Surprising element found in traces of Tycho Brahe’s alchemy lab confounds scientists

Renaissance astronomer Tycho Brahe, known for his studies of the heavens, was also a alchemist. A new study of glass shards reveals what Brahe was working with in his lab.

By Ashley Strickland

7 min. read · View original

Sign up for CNN’s Wonder Theory science newsletter. Explore the universe with news on fascinating discoveries, scientific advancements and more.

CNN —

While Danish astronomer Tycho Brahe is best known for his celestial discoveries made in the 16th century — before the

invention of the telescope — he was also an alchemist who brewed secret medicines for elite clients. But what exactly Brahe worked on in his alchemical laboratory, located beneath his castle residence and observatory called Uraniborg, has been something of a historical enigma.

The covert nature of Brahe’s work was common among alchemists of the Renaissance, who kept their knowledge close to the vest. Today, only a few of his alchemical recipes remain. Uraniborg, situated on the island of Ven off the coast of Sweden and named for the muse of astronomy, Urania, was demolished after Brahe died in 1601.

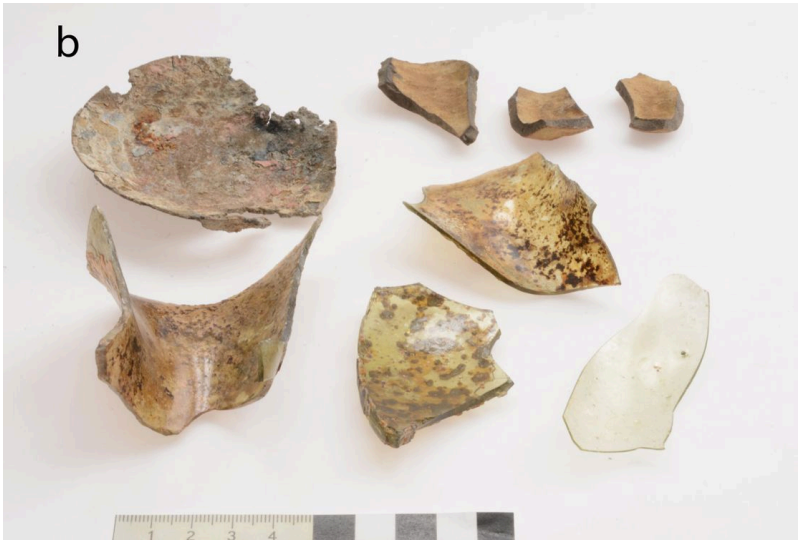
Now, researchers who conducted a chemical analysis of glass and pottery shards recovered from the site where the Uraniborg once stood say they’ve uncovered new clues to what took place in the Renaissance scientist’s laboratory centuries ago.

The five shards studied in the new research were among those found during excavations carried out by another team from 1988 to 1992. Discovered in the

remnants of a garden surrounding the site, the fragments were believed to have come from the alchemical laboratory.

Kaare Lund Rasmussen, a professor emeritus in the department of physics, chemistry and pharmacy at the University of Southern Denmark, was inspired to study the shards after wondering what insights they might offer into understanding Brahe’s alchemical work.

As lead author of the new research, he worked with coauthor Poul Grinder-Hansen, senior researcher and museum curator at the National Museum of Denmark in Copenhagen, on the investigation. Four of the shards contained higher concentrations of elements than expected, including nickel, copper, zinc, tin, mercury, gold and lead, the researchers reported Wednesday in the journal Heritage Science.



Gold was one substance Rasmussen already associated with Brahe. In an ongoing effort to understand why the Renaissance scientist died, Rasmussen coauthored a November 2016 study that analyzed some of Brahe's hair and bones, and found excessive amounts of gold in his remains.

