

Ruth Hardinger

the basement rocks

a back story April 2015

Dear friends,

This is my letter to you about loving the underground.

My back story is that I lived in Mexico several times, and became impressed by their ancient history and legends. The Mayans legends, along with many early cultures envisioned human life as beginning with the underground. It was a principal part of how they saw the world. The Popul Vuh, the creation legend of the Quiche Mayans, is a perfect example of emotions, pride, and revenge taking place in the underworld, which is often seen by anthropologists as the underground. The Popul Vuh designated between the underworld and upper-world's divisions. The gods of the underworld failed several attempts to create humans using mud and then wood, and finally were satisfied with humans made of corn. In searching revenge for the death of their father by the hands of their Grandfathers, the Hero Twins fought the Grandfathers with the ballgame. Then they succeeded through bitter, life threatening challenges that the Grandfathers made the Twins take on. Ultimately the Hero Twins beat the Grandfathers and then the Twins moved to the upper world and brought life and light to the Earth's surface. An early legend continually used by indigenous people in Oaxaca in the present is that the placenta from child-birth is placed under a tree so that as the tree grows, so grows the child.

I bring this up because I am fascinated by the relationships between underworld and the upper-world's landscape, sky-scape and life. Yet, the culture we live in now has lost much of humanity's relationship to nature. It was not until the 1990's that scientists began to understand the underground's diverse microbial and biological communities existing in the deep subsurface. In other words, the underground is alive and has vitality.

This letter shares my conversations with two scientists about what is going on down there in the underground. Bryce Payne, PhD, a soil scientist, has also been working on fugitive emissions of methane from natural gas extraction. Ron Bishop, PhD, a biologist and professor, has written about chemical and biological risks of gas extraction and the issue of many abandoned gas wells in NYS.

Both Bryce and Ron point out that we have very limited knowledge of the human impacts of the underground. The underground has been and is being modified by many sources, including hydro-fracking for gas, radioactive extraction and waste disposal, gold mining (that used cyanide) and more.

Conversation with Bryce Payne:

Sections of the Louisiana Gulf coastline are sinking into the earth.

There are two different positions for the reason for losing football-field-sized pieces daily.

There are more sinks due to extraction increases.

The first cause is channelizing. In the past, Mother Nature had a seasonal cycle of flow in the Mississippi River. Annually in Spring or early Summer the spring thaw or rains came and the Mississippi River flooded, a natural and regular event. These regular floods fertilized the bottomland soils and the wetlands of the Mississippi delta. The fertile bottomland soils drew farmers, who then wanted to keep floods out to protect their crops. So, government channelized the river to prevent flooding the crops and homes that had moved in along the Mississippi, making a man-made path for the river's flow. The channelized flow carried the sediment that previously recharged the bottomlands and coastal wetlands and dumped it into the Gulf of Mexico – that does not need it. So, the wetlands are deprived of life giving sediment. The sediment, full of nutrition for the earth, is sent into the Gulf, depriving the lowland life where it was needed. Further, the Gulf lost storm service, because the sediment deprived wetlands are withering and no longer protect the coast from the powerful Gulf storms. Denied nutrient and sediment replenishment that came from natural flooding cycles, the river-fed land that protected itself and those who live on it has been and is disappearing.

The second cause: This is related to drilling and fracking. Oil and gas deposits are often associated with salt deposits. So, drilling often occurs where there is underground salt, holes drilled through the salt to get the fuel. Drilling provides a pathway for both oil and gas extraction procedures and can provide pathways for water to move through the salt, which can then dissolve, causing the underground to weaken and sinkholes to form in the land above. There can be massive sinks, a Louisiana lake disappeared and took a bunch of land down with it.

Plants are the main connection between the upper world and the underworld. Where plants are involved there's a great deal of cooperative life. Roots provide the plants' energy from light of the sun to organisms underground, whether the root reaches down a few inches or a hundred feet.

