

## BRUSH FIRES AND ROCK EXFOLIATION.

K. O. EMERY.

THE heat of forest fires has been recognized generally as an effective agent in producing rock exfoliation (Blackwelder, 1927<sup>1</sup>), but little mention has been made of brush fires in this capacity. In the months of November and December, 1943, several square miles of brush and grass land in San Diego County, California, were burned over. In the areas having thick soils, the main geological result is probably an increased rate of erosion by rain wash. On steep hillsides where rock



Fig. 1. Exfoliated rock surfaces developed by heat of brush fire. Note the contrast between the blackened original rock surface and the white patches of freshly exposed rock. Just to the left of the hammer is a boulder with a slightly blackened patch marking the position of a spall broken off during the fire. Rocks in the foreground show a number of loosened but not completely detached spalls.

<sup>1</sup> Blackwelder, Eliot: 1927, Fire as an agent of exfoliation: Jour. of Geol., vol. 35, pp. 134-140.

crops out, exfoliation of rock surfaces was an additional effect. This was very marked in an area of quartz diorite near Lake Hodges, where the brush consisted chiefly of manzanita and sugar bush (*Rhus ovata*). Spalling exposed large patches of the fresh white rock beneath the blackened original surface (Fig. 1). Much of the blackened surface also consisted of detached spalls which had not yet fallen clear of the rock mass, as shown in the foreground of Fig. 1. More than 50 per cent of the original surface of many boulders and outcrops was thus removed.

Many of the spalls were roughly circular in shape, but most were irregular. Some were as great as two feet in diameter. They had a thickness of  $\frac{1}{8}$  to  $2\frac{1}{2}$  inches near the center and tapered to sharp edges. Locally, the spalls were abundant enough to form sizable piles around the larger boulders (Fig. 2). However, some spalls lay more than 5 feet

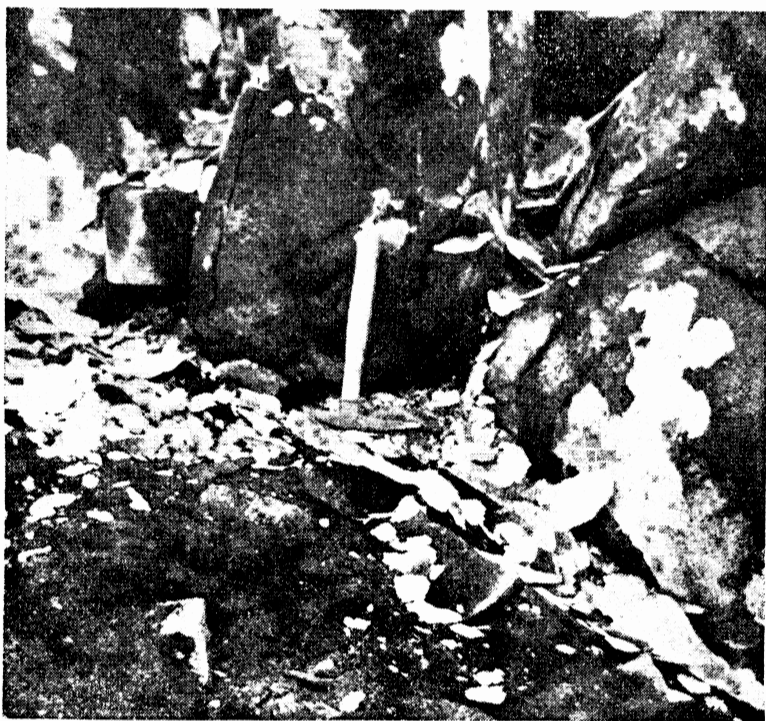


Fig. 2. Showing a pile of rock spalls such as commonly present around large rock masses.

from the closest large rock mass, indicating that they were thrown off with considerable force.

Many of the freshly exposed surfaces, both of the rock and the spalls, were slightly blackened, in contrast to the very black original surface, indicating that fracturing took place during the fire but evidently in the later stages. No evidence of chemical weathering was observed on freshly exposed surfaces, while weathering of the original rock surface was generally restricted to a slight cloudiness of the feldspar grains.

Spheroidal shapes are characteristic of quartz diorite outcrops in the region and further development of these shapes resulted from the exfoliation by the fire, since the thickest spalls were generally formed at the sharpest corners. Loosely attached to a few of the rocks were older but very similar spalls, suggesting that the spheroidal shapes of the rocks were partly due to previous brush fires. No evidence was found indicating recent splitting of boulders into large fragments along planes through the center, and thus forming more angular blocks. Apparently, the heat developed by the fire was sufficient to affect only the outer surface.

Since the heat even of a brush fire can produce extensive exfoliation, and since large areas of the west have a brush cover, it seems not unlikely that a great deal of exfoliation has resulted from brush fires, with the consequent tendency toward development of spheroidal rock shapes in widespread areas.

LA JOLLA, CALIFORNIA.