UNIT 4: PERIODIC TABLE

LAB	ARTICLE
#11: ANALYZING THE PERIODIC TABLE-COLOR CODING	THE RACE FOR IODINE
#12: SECRET AGENT OF PERIODICITY	MADE IN LAB, FLEETING ELEMENT MAY JOIN PERIODIC TABLE

ChemHistory

The Race for Iodine

By Mark Michalovic

The emperor

Napoleon Bonaparte was known for lots of things. He was a soldier, a general who conquered most of Europe. He was emperor of France. He had a dessert named after him. However, not everyone knows that the little emperor had a thing for science. It may seem odd that even though he was engaged in a war with England, Napoleon would allow the biggest star of British science to visit France to mix and mingle with the top French scientists of the day. Nevertheless, that's just what happened in October 1813. Napoleon granted Sir Humphry Davy permission to spend several weeks in France, even though their two countries were in the middle of a war. There wasn't much Napoleon loved more than war, but it seems even war could take a back seat to his love of science now and then. Little did the emperor realize how much trouble would be stirred up by his graciousness.

The showman

Humphry Davy was born in a far corner of England in a town called Penzance. His family wasn't wealthy, and Davy never had a lot of formal education. He educated himself through his own hard work and became the most important chemist in Britain. A man of many interests, Davy also wrote poetry. Samuel Taylor Coleridge, William Wordsworth, and Lord Byron were his good friends. He loved hunting and fishing as well.

Bonaparte

Davy first made a big splash in science when he discovered the effects of nitrous oxide, or laughing gas, when he was only 21 years old. Later, he discovered two new elements, sodium and potassium, with the help of electricity from a new-fangled battery. He then went on and discovered four more elements: magnesium, calcium, strontium, and barium.

Davy wasn't just a researcher. He was also an entertainer. In those days, lots of people paid money to see science demonstrations. Davy wowed audiences with the wonders of chemistry and electricity. His charm and charisma made him the most famous scientific showman in Britain, and there was nothing Davy loved more than fame.

He didn't mind money, either. In 1813, Davy had plenty of that too, as he married a wealthy widow named Jane Apreece, not long before he left for France. Humphry and Jane would make a sort of honeymoon out of the trip. Not many brides dream of spending their honeymoons in the middle of international scientific spats, but that's what awaited the new Mrs. Davy as the couple headed south across the English Channel.

The protégé

Joseph-Louis Gay-Lussac hailed from a part of central France called Limousin. He was the exact opposite of Humphry Davy in many ways. While Davy had taught himself everything he knew about science, Gay-Lussac had attended the best schools for math and science in France. While Davy was flamboyant and charismatic, Gay-Lussac was calm and reserved. Davy loved leisure, spending lots of time on his many hobbies, while Gay-Lussac seemed to have been wholly devoted to his science. Spending time with his wife Josephine and their children was about his only escape from his work.

Gay-Lussac was patient and careful in the lab. A very by-the-book kind of guy, he was very cautious about drawing any conclusions from his experiments. When he did draw conclusions, he always had lots of experimental results to back them up. This approach paid off when Gay-Lussac discovered Charles' law ($V_1 / T_1 = V_2 / T_2$) and when he discovered that gases always reacted in simple whole number ratios by volume.

Gay-Lussac and Davy were often rivals. After Davy discovered sodium and potassium, the two scientists competed to learn as much as possible about the two new metals. Each often thought the other was horning in on his scientific turf as they raced to make new discoveries. When Davy showed up in Paris in October 1813, perhaps it was only a matter of time before they'd end up competing against each other again.

Gay-Lussac was a friend of an older chemist by the name of Claude-Louis Berthollet. Berthollet had trained Gay-Lussac to work in the lab, and Gay-Lussac was like a son to Berthollet. Berthollet had also brought Gay-Lussac into a circle of scientists who often met at Berthollet's house in the village of Arcueil (pronounced "Ar-koy"), just outside Paris. This group was called the Society of Arcueil, and it included some of France's leading scientists. Members could use Berthollet's laboratory and were more likely to get their papers published in the scientific journals Berthollet published. It definitely paid to be a friend of Berthollet.

Berthollet had sent Gay-Lussac on one of his first adventures as a scientist. In 1804, Berthollet asked Gay-Lussac to carry out a very dangerous experiment. Wanting to measure the earth's magnetic field at high altitudes, he rode a hydrogen balloon to a height of over 23,000 feet above sea level. This set a world record that stood for almost 50 years.

Davy

Gay-Lussac

Nine years later, Humphry Davy was making a stir by visiting France during the middle of a war. In November 1813, while Davy was in Paris, Gay-Lussac was given an assignment by the National Institute, France's leading scientific organization. Two not-so-well-known chemists, Nicolas Clément and Charles Bernard Desormes had reported that a strange new substance had been discovered in seaweed. The substance formed small black crystals and could produce a purple vapor. Even though it was a solid, it seemed similar to chlorine in some ways. Clément and Desormes had carried out some experiments on the new substance and reported them to the Institute. They claimed, among other things, that the substance formed an acid when it came into contact with hydrogen. Gay-Lussac was assigned to review their experiments and repeat them to make sure the results were correct. He set to work, studying the substance carefully and thoroughly. While studying it, he gave the substance a new name. He called it iode, from an ancient Greek word for "purple." Little did he know that Davy had already been tipped off.

The outsider

Perhaps more brilliant than any of the scientists in the Society of Arcueil was a physicist and mathematician by the name of André-Marie Ampère. He had been a child prodigy and made important discoveries about electricity. He was a scientific genius, but he could be awkward in social situations. He never cozied up with Berthollet and the Society of Arcueil the way Gay-Lussac had.

