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THE ATOMIC POND

A Radioactive Wastewater Collection Site at Hanford Comes to Life

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The first time I saw the pond, it looked like a pleasant place to go fishing. The shorelines were cool from the shade of cottonwood and willows. Bulrushes, wild lettuce, and cattails grew in the marsh. Ducks and coots paddled around on the water. There was an island with trees and a boat dock with a small boat tied to it. But my boyhood reverie was broken when I noted the radiation control zone signs posted around the pond with radiation symbols and bright colors—a type of sign common at the Hanford site. Like every building and facility at the Hanford Nuclear Reservation, the pond was given a number, 216–U–10 pond.

Since my very first encounter with the pond, I have been struck by the irony that a pond containing atoms of a toxic element created by mankind in nuclear reactors became a flourishing aquatic Garden of Eden in the middle of a desert. The pond, like the plutonium atoms it contained, was a man-made creation that came to life in an isolated desert in 1944 at the height of World War II and met its demise (or decommissioning, in the language of Hanford) in 1984. In one of many scientific reports published on the pond, a scientist stated, "U–pond is unique among aquatic ecosystems. It has uncommonly large quantities of actinides and has contained transuranic elements longer than any other aquatic system." In other words, the pond was totally unique—contaminated with plutonium longer than any other similar place in the world.

GLOSSARY

Actinide*—any of a series of chemically similar, mostly synthetic, radioactive elements with atomic numbers ranging from 89 to 103.*

Transuranic*—an atomic element having an atomic number greater than uranium (92). Uranium has the highest atomic number of any naturally occurring element.*

Plutonium*—a synthetic element of 21 isotopes, mostly alpha emitters with half-lives of up to 80.8 million years (Pu-244).*

Plutonium is named after the planet Pluto, which in turn is named after the Greek god of the underworld. Pluto is an alternate term for the Greek name Hades, which is the underworld itself. It is only appropriate then that plutonium should be found in the pond sediment and algal scum of U–10–pond.

During its 40-year history, scientists studied U–10 pond assiduously. They probed every aspect of the pond with the methods and equipment of science: they "characterized" the sediments at the bottom of the pond for the presence of radioactive isotopes; collected and dissected small mammals living near the pond (pocket mice, deer mice, and harvest mice) and analyzed their fur, livers, lungs, bones, and muscles for radioactive elements; kept records of birds visiting the pond; caught and analyzed birds; collected and analyzed the waters coming into the pond, in the pond, and in the groundwater beneath the pond for chemicals and radioactivity; collected and inventoried insects, algae, snails, fish, and many other organisms in the pond; and sampled the trees and analyzed their leaves, soils, roots, and cores for "uptake" of radionuclides. Because at the time there was incomplete knowledge about how plutonium moved through the environment, the three most studied radionuclides were isotopes of plutonium (atomic numbers 239, 240, and 241).

U–pond was unusually productive from a biological point of view in part because the laundry discharges that went to the pond contained phosphates that acted as fertilizer for algae and diatoms growing in the pond. (The laundry was used to wash protective clothing called "whites" used by workers when entering radiation zones. The white clothing consisted of hoods, coveralls, boot covers, and gloves.) Scientists estimated that the primary productivity of U–pond approached that of a "highly productive terrestrial community, a corn field…." In other words, a great deal of biological mass grew in the pond.

But to locate this interesting pond in time and space, it is necessary to go back to the beginning in the geologic foundation. The pond would come to rest upon what geologists call the strata of the Pasco Basin that is underlain (from the bottom up) with the Columbia River Basalt Group, the Ringold Formation and the Hanford Formation. The Columbia River Basalts erupted from volcanic fissures starting 17 million years ago and ultimately covered almost 63,000 square miles of what is now eastern Washington, Oregon and parts of Idaho. After the last major eruption of basalts about 8.5 million years ago, the Ringold Formation was deposited by the early Columbia River meandering across the basalt and depositing sand and gravel. The Hanford Formation sediments were laid down on top of the Ringold strata by a flood of Biblical proportions when an immense lake blocked by an ice dam in Montana drained in a relatively sudden manner at the end of the Pleistocene ice ages. The floods left behind gravel bars and sands.

The engineers at Hanford in 1944 took advantage of a depression in the topography of the Hanford West Area to discharge wastewaters and cooling water from plutonium processing and reclamation facilities, a laundry, a uranium recovery plant, an evaporator/crystallizer plant, and several laboratories. During its history from World War II through the Cold War, U–pond received some 317 billion gallons of water. This amount of water occupied all of the pore space in the sediments beneath U–pond. During the heyday of wastewater discharge to U–pond, so much water was placed on the ground that the pond grew at one point to 30 acres and the groundwater table below the pond rose some 75 feet above the normal water table. Hanford used enormous amounts of water for the operation of reactors and chemical separation plants and other facilities. The abundance of water was a primary reason, along with the need for secrecy, that Hanford was located on an isolated reach of the Columbia River in a desert.

During the operation of U–pond about 8.1 kg of plutonium was released to the trenches leading to the pond. The bomb that destroyed Nagasaki in Japan during World War II was made with plutonium from Hanford and contained 6.1 kg of plutonium. Lest the reader think that the pond could explode into a mushroom cloud, it is important to remember that because the plutonium in U–pond was so dispersed throughout the sediments and water, there was no danger of a "criticality"— the formation of a critical mass of plutonium to cause a release of energy. But the seemingly bucolic U–10 pond contained enough plutonium to make a nuclear weapon.

I never will forget my personal feelings when upon a visit to Los Alamos I saw a piece of metallic plutonium being manipulated remotely in a "glove box." Metallic plutonium is very dense and for some reason it reminded me of gold though it was not gold in color. It did not have the beauty of gold: it was an ominous and dull metal—even ugly in a way. Perhaps it reminded me of gold because of the tremendous cost expended to produce it in even small amounts.

