# Sand, Rock, Water, Time

Woody Packard

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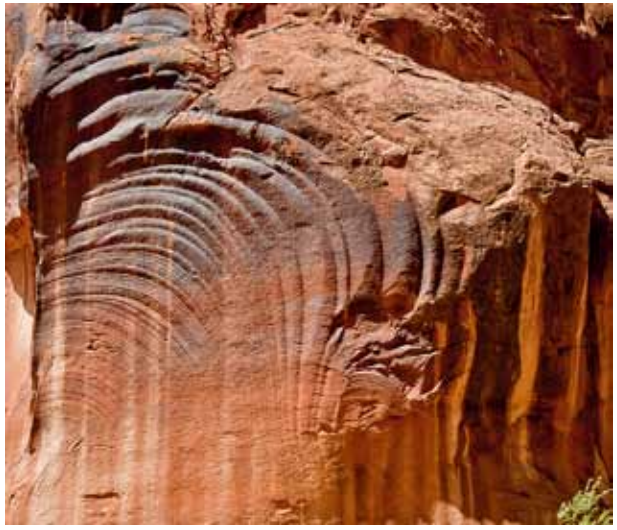
For Judy, who believes in me.

Watershed Erosion, Detail



Rock Fall, Grand Staircase–Escalante National Monument

Wind Erosion, Navajo Sandstone, Capitol Reef

Chadron Formation, Yellow Mounds, Badlands

Because of its generous rainfall, eastern geology is mostly hidden by the flora of the region, which also acts to slow the process of erosion. Except at road-cuts and at the tops of the relatively few high mountains, what you see traveling through the east is either biological, architectural, agricultural or industrial. Travel two days west of the Mississippi by car though, and the word *geology* takes on a different meaning. Instead of being just a branch of science, a topic of study that deals with rocks and the formation of the earth, it becomes the best word for what is moving past your windows as you sit behind the wheel of your car, or what your feet rest on as you make your way along the fragile edge of a wash.

Geology in the west is a visible part of any but the most transient experience there, visible enough to be read as both stable fact and ongoing process. Pull off the interstate at Ranchester, Wyoming, head west for the top of the Bighorns, and you will pass historic markers by the side of the road that point to the events of the past that you are now a witness to. Unlike similar markers in the east, where you might be told of a first settlement, the birthplace of a former president, or the signing of a treaty between whites and native inhabitants, these markers note a history that is measured in millions of years. Passing through earth whose layers are uplifted more steeply than the grade of the road you drive on, you penetrate layer after layer of sedimentary rock, each layer originally laid down on top of the one ahead of it. So, although you are driving uphill, you are descending into millions of years of recorded time, now exposed by erosion, dynamite, or bulldozers.

*Permian, Pennsylvanian, Mississippian, Devonian, Silurian, Ordovician, Cambrian*; *230, 280, 310, 345, 395,435, 500* million years. There is no marker for the brief Eden-ian epoch, or one that shows the deposits left from Noah's flood, and there is no trace of protesting vandalism to the roadside markers, which contradict, by a factor of 760,000, some Biblical literalists' interpretation of earth's age. If you don't want to accept the evidence left for your eyes, it would be best to avoid Wyoming. And Utah. And even South Dakota.

In Montana, I talked with Tom Chadwick, a geologist who consults with companies interested in finding valuable metals. I wondered what a geologist would think about the current crop of politicians who have decided to make an appeal to the large anti-science

part of the population. In particular, I asked for his take on those candidates who claim to be Biblical literalists, six-thousand-year-earth believers.

At first he looked puzzled, as though he didn't understand what I was asking. I'm sure I looked puzzled too, because I imagined an instant recognition of my concern—what an election victory for anti-science religious conservatives might mean. It took a few seconds for my concern to register with him, first concentrating intently on me, then leaning his head back with an "Ahh." As if to clear the air of gnats, he swished his hand and noted that "You'll always be able to find *someone* who believes in *anything*." He went on to explain that a person can believe what they want to until they are required to "do the hard work" of understanding their subject in a provable way.

If you are a geologist, you don't worry about creationists for the simple reason that corporations looking for oil or gold do not consult ministers or politicians to help them find it. For many of the rest of us, the prospect of faith-based answers to pressing questions of public policy continues to be a real concern.

While hiking beside an eroded draw on the Castle Trail in Badlands National Park, I spotted some white material at the base of a chalky slope that was cut sharply from the flat grassland above. Climbing down to investigate, I found bones embedded in the bank, as well as a few that were loosely laying on the surface. A few weeks after reporting these to park rangers, I got a letter thanking me for the report and letting me know what I had found. Bruce Bailey, a park physical science technician, explained that the bones, which had been buried around ten feet deep, had been from a young bison that had been covered between 500 and 2000 years ago. He then explained that they do not consider bones to be fossils until they are at least 10,000 years old, and that the fossils found in Badlands are between 30 and 32 million years old. So, even though they are buried under ten feet of sediment, my bones are recent. They are from a species that still roams the park. To put my little discovery into geological perspective, it would be something like calling in to report a road kill.

