New Element, 109, on the Table?

The accelerator hurled a beam of iron ions onto a thin layer of bismuth, another metallic element. For 10 days, more than a billion times a billion ions smashed onto the bismuth target. Then suddenly, for a mere fraction of a second, there were very definite signs that a projectile nucleus had merged with a target nucleus.

It happened only once—on August 29 at 4:10 p.m. Darmstadt, West Germany, time. There, researchers at the GSI nuclear laboratory, which houses the accelerator called Unilac, believe they observed the birth of a new element: 109. "We want to emphasize that this is our interpretation of one event," GSI researcher Peter Armbruster told SCIENCE NEWS. Whether the claim of creating element 109 is widely accepted in the scientific community, he says, remains to be seen.

Thus far, positive reactions have greeted the researchers' preliminary reports, which were presented both at the recent "The Neutron and its Applications: 50th Anniversary of the Neutron" meeting held in Cambridge, England, and also at the "International Conference on Nucleus-Nucleus Collisions" held last week at Michigan State University in East Lansing. "I think it's quite impressive and probably right," says Glenn Seaborg of the University of California at Berkeley, who co-discovered 10 of the manmade transuranium elements — those with a higher atomic number (number of protons) than uranium. "I think it's fantastic, says Albert Ghiorso, another University of California researcher. "I would say that it's ninety-nine percent certain [Armbruster and colleagues] have discovered a new element." Says Ghiorso, "I've been involved with the synthesis of 12 new elements, and this is beautiful work. I envy them. I wish I'd done it myself."

The seeds for this urge to create new elements were actually planted in 1869, when Russian chemist Dmitry Ivanovich Mendeleyev proposed that the existing elements be arranged into a specific order; although this arrangement eventually would be modified, it provided the first format for predicting properties of unknown elements. Then, by the 1930s, researchers were bombarding nuclei with other nuclei in an attempt to create such unknown elements. Finally, in 1940, element 93 was synthesized and dubbed "neptunium" (because it is just beyond uranium, element 92, on the periodic table, as planet Neptune is beyond Uranus). Scientists have continued to add to the sequence—plutonium, americium, curium, berkelium and so on — and elements through 105 now have been identified. Elements 106 and 107 also have been synthesized, but there is disagreement about who first created them, so they remain unnamed.

Armbruster and colleagues skipped over element 108 and instead aimed for the synthesis of 109, because they knew it would be easier to "prove." Immediately after their creation, heavy elements break down by one of two methods, Armbruster explains. They either spontaneously fission — that is, split — or they decay by emitting an alpha particle — which is essentially a helium nucleus, or two protons and two neutrons. The creation of a heavy element that decays by spontaneous fission is difficult to prove, because the masses, charges and atomic weights of the fission products — information necessary to unambiguously identify the parent product of the nuclear reaction — cannot yet be easily measured. On the other hand, it is a relatively simple task to measure the energy that escapes during alpha decay, and that quantity is a clear signature of the parent compound. Because conventional nuclear wisdom deems that 108 should decay by spontaneous fission and 109 by alpha decay, Armbruster and cohorts chose to tackle the creation of 109.

They proceeded to bombard bismuth 209 (the number indicates the sum of protons and neutrons in that element's nucleus) with iron 58. On day 10 of their experiment, the GSI researchers observed an 11.1 million electron-volts-releasing alpha decay that occurred 5 milliseconds after a nuclear reaction product was formed. Both the time lag and amount of energy released signaled that an isotope of element 1that contains 266 neutrons and protons may have formed. In other words, Armbruster and cohorts believe that an iron 58 nucleus fused with a bismuth 209 nucleus to form 109 267 and that "hot" compound nucleus immediately "boiled off" one neutron to form element 109 266.

Then came the rapid-fire decay process. The new element emitted an alpha particle to form 107 262. Shortly thereafter, Armbruster and associates believe, another alpha decay broke down 107 262 to 105 258. Next, a beta decay (release of one charged nuclear particle) transformed 105 to 104, which in turn spontaneously fissioned. Says Armbruster, "It took ... a team of 11 researchers and 10 days of bombardment, and within milliseconds, it was gone."

With the apparent synthesis of element 109 behind them, Armbruster and colleagues now are turning their thoughts toward superheavies — as yet undiscovered elements that have nuclear particle sums of around 300 and greater. Armbruster and his GSI cohorts this week are teaming up with Ghiorso, Seaborg and colleagues to begin bombarding curium 248 with calcium 48 in an attempt to create such an element. While this research has little immediate practical application, Ghiorso says, "It has an inherent fascination ... that tells you to go on."

Says Ghiorso, "I never get bored by it."

—L. Garmon

Sex and the celibate fruit fly

According to a fundamental hypothesis of evolution theory, traits that offer organisms neither advantages nor disadvantages should disappear over the course of generations, destroyed at the genetic level by the accumulation of naturally occurring mutations. This idea has been around for over 30 years and has been used to explain everything from the mole's minuscule eyes to the kiwi's vestigial wings; yet more than circumstantial evidence has been virtually lacking. Now, a group of geneticists at the University of Hawaii at Manoa has produced support for the hypothesis: a study showing that the genetically controlled sexual performance of female fruit flies declines in the absence of selective forces favoring successful mating.

Hampton L. Carson and his co-workers, reporting in the Oct. 1 SCIENCE, studied fruit flies from an all-female strain that had reproduced solely through the asexual process of parthenogenesis for 20 years. During this time, the females were kept isolated from males. In 1973, 150 of the females were allowed to mate with males, and their average mating speed was recorded. When another 150 flies from the same strain were tested in 1981, their mating speed was found to be much lower than that of the earlier group. On the other hand, flies from normal, bisexual strains showed only a slight decline over the same period — perhaps due to the effects of inbreeding, Carson says.

The deterioration of sexual performance witnessed in the all-female strain is a heritable change, and the researchers conclude that it resulted from accumulating mutations in the genes controlling mating behavior. Natural selection would normally operate to eliminate flies with such mutations from the population and to promote sexual agility. But in the absence of males, Carson says, sexual prowess ceases to be of any advantage to the female flies, and mutant flies dominate the population.

Why has experimental evidence for such a basic process been so scarce? "Because in the case of most organisms we don't have well-defined genetic traits and selective forces," Carson explains. "But with the mating behavior of female fruit flies, we have a very distinct agent of selection — males — and they're easy to remove."

—R. Pollie