There are three categories of microorganisms: actinomycetes, bacteria and fungi. These work collaboratively with the plants. All the plant community supports all above ground.

The next level in depth is beyond the reach of plant roots but life supporting life goes on there, too. Water from the surface percolates to lower depths. Microorganisms continue to grow in the depths. What they do is important to us: they contribute to cleaning ground water.

Rocks movements are part of the long-term balance between the upper-ground and underground. When change occurs down there it affects us above: for example, certain pressures can force underground water to go to surface.

We used to drink natural spring water with no problems, but industrialization and careles handling of human and animal wastes resulted in chemical and biological contamination of the previously naturally clean ground water. We lost ability to drink that water without chemical protection.

When plants and microorganisms work together, there are good, positive consequences. When we monkey around - squeezing one corner, then the rhythm and equilibrium change. The adjustments do not have a positive result for the system as a whole. Like, for example - if somebody who has smoked gets lung cancer and then is treated by potent drugs, the treatment can cause damage to the person's other internal systems. Once there is damage on one part of the body, the body will take action and can harm itself. Once Mother Nature is messed with - aka modified - nature will do what it has to do to restore balance. Once the apple cart is upset, we can't set it right, only Mother Nature can. And, she does not care whether humans are benefited or harmed when she restores balance

Mother Nature buried large amounts of carbon millions of years ago, and since then has let that carbon out only very slowly. All that carbon, most of which is in gas, oil, coal and limestone, are part of the underground structures. That sequestration of all that carbon has been critically important for the underworld and made the upper-world what it is. We have, purely for our own convenience, taken that carbon and brought it back up into the upper world. This began in the ancient cultures of Romans and Mayans who devastated mountainsides and roasted limestone to create concrete for buildings.

We crossed the link of excess in the mid-1800s, reaching a point that went a bridge too far. We altered that balance and not in a small amount. The extraction of oil and gas took away the barriers between underworld and upper-world. Those original barriers were there for a reason.

We do not know what we are doing in the underground. It's a WORLD WE CAN'T SEE. We don't know what is its normal status and we don't know what is healthy.

Rocks have a fault and fracture system, a natural system that functions like a spring or rivers where liquids and gas can move. They are called pathways. These rocks can have an over-arching structure which may be small as sand or as enormous as a mountain. The fracturing actions for gas extraction penetrate these systems to make connections to the natural fractures and fissures. They create artificial connections, short circuiting these pathways that did not connect in the past but do now. We don't know the consequences of these actions. Intermingling of underground fluids is invisible to us, but bad enough all by itself. In places we add to that intermingling massive amounts of waste product produced by injections of frack fluids with biocides or toxic wastes for disposal, leading to bio-modification. These alterations are done intentionally to gain access to carbon reserves, and unintentionally to dispose of wastes by deep well injection.

Water is one of the most incompressible substances. It's a liquid yet is more incompressible than most rock is. Rock is fractured by water pressure. Water will squeeze rock till it breaks. Water can deliver more energy than rock. So, injecting mostly water into all these

fractures and fissures of cracks and spaces, and then pumping it sets up a bed of pressure-cracked rock that has its mechanical stability compromised.

Natural systems are complicated but the underlying principles are simple. How does the complexity of the system balance the processes in principal?

For now, the US is producing much more gas than can be used. One of the current practices now is to take that gas out of active wells and pump it into old gas wells for storage. Old well formations were conventional gas wells with large reservoirs. The old well has become an underground gas storage tank.

If gas is at moderate pressure and stored under a layer of ground water, the pressure can push the ground water up by a few inches or a few feet. When the pressure sinks, the ground water settles back down. Too much pressure will cause gas to leak and if it is an over-pressure storage area the gas will migrate. A farm owner in PA reported seeing the bottom of her pond rise up and settle back down in accord with the pressure in the old gas well storage field.

