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DESERT VARNISH: SUMMARY OF INVESTIGATIONS

One of the conspicuous features of any desert landscape is the dark stain of iron and manganese oxide, called desert varnish, that covers much of the surface of rocks. It produces a decorative tapestry effect on canyon walls; it darkens boulder fields at the foot of cliffs and on mountain sides and it colors the extensive desert pavement on gravel terraces and gravel fans. It occurs on every type of rock, although it is less common on limestone and dolomite than on the less calcareous rocks. The surfaces stained may be the top or sides of isolated individual stones; they may be vertical or overhanging cliffs, or other surfaces splashed by rivers or wetted by seeps. These stained surfaces may be exposed to direct sunlight or surfaces never reached by the sun, such as joint planes or tunnel walls.

The stain, usually no thicker than a thin coat of wood varnish, consists of the oxides of iron or manganese. It has been observed as thick as a millimeter in some locations (Engel and Sharp 1958). The proportion of iron to manganese varies between 1:1 and 10:1 (Hunt and Mackey 1966). Trace elements mixed with the stain indicate that rocks resting on the ground derive their stain from the ground and not from the rock that is stained. These trace elements are the same whether the stone is a chert, sandstone or igneous. On extensive bedrock surfaces the stain is derived from the bedrock. Airborne material contributes little to the staining.

If we accept that the present is a key to the past, and consider how and when desert varnish is being deposited, we can look at locations where varnish is observed today.

In the humid, eastern part of the United States staining by iron and manganese oxide is going on extensively at the present time, as in railroad cuts or walls of diversion tunnels of the Tennessee Valley Authority. Clearly the stain is being deposited where there are seeps along the face (or fracture) of a cut. It seems absurd to refer to these deposits as desert varnish, but they are no different from the western type in any way.

Along the walls of canyons on the Colorado Plateau the stain or varnish is being deposited wherever there are live seeps. Rings of desert varnish also mark the level of high water in rock tanks. Varnish occurs on rocks of all ages: Paleozoic, Mesozoic of the Colorado Plateau and on rocks in the Basin and Range Province. Desert varnish is forming today where water is sufficient to transport iron and manganese to the rock surface. Canyons of Glen Canyon and the Colorado River illustrate long stripes of stain that imply a drip effect quite like those at live seeps, only on a far grander scale. Tapestries head at places that in a wetter period would be seep zones or at low places in the cliff tops where runoff would collect.

Desert varnish also covers stones lying on the ground. This is observed in two ways: the first are varnished talus blocks that are found on a slope below a varnished cliff. The varnish on the blocks is a relic from the cliff. The area on the cliff where the blocks fell is now free of varnish—varnish has not yet formed on the scar. A closer view of the talus blocks show the varnish on them is being removed, knocked off at the corners and edges, and the varnish remains only on the relatively protected flat surfaces. In

most places where there is gradation between varnished and unvarnished surfaces, the gradation is the result of erosion of ancient varnish. At many sites a higher percentage of talus blocks have their varnished surfaces upward, and must have slid rather than rolled down the slope.

The second instance of ground-level desert varnish is called desert pavement. Stones closely set or widely spaced can form dark, burnished cover over many square miles such as observed on the high benches of Death Valley (Hunt 1960).

Generally throughout the Colorado Plateau and Basin and Range we find compelling evidence that extensive varnished surfaces antedate (come before) those prehistoric Indians who were in the region after about 1 A.D. (Dutton 1975) The most artistic and majority Southeastern pictographs are younger than the varnish on the rock surfaces where they were engraved, and this is true whether the surfaces are nearly flat and near the ground, or on cliffs and walls of overhangs. The stone walls of cliff dwellings at Mesa Verde, Colorado are not stained but are built against varnished sandstone cliffs. There are hundreds of these prehistoric apartment houses along the cliffs of the Colorado Plateau. Many of these stone structures date back to the first millennium A.D., but they are not stained with varnish *except* where the stones abut against live seeps. Yet the cliffs back of them, and the ground around them, are darkly stained.

Referred to as lacquer, varnish, "patina" or sheen, desert varnish is a deposit of considerable antiquity, a relic of past environments; with an origin that is unclear.

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