“Coats of Many Colors”

Yellow paint lichen coats dark boulders on Black Mountain, near Carefree, Arizona.

Top Coat

Life has a way of inhabiting even the strangest of places. And in doing so, it makes those places themselves come alive, in a bigger way. As any artist knows, it is the small touches that make the larger artwork extraordinary.

I was drawn to the pinnacles and cliffs of the desert the first time I saw them. It wasn’t just out of scientific curiosity, or an interest in a landscape different from the one with which I was familiar. It was that in many ways, the rocks themselves *looked alive*. They had colors of their own – yes – but superimposed upon those were abstract patterns and splotches of yellow, orange, green, and gray. And then there were the dripping streaks of brown and black, looking so much like dark chocolate frosting looks as it spills casually off the side of a layer cake.

In some such places, and when I was alone, I would be still for a moment, let my mind calm, and just take in the view in front of me, without trying to analyze it. Detailed and complicated patterns would appear among the more readily apparent boulders and fractures, turning the scene into a kaleidoscope of colors, shapes, and figures. Jackson Pollock himself couldn’t have displayed more impressive works of art.

A *coating of life* is what is responsible for that look – small life creates bigger life, so to speak. Growths of lichens, desert varnish, and moss are the “paints” upon the land. But they are not just “on” the rocks indifferently. They are *connected to* the rocks – the rocks give them life.

Tourists from other climates often ask me about the colors and patterns on the formations around the Valley of the Sun. Maybe we residents take it all for granted, but they notice them right away. I explain that they are living things, and they grow very, very slowly.

The brightly colored patches and spots that look like “splatter” paintings are *lichens*. Lichens are actually two life forms living together: algae and fungi. There are many different “species” of lichens; hence there are many different hues and textures. Algal cells are enclosed in masses of fungal filaments, all in compact arrangements that clutch onto barren rock surfaces.

The algae conduct photosynthesis and provide the fungi with nutrients, and the fungi provide the algae with protection. Neither could make it on its own in such a harsh environment.

There is a budding science of *lichenometry* – the use of lichen growth as an age-dating technique – but it is still in an inexact stage, and there are many factors that influence growth rates.

However, in central Arizona, when you see a spot of lichen that is, say, several inches in diameter, you can probably assume that it is on the order of a few hundred to a few thousand years old or so.

Desert varnish (or “rock varnish”, as it is sometimes called) is what we call the dark, surreal staining that cascades down rock cliffs and spires in our area, and it too, takes a long, long time to develop. The varnish is a very thin layer of manganese and iron oxides, together with clay particles.

But the key to that covering’s existence is a community of tiny bacteria which live on the rock surface, and process the mineral compounds into a protective coating. By sheltering themselves with the minerals, they shield themselves from heat and drying-out, and intense sunlight.

The dripping effect (on the landscape) is a result of their having an easier life where water occasionally flows, but desert varnish also coats many rocks just sitting out in the open. They look black and metallic in the sun’s glare.

Ancient rock art all over the world owes a lot to those little one-celled creatures. Prehistoric humans systematically and artistically pecked through desert varnish on various rock surfaces to produce what we call petroglyphs. The thin, organically-caused patina masks the lighter color in the rock underneath, and it is that showing-through of the rock itself which forms the desired image.

Moss is a plant that also grows in small communities on rocks, but you don't see it in too many places in the desert, as it needs more water. Look for it in spots where the sun never shines, and where water can flow periodically. Most of the time it is a dark-gray or black, soft, puffy growth. The time to see it in its glory is right after a good rainfall, when it comes alive again, and is a bright, emerald green in color. It is also much softer to the touch, then.

All of this life is part of the surface of the rocks. But there's more underneath, and there is *plenty of that*, too.

****

Under Coat

Granite in cross-section.

That the native inhabitants of the Americas had a different way of relating to the landscape is without much question. Their sacred sites and temples were placed in special geographic places. But what led to such a philosophy?

Could it be because that within their culture, they value fitting in with nature, not trying to change it? Seeing yourself as *part of something* is, to be sure, not the same as seeing yourself as *separate from something*.

What we are all part of is a vast web of life that covers our planet. So far, based on the current state of scientific knowledge, it is that web which makes Earth distinct and unlike any other place we know of in the Universe. That "coating" of life includes plants, of course, and animals, fungi, and microbes of many kinds. Life lives in the air, in the water, and on the land. And, now it turns out, *inside the planet*, too. It thrives even in the rocks.

Above, in "Top Coat", I talked about life on the surface of rocks. However, that layer pales in comparison with what is underneath. Geologists and other scientists are beginning to realize that what we once thought was barren, lifeless stone, is, in many cases, teeming with microorganisms. Some of those microscopic life-forms are strange indeed, and can feed from the rocks, without needing air or light.

Sedimentary rocks (which are deposited by water or wind) usually have small pore spaces within. These pores can and many times do, contain water, oil, or gases. It is from this porosity that we pump groundwater, petroleum, or natural gas. Other kinds of rocks, by nature of the way they formed, have no pores *per se*. But they frequently contain fractures of all sizes, and water or hydrocarbons can occupy those cracks, too. Living things – microbes – can occupy them all.

Various experiments over the past few decades have shown that certain bacteria can flourish in such environments. No sunshine. No fresh air. Sometimes stiflingly hot temperatures. Yet, there they grow and multiply. The only thing that seems to be required in all cases for life to exist is the presence of water.

We have lots of that, and we know now that our neighbor planet Mars probably does (or at least once did), too. No wonder that space scientists look with intense interest upon such organisms. If they can exist in the rocks here, then maybe they can exist in the rocks of Mars, or other worlds, too. And for earth scientists, such "deep life", is leading to a new level of understanding of how the world works.

Is there anybody in there?

Based on data derived from deep-drilling projects, the late, brilliant, and controversial Cornell University astronomer Thomas Gold did some calculating. His reasonable estimates indicate that the top five kilometers (about three miles) of the Earth's crust could contain as much as 200 trillion metric tons of live bacteria.

This would be like covering *the entire planet* with a layer of bacterial organisms one and a half meters (approximately five feet) deep! It is *more than a hundred times* as much living mass (called biomass) as *all of the other life-forms (including us) of the world put together*! If aliens from another world were studying our planet, they would easily conclude that the rocks are the most alive part of it.

There are, of course, visible remnants of past subsurface life: coal beds, fossils, tar sands and other petroleum formations. There are metallic mineral deposits which seem to have been "helped along" in their genesis by organic life.

Professor Gold even suggested that diamonds come from deep-seated organic materials, and we know today that diamonds must form in an environment at least 75 miles down. If hydrocarbon compounds can exist that far below us, and the rocks are alive, so to speak, then the Earth we all know and love is a very unusual place.

Perhaps, though I can't prove it, life gravitates towards other life, and I don't mean just to eat it, either. Maybe it's a stretch, but think about it the next time you pull into an almost-empty parking lot, and you park *right next to* another person's lonely vehicle.

The Indians (and to be fair, many other ancient cultures) may have subliminally recognized the existence of places where life was, in effect, somehow concentrated nearby, though not apparent on the surface. Some of those places became special to them. Ponder that the next time you are out in the great outdoors somewhere, and "feel alive".

Look around and see what makes that so, and *then look down*, too. It may all be *underneath you*.

To learn more about the Phoenix area's engaging rock formations and prehistory, visit **www.gemland.com**, go to the "GeoScenery" section, and click on whichever name on the map interests you. That will initiate a series of images, together with geologic explanations, and you can even send any picture you like to your friends as an E-postcard for FREE!

----- *Richard Allen*

April 2006