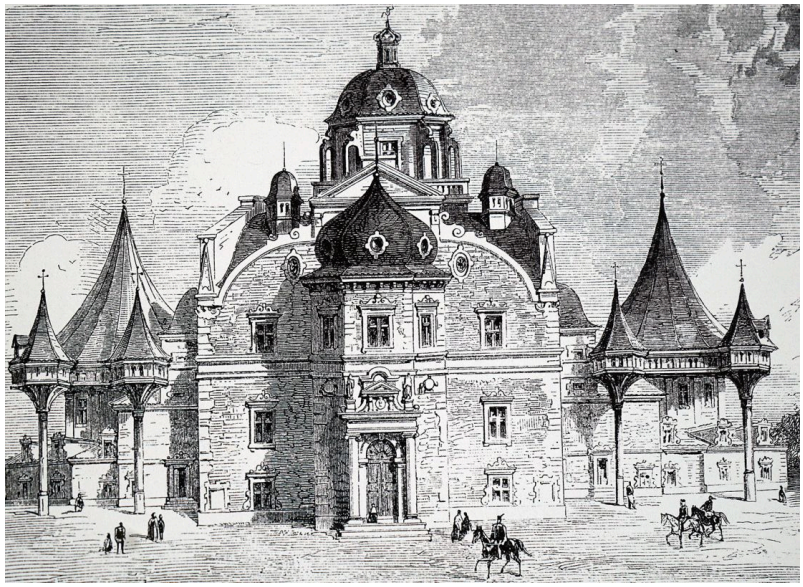
But the biggest revelation from the glass and pottery fragments in the new analysis — and the source of a separate mystery — was the presence of an element that wasn't even known to scientists of Brahe's time.

A surprise among the shards

Rasmussen and his team were stunned to detect tungsten among the elements found on the inside and outside of the shards. During the Renaissance, mercury and gold were commonly used in recipes

for medicines to treat a wide range of diseases, but the evidence of tungsten among them is "very mysterious," he said.

"Tungsten had not even been described at that time, so what should we infer from its presence on a shard from Tycho Brahe's alchemy workshop?" Rasmussen said.



Swedish chemist Carl Wilhelm Scheele uncovered tungstic acid in the mineral now known as scheelite in 1781, more than 180 years following Brahe's death. Not long after, Spanish chemists Juan José and Fausto d'Elhuyar y de Suvisa conducted follow-up experiments that successfully isolated tungsten, described in a paper published in 1783. The chemical element, also known as

wolfram, occurs naturally in certain minerals.

It’s possible that tungsten appeared in Brahe’s lab through a mineral, or perhaps he processed one in a way that isolated the tungsten without Brahe realizing it, Rasmussen said.

There is also the chance that Brahe encountered tungsten through the work of German mineralogist Georgius Agricola, who discovered the formation of an unusual substance when he attempted to smelt tin made from tin ore. Agricola named the substance wolfram in his 1546 book “De Natura Fossilium.”

“Maybe Tycho Brahe had heard about this and thus knew of tungsten’s existence,” Rasmussen said. “But this is not something we know or can say based on the analyses I have done. It is merely a possible theoretical explanation for why we find tungsten in the samples.”

The results of the new study will be of interest to historians and archaeologists alike, said Lawrence Principe, Drew Professor of the Humanities and director

of the Singleton Center for the Study of Premodern Europe at the Johns Hopkins University in Baltimore. Principe was not involved in the research.

“As the authors note, the discovery of a tungsten residue is very surprising,” Principe said. “Tungsten ores are relatively rare and we know very little about how much they might have been experimented with in the early modern period.”

Principe thinks that anyone who came across a tungsten ore would have been struck by its extreme heaviness — the name of the element means “heavy stone” in Swedish — “and so might well have tried to smelt gold out of it, which is what I would hazard a guess might have been going on in this case,” he said.

An astronomer and an alchemist

Brahe was a dynamic scientist during the Renaissance who became famous after his discovery of a supernova in 1572. Brahe was so well-regarded that King Frederick II of Denmark and Norway offered the island of Ven to Brahe as a place to build his observatory and alchemy lab. The estate served as a home and a scientific research center where students from all across Europe came to live and work, and the alchemy lab in the basement contained a number of special furnaces, according to the study.

The lab was uniquely designed, containing 16 furnaces for heating, producing ash and distilling, with copper pipes that ran outdoors for cooling. A spiral staircase led up to the family living room, called the Winter Room, so Brahe was never far from his experiments.

