



Can the Periodic Table Tell a Story?!

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Ron Hietala's Minutes of Sam Kean's Talk

On the occasion of the Annual Meeting and Award Ceremony of the Washington Academy of Sciences, Dr. Jacqueline Maffucci introduced Sam Kean, the featured speaker. Mr. Kean is a correspondent for *Science* magazine and recently published his first book, *The Disappearing Spoon and other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements* (Little, Brown, 2010). The book has received very favorable reviews and comment. Briefly, reviewers find it, as do I, an unusually good read and a fun, interesting book about science, especially science history. Mr. Kean's address to the Academy was also a recount of tales from the Table.

When a kid, in the third grade or so, Mr. Kean had a streak of strep throat infections. He stayed home from school for several periods. His mom took his temperature with an old fashioned thermometer, and more than once, Mr. Kean, who says he was a clumsy kid, dropped it and broke it. He was secretly excited by this. Brilliant spheres of mercury scattered about the floor. His mother got down with a toothpick to scoot the blobs together. It was cause for wonder how two blobs would come close together, and, with a jiggle, jump into one slightly larger blob. Mercury was so neat that the Keans kept it, in a little pill bottle. Sam's mother would get it down sometimes and show it to the kids. That was how he got started on the Periodic Table.

When they gave him the Table in school, he looked for mercury and did not find it. When he learned the symbol for mercury was Hg, he found that really strange; neither of those letters actually occur in the word, mercury. He asked around about it and found the letters come from Latin and Greek words.

This led to further inquiry. He found the element had been known since ancient times. There was a god with the same name and a planet named for it. Alchemists used mercury in their experiments and demonstrations.

Nearer home, Mr. Kean found some more history involving mercury. In South Dakota, they always had a long section of history courses devoted to Lewis and Clark. Benjamin Rush, a physician who was also one of the signers of the Declaration of Independence, supported the Expedition. Rush stayed behind to fight a yellow fever epidemic but did leave a mark by assisting them nevertheless.

One of Rush's favorite treatments was a mercury chloride sludge. He prescribed this often, sometimes until his patients' hair and teeth fell out and they drooled. He also had a patented

mercuric pill called "Dr. Rush's Bilious Pills." About four times the size of an aspirin, 600 of them went with Lewis and Clark. They were powerful laxatives, popularly referred to as thunderclappers, and Rush encouraged their liberal use. They flushed people's systems very effectively. Historians and archeologists today can pinpoint the locations of some Lewis and Clark camps by concentrations of mercury in the soil.

From this one element, Mr. Kean said, he learned much beyond chemistry. He learned about history, alchemy, entomology, poisons, and psychology. He gravitated toward the teachers who told stories that included such broad context with their material, and that was the pattern he followed in

The Disappearing Spoon.

Take aluminum, for instance. Today it is one of the most common metals. For a long time, it was more precious than silver and gold. This was because it was very hard to get it purified, to separate it from the oxygen. When scientists did start to get it, it was considered miraculous; it was light, strong, and beautiful. Kings and emperors wanted it. Mr. Kean showed a picture of an aluminum sculpture used by Napoleon III as a centerpiece. Gold items held places off the center. Napoleon III also had an aluminum cutlery set used by his most important guests, while less favored guests used the gold pieces. The top of the Washington Monument was finished with a small square of aluminum, to show the wealth of the developing nation in 1884.

Not long after that, chemists figured out how to separate aluminum efficiently. One of the chemists, Charles Martin Hall, formed a company called Alcoa, which started shipping aluminum at the breathtaking rate of 50 pounds a day. The price of aluminum dropped quickly from dozens of dollars an ounce to 25 cents a pound.

So aluminum has all the elements of a great story. It had a romantic history, a breakthrough development, and a great change in practice. Finally, it had a new and changed state of being. Your interpretation may depend on your temperament, whether aluminum was better off as a precious metal or a useful metal.

Cadmium has a similar story arc. Early on, it found use as a pigment to make red and yellow paints. Painters favored the vibrant cadmium colors. In Japan about the time of WWI, they were refining zinc. Cadmium has similar properties to zinc, and some of the processes yielded cadmium that contaminated the zinc. When they got the cadmium separated, they dumped it in the streams. It followed the streams down to the rice paddies. Rice, it seems, is a cadmium sponge, and farm families soon experienced problems including kidney disease, pain and brittle bones. One woman reportedly had her wrist broken by a doctor taking her pulse. They called it itai-itai (ouch-ouch) disease, for the pained shouts of the afflicted.

A local doctor figured out that what was happening was chronic cadmium poisoning. A long and tortuous civil action resulted in a large settlement for the victims, and cadmium became a symbol for evil in Japan.