Maybe if Ampere had been tighter with the Society of Arcueil, they might have told him to be more careful about what he told Davy. At any rate, some time before Clément and Desormes announced their new substance to the National Institute, they gave a sample of the substance to Ampère. Six days before the announcement, Ampère, Clément, and Desormes paid a visit to Humphry Davy. Ampère brought with him a sample of the substance to show the famous visitor. It's at this point that a misunderstanding took place. Ampère probably thought he was showing Davy the new substance as a courtesy to a visitor. On the other hand, Davy claimed the French scientists were asking him to investigate the substance—as if French chemists weren't smart enough to do that themselves. (Davy was known for his big ego.) Davy had brought a trunk of scientific glassware and instruments with him from Britain. Now, he had a reason to use it and got to work. He began to study the new iode, and gave it it's English name, iodine.

The race

Once again, Davy and Gay-Lussac were in competition. Gay-Lussac thought Davy was being a bad guest by nosing in on a French discovery right on their home territory. Both probably couldn't forget that their two countries were at war, and the rivalry took on a nationalistic tone. Davy was researching for King and Country, while Gay-Lussac was researching for the glory of France. As they carried out extensive investigations of iode, neither Davy nor Gay-Lussac seemed to care much that they were both technically nosing in on Clement and Desormes, who had first brought iodine to everyone's attention in the first place.

Both had originally suspected that iodine was a compound of chlorine. But before long both Davy and Gay-Lussac were thinking that this might just be a new element. In those days, the word "element" didn't mean exactly the same thing as it does now. Today, we learn in chemistry class that an element is a substance made of only one kind of atom. But in 1813, John Dalton's atomic theory was only a few years old, and not everyone accepted it yet. Davy especially didn't like it. Gay-Lussac thought Dalton was onto something but didn't say so publicly because Berthollet felt otherwise. Even so, chemists still talked about elements. To chemists of those days, an element was a substance that couldn't be broken down into simpler substances. In fact, this definition is just as valid today as it was then. Only now we have a microscopic view (where all atoms are the same) to complement the macroscopic view. Davy and Gay-Lussac both tried to break iodine down, hoping to free the chlorine they thought it contained. Neither succeeded, and both suspected that iodine wasn't a compound of chlorine, but an element in its own right.

Both Davy and Gay-Lussac published their ideas. Gay-Lussac beat Davy to press by one day, but each always insisted that he'd reached the conclusion first. Either way, Gay-Lussac probably discovered more new knowledge about iodine in the long run. While Davy soon left Paris, traveling with his new bride to Italy, where he studied the chemistry of diamonds, Gay-Lussac kept studying iodine. Gay-Lussac finally published a 155-page paper filled with his experiments and the results. It was considered the best source of information about iodine for many years.

It took several different scientists to get to the bottom of the puzzle of iodine. Courtois, Clement, Desormes, Gay-Lussac, and Davy all played roles. This is how science often works. Many people take part in a discovery, sometimes working together, sometimes competing against each other. Sometimes, the world outside the lab plays a big part in shaping what scientists do. While the path is seldom straight, the road to discovery is almost always an exciting one.

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Made in Lab, Fleeting Element May Join Periodic Table

By KENNETH CHANG

Scientists may be adding a new element to the periodic table, but don't expect to see it anytime soon: created in a laboratory, it exists for less than a second.

The new superheavy chemical element has 115 protons and would fill a gap in the periodic table, taking its place between the two elements, 114 and 116, which were added just last year. The newcomer, as yet unnamed, was first discovered a decade ago by Russian and American scientists, but the official organizations of chemists and physicists that act as gatekeepers for the periodic table wanted another laboratory to repeat the experiment before they would officially add it.

A Swedish university announced Tuesday that that had finally happened. The new work, led by physicists at Lund University in Sweden and performed at an accelerator in Darmstadt, Germany, duplicated the earlier experiment and observed the similar patterns of debris. The new findings will be published Thursday in the journal Physical Review Letters.

"Everything is perfect," said Krzysztof Rykaczewski, a scientist at Oak Ridge National Laboratory in Tennessee who was a member of the confirmation team.

The experiment also provided additional confirmation of earlier claims for element 113, which also has not yet been added to the periodic table, Dr. Rykaczewski said. In the first decay, element 115 turned into element 113 while emitting a chunk known as an alpha particle.

The Russian-American team had already replicated its own results, but, "it's always better when someone else does it," Dr. Rykaczewski said.

To create the element, calcium nuclei were fired into a target containing americium atoms. Occasionally, a calcium and an americium merged together, creating a new atom with 115 protons in its nucleus. Then, in less than a second, it fell apart. The researchers deduced its existence from the pieces of debris.

In addition, for the first time, the researchers observed an X-ray "fingerprint" emitted during the decay, which provided more direct evidence that the initial atom contained 115 protons.

Dirk Rudolph, a professor of nuclear physics at Lund University, said he was "most satisfied" that the team had created the element. "Mother Nature has not been as kind as she could have been," he said.

The number of observed X-rays — just two — was too few to be definitive, but "we obviously show the feasibility of such experiments," he said.

If the new data proves convincing, the Russian and American scientists who made the original discovery would be given the opportunity to name the element, a process that would take months.

Just last year, the overseers of the periodic table acceded to the addition of elements 114 and 116 as flerovium and livermorium, more than a decade after they were first made. The elements 117 and 118 have also been claimed, but not yet confirmed.

The study of superheavy atoms — which are unstable chemical elements with atomic numbers greater than 92 — help scientists better understand the basic forces that hold matter together.