Rasmussen believes that the king made such a generous gift to Brahe not just because of their good and trusting relationship, but because European kings were more esteemed if they retained famous scientists within their countries — and they didn’t want to lose them to

other nations. And Brahe himself wrote that the king was eager to support the scientist’s work in both astronomy and alchemy.

Alchemy, the precursor to chemistry, served two purposes: gold-making and medicine making. Alchemists who focused on the creation of gold attempted through experimentation to make it from less valuable metals and minerals.

Brahe, inspired by the German physician Paracelsus, devoted his time and energy to making medicine rather than gold. Diseases such as the plague, leprosy and syphilis were common at the time, so alchemists like Brahe focused on

creating medicinal recipes to treat such ailments, along with fevers and stomachaches, Rasmussen said.

“Today we can be a little skeptical about the effects of the Paracelsian medicines of the late 1500s, but at the time it was high-tech and cutting edge,” Rasmussen said.

Brahe only shared his treasured recipes with a few people, including his patron Rudolph II, Holy Roman Emperor, who allegedly asked Brahe for plague medicine.

Brahe’s plague medicine recipe was complicated and contained theriac, a remedy for a range of things at the time that could include up to 60 ingredients such as opium, snake flesh, oils, herbs

and sulfates. Valuable tinctures could also be added to Brahe’s plague medicine recipe, including hyacinths, coral, sapphires or potable gold.

Given the amount of gold found in Brahe’s remains, he may have also taken medicine containing potable, or drinkable, gold.

The new findings provide more questions than answers about Brahe’s alchemical work, but Rasmussen said he looks forward analyzing a new and larger set of samples from the alchemy lab in the future to seek out more clues.

While it may seem strange that an astronomer who created precise instruments to study the heavens and chart the positions of more than 700 stars would be involved in alchemy, it all came down to Brahe’s worldview, study coauthor Grinder-Hansen said.

“He believed that there were obvious connections between the heavenly bodies, earthly substances, and the body’s organs,” Grinder-Hansen said in a statement. “Thus, the Sun, gold, and the heart were connected, and the same

applied to the Moon, silver, and the brain; Jupiter, tin, and the liver; Venus, copper, and the kidneys; Saturn, lead, and the spleen; Mars, iron, and the gallbladder; and Mercury, mercury, and the lungs. Minerals and gemstones could also be linked to this system, so emeralds, for example, belonged to Mercury."

Brahe and English physicist-mathematician Isaac Newton were some of the canonical figures of the Scientific Revolution who engaged in alchemy, said Principe, the Johns Hopkins historian of science.

"This is because, contrary to the rhetoric against alchemy that was popular from the 18th century, alchemy and chemistry were not different things in terms of practices, and so anyone seriously interested in matter and its transformations, and especially having the desire to control those transformations in order to produce things, would naturally have engaged themselves with alchemy," he said.

A legacy of scientific achievement

After King Frederick II's death, Brahe and the new king, Christian IV, did not

have a good relationship. Brahe was known to ignore orders from the king, including those regarding his responsibility for maintaining a fire in the Kullen Lighthouse on the southwest coast of Sweden and safekeeping a chapel containing the remains of the king’s mother and father, Rasmussen said. So when Brahe died in 1601, the king and his advisers had Uraniborg torn down so it couldn’t exist as a monument to the scientist, and the bricks were repurposed for other buildings.

But Brahe’s scientific achievements have not been forgotten. He was recognized for making great strides during his lifetime, and those milestones paved the way for future scientists.

While Brahe correctly believed that the moon orbited Earth and the planets orbited the sun, he also thought the sun must orbit around Earth. But it was his assistant Johannes Kepler who developed the laws of planetary motion to understand how the planets orbited around the sun.

Brahe, Kepler, Newton and Galileo Galilei changed the way people understand the

world and its place in the universe.

“Tycho Brahe was the first of four giants standing on each other’s shoulders with 25-year intervals from 1580 to 1680, who formulated what can be called the modern view of the world — as opposed to the medieval view,” Rasmussen said.