Much of geology revolves around the chicken-and-egg process of erosion and deposition. Solid rock is ground to sand and mud by the action of water and wind, fused into new rock by the force of gravity, then cut to its elements again by the action of wind and water. To see

this process clearly you must visualize it through the multiplier of mind-numbing stretches of time. A sense of this same multiplier is required to envision the effect of random genetic mutations upon a species. Accepting personal responsibility for environmental change requires a sense of how each individual decision plays out when multiplied by the seven billion inhabitants of the earth. Intelligent as we homo sapiens believe we are, this is not a sense that comes naturally.

With these images, I am not looking for gold or oil or even ancient forms of life. I am looking for evidence that can give a tangible sense of the efficiency of small change multiplied by large numbers, and I have been searching in several areas of the west that have been set aside as refuges against human alteration. Although it is important to know the facts of science intellectually, it is also important to know them emotionally, through the gut, or more accurately, through the eyes.

Many of these views can be explained by the hard facts of sedimentation and erosion. Still, there are mysteries. A well worn pattern of erosion is cut off sharply by another at a different, improbable angle. Two hundred feet of rock face peel away and leave the shape of an art-deco façade. The erosion of one side of a mountain exposes an area that weathers into tall spires and steeply cut walls. Geological accidents, which act to remind us that we do not even know the half of it.

