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Rock Slides in Yosemite

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It is now well known to all who visit Yosemite National Park that the abruptness of the valley walls and the jagged ridges, peaks and the hundreds of lakes in the "back country" are due, chiefly, to the activity of glaciers during the Pleistocene Epoch or Ice Age. Since that time, no great topographic changes have taken place in the Yosemite region except the slight transfiguration caused by rocks falling from the canyon walls.

When the rock debris has had a more or less concentrated origin, the result is a "talus cone" composed of large and small, angular blocks of granite; when the source has had considerable lateral extent, the coalescence of several cones results in a "talus apron." The latter are the most common in the valley region, and probably the most conspicuous are the rock slides across which the lower portion of the Big Oak Flat road has been constructed.

WORK OF THE CENTURIES

The cones and aprons are built up over hundreds and thousands of years by the gradual accumulation of falling rocks. However, in some instances, cones may be built in a single year or by a single fall of rock. In other cases, it is known that no rocks have fallen on some of the cones since the white man entered the region. It has been estimated that the glaciers in the Yosemite Valley area melted away approximately 20,000 years ago. With this figure in mind, all that can be said is that the present configuration of the cones and aprons is the result of 20,000 years of intermittent rock falls.

In noting these conspicuous features at the bases of the valley walls, many visitors inquire about the conditions under which the talus has formed. Several such conditions are enumerated below.

In humid countries, where there is combined heat and moisture, the rocks tend to break down by chemical decomposition or rotting; in a region such as Yosemite, the action is predominantly one of mechanical disintegration. True enough, acids generated by humus materials and the weak carbonic acid formed by the combination of water and the carbon dioxid of the air cause some decomposition. This chemical activity, although subordinate to the mechanical, aids considerably in widening the joint fissures and weakening the support of partially loosened rocks.

AFTER THE SPRING THAW

As far as observations are con-

cerned, the greatest number of rock falls occur in the early spring when the ice and snow begin to melt. Snow avalanches also have played an important part in bringing free and slightly adhering rocks from the high walls to the valley floor.

The granitic rocks of Yosemite are traversed by great systems of joint fissures in which water accumulates during the early winter. As coolder weather approaches, the water freezes, exerting its well-known outward pressure so detrimental to water pipes in cold countries. In this way, the separation becomes greater and greater each year until, finally, support is lost; and when the last ice has thawed, gravity overcomes the former adhering qualities and the rocks fall. Probably the greatest number of falls can be attributed to this type of activity.

SLIDES OBSERVED

On the afternoon of Sunday, May 22, 1932, the attention of the writer was called by a thunderlike roar coming from Indian Canyon, the first canyon east of Yosemite Falls. A great mass of granite had fallen from the east wall, and rocks could be heard rolling for a few seconds thereafter. A cloud of dust hovered over the tree tops for several minutes. Two days later at 4 o'clock in the morning a mass of rock fell from the south wall of Yosemite Valley 300 yards east of the Old Village. The next evening more were heard in Indian Canyon. Slides occurring at about the same time were reported as having fallen in the vicinity of Camp Curry. Fresh debris near the Old Village was examined and found to contain angular blocks of granite ranging in size from small grains to some weighing more than a ton. The largest was estimated at between five and ten tons.

The mind of the reader is, no doubt, turned toward thinking what would happen to a person or an encampment directly under such a fall, but never in the 81 years that white men have known the valley has anyone been close to such a predicament. The angularity of the debris making up the cones and the falling blocks does not permit the latter to roll far, and encampments directly at the base of a cone would stand very little chance of being hit. Aside from this fact, there is only one chance in several hundred thousand that any rocks would fall.

OBSERVED BY JOHN MUIR

If we delve into the history of the park, several rock falls have been noted, many notations of which are without definite foundation. However, a classic example is the great rock fall which occurred at the lower end of Mirror Lake many years before the discovery of the valley, perhaps 250 years ago. This slide resulted in the damming of Tenaya Creek and the formation of Mirror Lake. In 1872 a large earthquake resulting from a sudden 20-foot displacement on the great fault along the west side of Owens Valley caused many rocks to come tumbling from the walls of Yosemite Valley. John Muir, one of the few who had the good fortune of witnessing this quake, saw a pinnacle on the south wall of the valley collapse and come tumbling down. In his written account of this tremor he has stated that in his opinion "more than nine-tenths" of the talus along the walls of the valley has been the result of intermittent earthquakes. It is true that earthquakes contribute materially to the debris in the cones, but in other regions where earthquakes are not likely to be so prevalent, similar cones have apparently been built by other processes.

The earthquake of December 20, 1932, was severe enough to be felt

over a large area of several western states. In Yosemite valley local residents were quite disturbed by the rocking effect on their homes. Pictures were shaken from walls, chandeliers swayed for several minutes, dishes were broken, and many left their houses for safety Members of the naturalist staff especially were out to observe the effect on the canyon walls. They expected to hear Lost Arrow come crashing down or large rock slides started but there was no such result. A few scattered rocks fell here and there, all of them very small. There were some 20 succeeding smaller tremors during the next few weeks none of which dislodged a rock so far as local observers could tell. With so many rock falls witnessed in Yosemite in the early spring and because no major earthquakes have been recorded in the region before or after 1872, it is hardly logical to credit such tremors with even so much as one-third of the debris at the bases of the valley walls.

OTHER RECENT SLIDES

In February of 1923 a huge slide occurred at Rocky Point near the base of Three Brothers. The huge blocks may be distinguished easily from the old debris, for the granite appears as fresh as if it had fallen yesterday. All of the older blocks are blackened by lichen growths which require approximately 100 years, under favorable conditions, to gain a noticeable foothold. This fall occurred without earth tremors and was no doubt loosened by the freezing and thawing action and the slight decomposition outlined above.

Some time during the early spring of 1932, a slide originating at the base of Liberty Cap obliterated the trail to the north of Nevada Fall, and at about the same time a mass broke loose from the center of Panorama Cliff. The latter will be plainly discernable even to the untrained eye for several years to come. Here again, freezing and thawing must receive the greatest credit, but in the former of these two occurrences the same activity will probably receive the greatest damnation from the trail crews.

HEAT PLAYS A PART

Other factors causing rock falls must receive their share of discussion, for often some one activity has caused the fall while others have taken place to but slight extent. Great insulation or heating by the sun's rays causes the various crystals in the rocks to expand, and because the crystals expand to a different degree in each of their three dimensions, disintegration results from the long-continued heating during the day and cooling during the night. The rounding of the Yosemite domes has been attributed to this cause. In desert regions, loud cracks similar to the report of a small rifle are often heard when slabs of rocks fall off due to fast changes in temperature. Forest fires may produce the same result.

Rain-wash commonly undermines rocks lying on loose soil, and one boulder in its descent may dislodge others that follow in its path. Large animals such as bears and deer are similarly responsible for small slides. Tree roots following cracks and joint planes play no meager part in the whole system of dislodgment.

Thus it may be seen that it is difficult to point out a single process responsible for the formation of talus cones and aprons in Yosemite. In the whole scheme of natural phenomena, be they geological or otherwise, several factors are in operation although one or two are in the spotlight.