As a scientist I knew the plutonium was emitting alpha particles detectable with instruments, but as a poet I felt the plutonium emitted something else. There was something sinister about it—as though it was mocking us for our incredible ingenuity to create such a thing and our incredible hubris and folly to allow it to live. Suddenly I understood the extraordinary precautions of those handling it, including the building itself, with a door of enormous thickness and huge steel pins, able to withstand tornadoes or the crashing of an airplane. I was very aware that this stuff could kill us either by blast and heat from a weapon or just by entering our lungs as atoms. In a real sense the plutonium seemed to require being worshiped and housed in a complex palace of enormous expense, tended constantly by procedural ritual. It had somehow managed to achieve godlike status.

Buried in the documents resulting from the study of U–pond are glimpses of a few interesting stories that intersect with my own life. Of the five ponds at Hanford, workers planted goldfish in two—Gable Mountain Pond and U–pond. I remember my first visit to Gable Mountain Pond, a much larger pond than U–pond but without the biological diversity or the plutonium contaminants. I recall coyotes jumping from the abundant cover at the edge of the pond and rabbits and ducks and coots. The goldfish in that pond were quite large—like well-fed koi in a private pond. In U–pond the goldfish did so well that the standing crop was estimated at 75,000 individuals. I am still struck by the irony that a man-made pond devoted to the disposal of waste water could be a haven for a wide range of fauna, including the common goldfish. It is a testament to the fecundity and resilience of nature that a few fish planted in U–pond could flourish to number in the tens of thousands.

Being an avid bird watcher, I was intrigued to find in the documents about U–pond detailed studies of the birds that frequented the pond. Judging by the lengthy species lists and numerical inventories of birds visiting the pond on any given day, Hanford scientists must have spent a great deal of time bird-watching at U–pond and the other Hanford ponds. A far greater variety of birds visited U–pond than the other ponds at Hanford. Among the perching and small birds were peewee, kingfisher, three species of woodpecker, flicker, two species of kingbird, flycatcher, phoebe, lark, magpie, raven, crow, starling, cowbird, three species of blackbird, meadowlark, oriole, finch, goldfinch, eight species of sparrow, junco, towhee, tanager, two species of swallow, shrike, three species of vireo, eight species of warbler, pipit, thrasher, mockingbird, three species of wren, two species of kinglet, solitaire, two species of thrush, robin, and bluebird. The list of waterfowl reads like a who's who of western shorebirds, diving birds, and wading birds including, most notably, widgeons, mallards, coots, shovelers, teal, geese, sandpipers, scaups, and pintails.

The studies reminded me of my college days when I was required to develop an insect collection in an entomology class. The avid scientists at U–pond must have spent a considerable amount of time to ascertain the relative abundance of insects at U–pond, including: dragonfly, damselfly, mayfly, water strider, backswimmer, water scorpion, water boatman, caddis fly, diving beetles, and the like. Many of these species would be of interest to a fly fisherman on any normal pond or lake in the American West. The scientists also reported mammals visiting the pond, including rabbits, raccoons, coyotes, deer, and rodents. I would not be surprised if members of the once-present wild horse herd at Hanford visited the pond or members of the still-present elk herd.

As a result of U–pond studies it was determined that sediments were the principal concentrator of plutonium, with concentrations in water being much lower. In the plants and animals of U–pond, the decaying algae mass was the principal concentrator. Likewise, soil sediments had higher concentrations of plutonium than tree parts. These findings confirm my memory of the behavior of plutonium. My engineering group at one time had a project to develop a machine to wash plutonium and other radionuclides from the soil. We discovered that plutonium so tightly binds to soil particles, particularly sand grains, that it was very difficult to wash out. Unlike some other radionuclides, plutonium is relatively immobile in the environment. The irony of U–pond is that a toxic element can be immobilized and shielded by the mud, sediment and soil while all around it nature goes about its normal proliferation of type and form.

Reading through some of the scientific documents written about U–pond, I am struck by the fact that they are so well-written. They were composed before the ubiquity of computers and word processing programs, yet the spelling is perfect. The species names, by convention today written in italics, are in these documents underlined—a concession no doubt to the limitations of the typewriter. The style is spare, clear, and efficient. There is not a single wasted or misplaced word. The documents themselves, on aging, sturdy paper, are for a bibliophile like me a joy to the touch. They seem like the well-crafted furniture one might find in a good antique shop. But the cold objectivity of the documents—documents that could have been written by an alien studying the pond from space via instruments and analysis—leaves me with a hunger for something more—some taste of human perspective, of humanity, of historical context. There is nothing in the documents of the hubris of the human enterprise—the creation of a living ecosystem in the service of weapons to incinerate cities. There is no hint of the Faustian bargain involved in appropriating the secrets of the sun—the creation of elements beyond what nature itself has created. And there is no hint of awareness much less atonement at forming a living oasis in the middle of a desert— creating a magnet for all sorts of life—only to bury it when it no longer had utility.

Perhaps, then, U–pond is a metaphor for both the strength and weakness of science—the strength of objectivity beyond the reach of ideology or emotion, the weakness of a lack of human context and meaning and feeling. I long for the sturdy documents to somehow end with a poem or a painting or even a prayer—something to place the pond in perspective. U–pond was filled with soil and planted to bunchgrass. Bunchgrass is an angiosperm (Angiospermophyta—flowering plants; 230,000 species; 70 million years old). Grasses have been on the earth less than a half-life of plutonium-244. My epitaph for U–pond: "Plutonium was born here in the year of our Lord 1945, buried here in 1985, entombed in soil and ancient grass—it never dies—may it rest in peace."

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