Badlands National Park

Fins, Flats

Erosion Flats Along Castle Trail

Near Sage Creek

The Edge

Sedimentation Layers, Eroded

Toward White River

Bryce Canyon National Park

Soft, Weathering Sandstone

Hoodoos, Bryce Canyon

Mid-Slope, Among the Hoodos

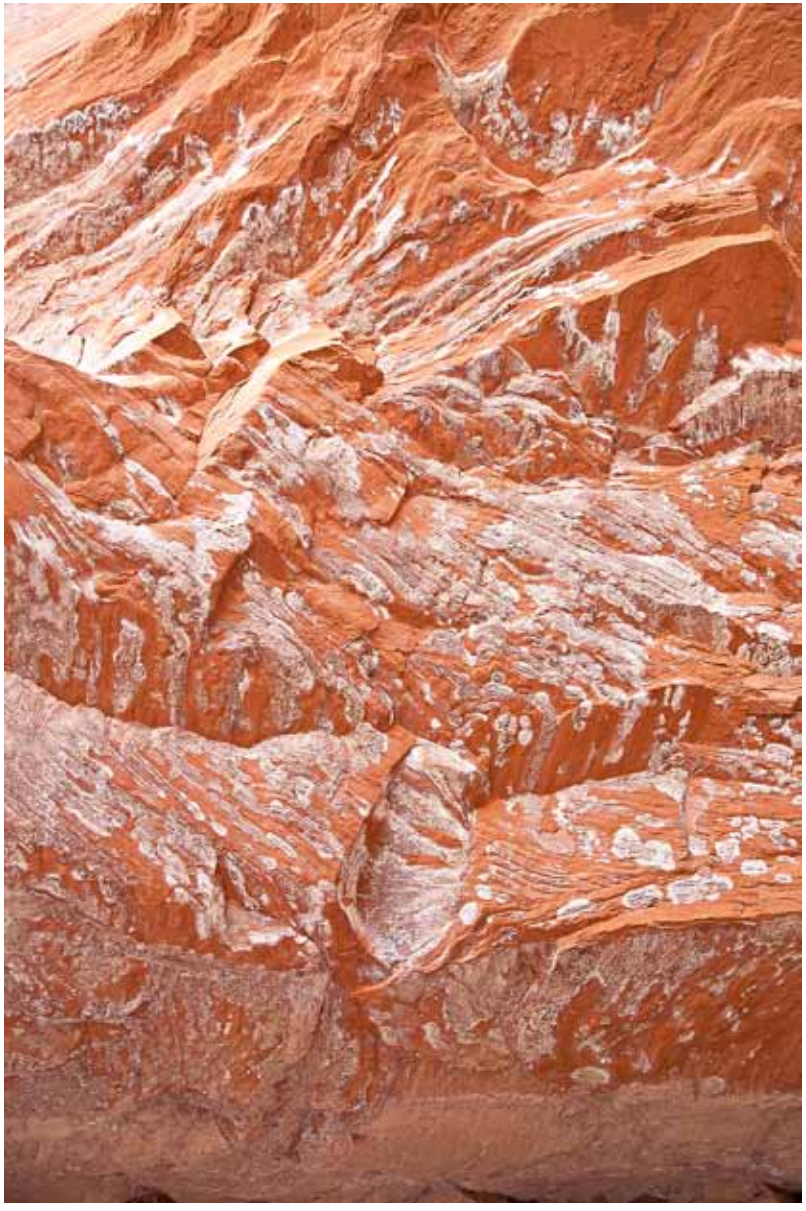
From Above, Bryce Canyon

Grand Staircase–Escalante National Monument

Straight slab, Harris Wash

Mud Cracks, High Water

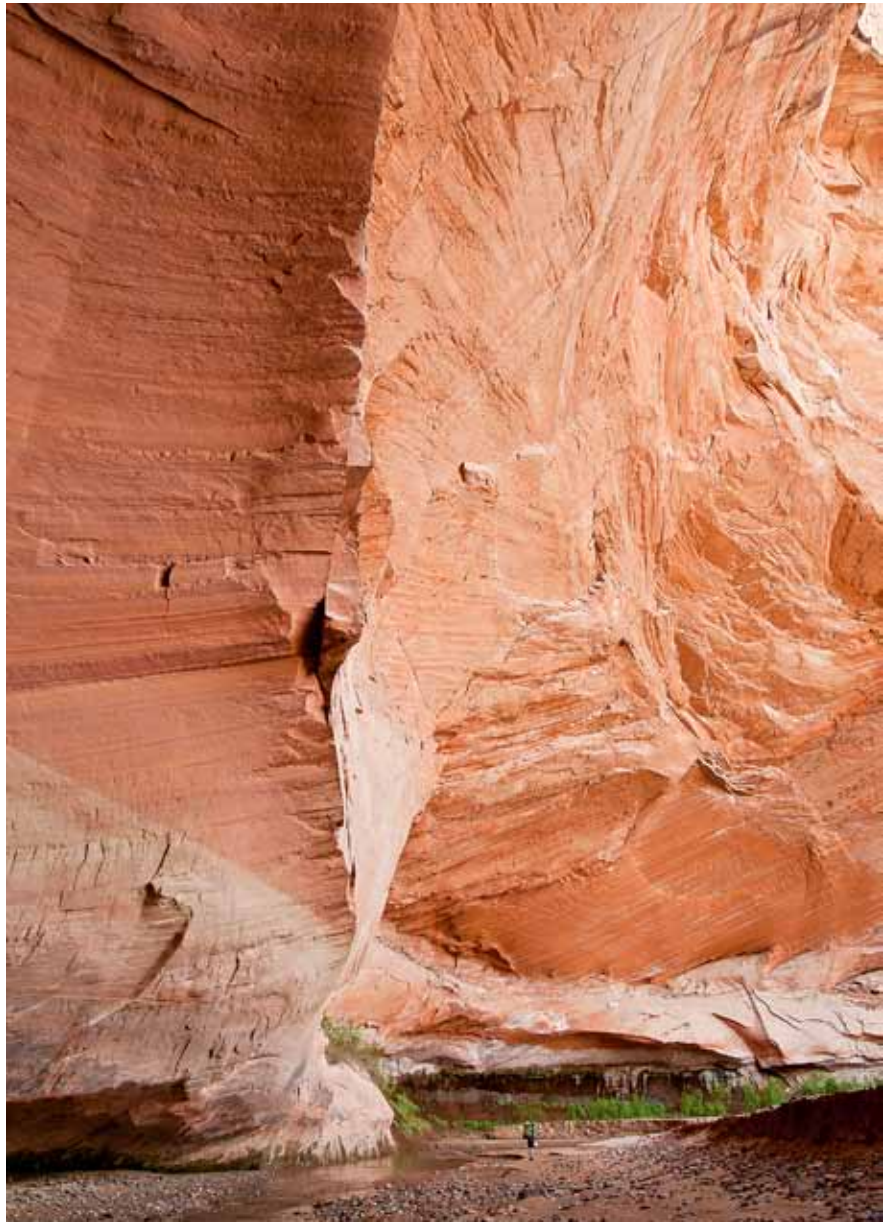
Russian Olive, Sandstone



Mineral Deposits

Erosion Mystery #47

Sandstone, Weathering



Hiking the Bottom, Harris Wash

Capitol Reef National Park

Top of the Switchbacks, Burr Trail, Waterpocket Fold

Route 12, Above the Escalante River

Telephone lines, above the Escalante River

Route 12 Beside the Escalante River

Common Globemallow

Claret Cup cactus

Greenstem Paperflower

Uplifts, from Burr Trail

Navajo Sandstone, Capitol Reef

The Goosenecks, Capitol Reef

Switchbacks Following Uplift, Waterpocket Fold