Even in the 1980's, in making another in the Godzilla series of movies, the evils of cadmium were summoned. To kill off Godzilla, the heroes used missiles tipped with cadmium. Cadmium, even in

1980, was the nastiest thing they could imagine. Considering that Godzilla was himself the biological accident of an H-bomb explosion, that is quite a distinction for cadmium.

Mr. Kean speculated that, had he given this talk a title, it might have been, "... can the Periodic Table tell a story...." Not, "Can the Periodic Table Tell a Story?" but, "Boy, Can the Periodic Table Tell a Story!" You can really learn a lot of science from the Periodic Table. People remember and absorb better what they learn through stories. The personalities of the people also tell us things.

People eat and breathe the Periodic Table. They bet huge sums of money on it. Philosophers use it to probe the meaning of science. It even spawns wars sometimes.

During the cold war, the Periodic Table was a contested field. Science was then acknowledged to be led by European scientists, who viewed Americans as upstarts. Elements then discovered might have been named for Alabama, Illinois, or Virginia, where they were discovered. The European scientists who were in charge then did not trust the American claims. Later European scientists found these elements and named them things like Francium. After WWII, however, Americans, especially the Berkeley group, started filling in box after box after box.

When the Soviets got going in science during the cold war, they generally had the support of Stalin. That was with the exception of the new variety of physics. Stalin, who considered himself an intellectual authority on just about everything, was suspicious of the developing sciences of relativity and quantum mechanics. He wanted them gone. He thought they were spooky and counterintuitive. He was planning to order the purge when he was told by a brave adviser that this might hurt the nuclear weapon program. Stalin thought about that a few seconds and then said, "Leave the physicists in peace; we can always shoot them later." On that basis, Soviet atomic physics moved ahead apace.

Soviet scientists were more comfortable studying elements. These new elements had obvious value and obvious validity. Accomplishments there were ones that the whole Soviet Union could be proud of. They did make progress, and in 1963, they finally beat the Americans at what had become the Americans' game; they discovered an element before the Americans did.

Then, the Americans treated the Soviets the same way the Europeans had treated the Americans. The Americans refused to admit the validity of the proof of the new element. Subsequent discoveries were contested at length and with strength, and the disputes over who had discovered them outlasted the cold war.

The Americans managed to get one named Seaborgium, after Glenn Seaborg. This seemed quite boorish elsewhere in the world, as the tradition had been that you had to be dead before you could enjoy such an honor. Mr. Kean showed a picture of Mr. Seaborg as an elderly, smiling cherub looking proudly at his box, box 106, on the Table. New rules were made after that, and if they last, Mr. Seaborg will be the only living man ever so fortunate as to have his name in the Table. Mr. Kean calls the Table "the most limited real estate in science," as there are only 100 plus a few spaces on it.

In writing *The Disappearing Spoon*, Mr. Kean spoke to many scientists, some of whom had not

looked at the Table in decades. Some were surprised at how much this very fundamental construct had changed. It used to be only eight boxes wide. Some elements did not even rate their own box; they shared one with another element across a diagonal line. Many elements have been added.

One might wonder, are they going to discover more elements? Presumably so. The most recent one was added only a little over a year ago. It is called by a temporary name, ununseptium, which is Latin for 117. It filled the bottom row and made the Table a perfect rectangle, and that may be the last time that occurs, also. The larger elements are very fragile and last a few seconds at most, so discovery is likely to be more haphazard from this point forward.

The Table has been pictured in many ways. It has been portrayed as a galaxy, as board games, as a sort of double helix, maps, mobius strips, and even as a Rubik's cube. (That last one was patented.) Mr. Kean found one woman who went to a photomat and made about 120 pictures of herself. She used them to decorate a Periodic Table which she keeps on her refrigerator. Mr. Kean doesn't know how some of these unorthodox Tables are useful, but he is pleased that people continue to tinker with the Table.

Finally, Mr. Kean pointed out that the Table, in addition to being a very compact scientific heuristic, has implications that are very broad. Astro-scientists have searched for ways to try to communicate with intelligent life elsewhere in the universe. This is a tough question, since these beings would likely share little of our culture. How could we communicate with them; what might we have in common with them? Various ideas were offered, such as prime numbers and pi, the relationship of the circumference of a circle to its diameter. Mr. Kean liked the notion of using the Periodic Table. There are only 100-some elements in the universe and it seems likely intelligent beings would know of them. It is a literally universal concept, perhaps the most nearly perfectly universal concept we know, and the elements are arranged the same everywhere.

After the talk, Mr. Kean offered to answer questions and sell books. The appreciative audience took both offers.