressure of falling water. We found it offered good footing, being composed of small blocks of ice and softer snow-ice. Three years ago Mr. Beatty, Norman Clyde and I made a trip to the cone in February (see Nature Notes, May 1932) and found its top surface made up of very small and very hard frozen particles, so that steps had to be cut with an ice axe. We found then that very little water was coming over the fall, while on this trip a large volume was rapidly melting the cone away.

#### How Formed

All winter some water trickles over this highest fall in the world. Many days and most nights it is

cold enough to freeze this moisture so that the usual winter morning spectacle is to see a great fan of white extending 1400 feet up this cliff wall and a couple of hundred feet wide at the base. It is frozen moisture and spray at the edges of the fall, often several inches thick.



#### Ice Cone & Fan, March 25, 1935

When morning warmth loosens it from the granite, this ice crashes down to pile up in the natural basin at the foot of the upper fall. Some water of the fall during the ten or more seconds required to fall the 1430 feet also freezes during cold periods to assist in building this ice cone. Every waterfall in the valley of course forms a similar cone, but none on so grand a scale as this.

#### How it Disappears

As days grow longer and warmer this ice cone starts melting away. The increase in volume of water as spring comes on speeds this melting. In winter what water does



come over the fall stays close to the rock wall, flowing back of and under the cone. By March water is splashing all over the cone and usually with temperature above 32 degrees. In most years the cone is melted out by early April.

This year on April 20 a quantity of ice washed loose and came over the lower fall. The stream rose two feet in a short time and blocks of ice were thrust out on the banks or were carried on to the river. Thru binoculars next day I observed a small section of the remaining ice cone had disappeared.

Then what of the stories so often heard and so widely circulated that the Yosemite ice cone breaks up each spring and comes crashing over the lower fall to dam Yosemite creek with great quantities of broken ice to its junction with the Merced river and producing flood conditions in the Lost Arrow section of the Valley? It is certainly true that there is this phenomenon of the creek becoming filled with snow and ice and that it comes about the time the ice cone disappears, but we know there is no necessary connection.

April 17, 1933, 33 acres between the foot of the falls and Yosemite creek bridge were covered with this snow and ice up to a depth of five feet. Mr. Charles Michael climbed up to investigate the cone next day and found the fragments remaining were the same as several days previous.

Several of us and park engineers, instructed by Superintendent Thomson, made investigations to determine the cause.

Weather records kept by the ranger department furnished a fruitful source. They showed a warm period which produced a great melting of snow in the Yosemite creek basin, resulting in a large flow of water over the falls, and a sudden drop to freezing conditions which produced thousands of tons of ice as this water, mostly in the form of spray, made its aerial journey the 2565 feet distance from valley rim to valley floor. Quantities of snow, loosened from banks in the upper reaches of the creek by high water also poured over the falls carried in suspension. The following maximum and minimum temperatures furnish the key to the phenomenon:

1933	Temperatures: Max.	Min.
April 15	75	43
April 16	62	38
April 17	42	20
April 18	44	20
April 19	62	41

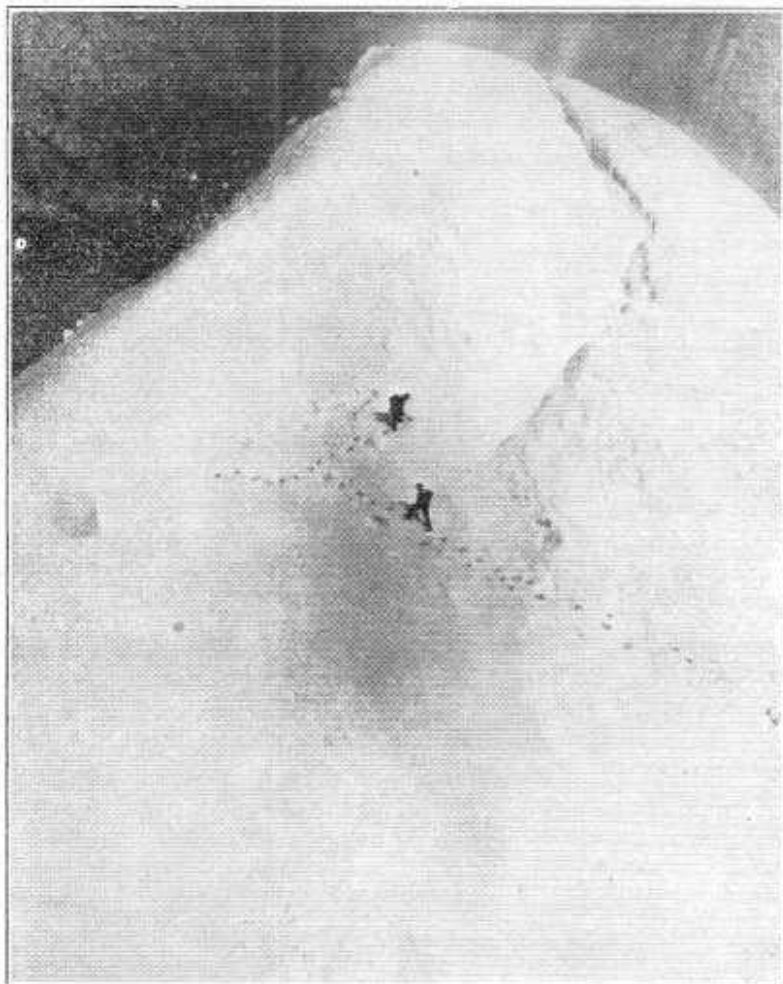
On the morning of April 19, 1933, Yosemite creek was flowing 69.3 second feet or an equivalent of 44,790,000 gallons of water per 24 hours. The temperature of this water was 31 degrees Fahrenheit and it carried 7.6 percent by volume of suspended ice and snow. Because the velocity of the stream was greatly slackened below the fall, the current was unable to carry this load of suspended snow and ice, so for approximately two days much of it was deposited along the stream bed. In addition, due to freezing temperature and slowed



## YOSEMITE NATURE NOTES

velocity, these deposited snow banks were augmented by further particles freezing and adhering to the mass. By noon of that day the air temperature raised to 62 degrees and the water to slightly over 32 degrees Farenheit and this accumulated mass of snow and ice rapidly disappeared.

Temperature conditions then are responsible for this creek flooding condition and they may be, and frequently are right to produce this phenomenon more than once per year—always during early spring months. On April 9 of this year a limited amount of snow and ice was deposited by Yosemite creek.



YOSEMITE FALLS ICE CONE IN FEBRUARY, 1932



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Dan Anderson