We walk on the underground, construct our shelters and factories on it, obtain our food and fuel from it, feed our animals on it, derive our medicines from it. It cleans our air and water. The underground did all very nicely until we grew greedy and smart enough to brutalize it and interfere with the natural balance between the underground and the upper-world. Probably the worst is our greedy, reckless extraction of the carbon energy stored under our feet. It all goes together – poetic and scientific harmony.

Conversation with Ron Bishop

What happens when substance from the underground is placed in the surface?

Natural gas is comprised of largely of methane, but there are small amounts of the heavier molecule gases: ethane, ethylene, propane and butane. Further, these gases can include radon. Methane comprises about 98% of natural gas, and can go as low as 95 %. After taking it out of the underground, the procedure to deliver it to customers requires those heavier gases to be stripped out of the mixture because they liquefy under pressure, then the methane is sent into a high-pressure pipeline. The #1 problem of transporting natural gas is that the pipelines leak. They leak more than the industry is willing to admit. Besides, many of the stripped-out hydrocarbons are simply vented into the atmosphere.

An underappreciated and understudied problem is when the ground is cracked, methane gets into a water well. The methane can stir up dirt and silt with its bubbling that muddies the water and makes the well water non-potable. Methane is soluble in cold water and out-gases from hot water quickly. Although there is not much documented health impact evidence, people who take warm showers when methane has migrated to their wells, have complained of nose bleeds, headaches, nausea, and other symptoms of negative health impacts.

Fluids (both liquids and gases) are under huge pressure when they arrive on the surface from drilling; then the workers let off the pressure and they come screaming back. They can let it out into the open air or use a closed-loop system. The trouble of an open pit is that it can contain archaea and other underground bacteria, that can be carried up into the air by evaporation or can be consumed by birds or animals. Archaea are single-celled microorganisms. They tolerate extremes in temperature and acidity, and they easily tolerate brine that leaches from salts in the rocks.

Along with forming oil and gas from living organisms, archaea also contributed to trapping uranium in the ancient sea beds, which eventually became the oil- and gas-bearing shales. Therefore, considerable radioactivity was trapped in the ancient shales by these bugs. Ancient life forms are not quite the bacteria that live on us or in the soils. They are native to the very ancient and deep rock and brines in those rocks. They don't belong on the Earth's surface. After drilling, salty (and toxic) brine are often sprayed into the air. A scientist hit with the spray was exposed to the archaea and quickly developed a rash on his skin, similar to lesions which had been described to him by people who live in the "sacrifice zones" we call oil and gas fields.

There are thousands of 'salts' in the underground and they can include nearly any metals reacting with non-metals. Some are soluble forms converted from soluble to insoluble by oxidation-reduction (like uranium). Since uranium undergoes nuclear decay to, among other elements, radon, nearly all gas and oil from shale is caught up with radon. Radon, a noble gas, cannot be separated out from gas, particularly propane. Another decay product of uranium is radium, which is in the same chemical "family" as calcium, and, like calcium, targets our bones and teeth when it gets inside humans. Drill cuttings, a waste brought from the underground to the surface, contain radon, radium, and other radioactive elements that are not separable and currently are not disposed of safely.

We don't have a complete grasp of either end of this story of what is going on in the underground, understanding human impacts of our killing all these bacteria. After drilling, the industry does not fix anything that has been changed in the underworld.

Abandoned wells:

A recent report noted that there are over 4 million abandoned wells in the US. A 1980's study said that one of every six wells is leaking to the surface, which is about 17% of the abandoned wells. About 15% of concrete casings in wells are leaking by the first 5 years of operation, then 30% are leaking by the end of 10 years, and after 50 years, all concrete casements fail. All wells are capable of leaking but not all of them do that. More than a casing break, original pressures can create a re-development of leakage. If it is a depleted well, it won't leak again, but if pressures are still there, the well can re-pressurize. This is another aspect of what we don't know enough about. Offshore and onshore abandoned wells share the problem.

Dear friends, thank you for reading this and Bryce and Ron for their conversations!
Best regards,
Ruth