Science News of the Week

The Newest Element: 106

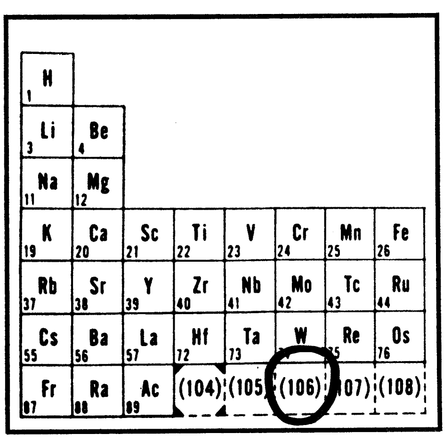
LBL

Element 106 co-discoverers Hulet, Seaborg and Ghiorso.

When nature finished with the earth as we now have it, it contained 92 chemical elements. For more than 30 years scientists have continually striven to produce more. The new elements are called transuranic because uranium, number 92, is the heaviest to occur naturally on earth. There is debate over whether the transuranics can and do exist naturally in the universe outside earth, but from a provincial terrestrial point of view they can truly be called manufactured elements. The parade started in World War II days with numbers 93 and 94, neptunium and plutonium. The latest news is that it has now reached element 106.

One report comes from the Lawrence Berkeley Laboratory of the University of California, a place that has a large number of transuranics to its credit. The experimenters include two nuclear chemists prominent in transuranics manufacturing since its early days, Albert Ghiorso (co-discoverer of eight other elements) and Glenn T. Seaborg (co-discoverer of four others including plutonium). Other members of the group are E. Kenneth Hulet and R. W. Lougheed of the Lawrence Livermore Laboratory and J. M. Nitschke, Jose R. Alonso, Carol T. Alonso and Matti Nurmia of LBL. The report was presented this week at the meeting of the American Chemical Society in Atlantic City.

LBL's chief competitors in the new-element business are in the Soviet Union. It is often difficult to decide who did what first to what and with what in these matters. The discoveries of elements 104 and 105 are still-unresolved matters of Soviet-American dispute. Element 106 is no exception. The Soviet claim is entered by G. N. Flerov of the Joint Institution for Nuclear Research at Dubna and 11 others. Element 106 falls into the same family of elements in the periodic table as chromium, molybdenum and tungsten.



106: Below tungsten in periodic table.

Newer and heavier elements are made by taking nuclei of a known heavy element and bombarding them with nuclei of another in hopes that the two will fuse and make nuclei of the desired element. One has to work fast because all the transuranics are radioactive. (That is why, if they ever did exist on earth, they no longer do.) Plutonium is stable enough that it can be made in large batches and is commonly used as a reactor fuel and bomb charge. Most of the others are so ephemeral that they disappear before anyone hardly knows they were there. The half-life of element 106 is 0.9 seconds.

In these circumstances chemical tests for the existence of a new element are not possible. So the experimenters record the products of radioactive decay, perhaps alpha particles, perhaps fission products, and try to identify the nuclei produced.

The LBL technique was to use the laboratory's SuperHILAC accelerator to bombard a target of californium 249 with oxygen 18 nuclei in the hope of producing the isotope of 106 with atomic weight 263. The chain of events the Berkeley scientists recorded as evidence of the presence of 106 starts with the emission of an alpha particle with 9.06 million electron-volts energy, which changes the 106 into an isotope of element 104, which the Berkeley people call rutherfordium 259. The element 104 emits alpha particles of 8.8 million electron-volts and becomes nobelium 255 (element 102), and then the latter decays, giving off an 8.11-million-electron-volt alpha particle.

In the Soviet Union, Flerov and his colleagues bombarded lead 207 and 208 with chromium 54. They then recorded fission products that they consider evidence of element 106. On the whole the American group tends to feel that its evidence is better, but it intends to try to duplicate the Soviet experiment to prove it right or wrong.

Usually the discoverer of a new element has the privilege of suggesting a name for it. In view of a simultaneity of the Dubna and Berkeley work, the LBL group is not doing this, but leaving the choice to the International Union of Pure and Applied Chemistry. IUPAC is still juggling the hot potatoes involved in the discoveries of elements 104 (rutherfordium or kurchatovium) and 105 (hahnium or bohrium), so it now has three such disputes to decide. □

Chemical prevents fertility in mice

The search for a male fertility control agent has taken researchers from hormone control to sperm duct valves to immune-reaction control. Many of the experimental techniques have worked but most have unfortunate side effects that send researchers back to the lab bench. Now, for the first time, fertility in male mice has been controlled with a nontoxic sugar, an effect which the major investigator calls "quite startling and remarkable."

Roy L. Whistler, a Purdue University biochemist, reported at the American Chemical Society's annual meeting in Atlantic City this week that his team has successfully prevented spermatogenesis in male mice for up to two months with oral and injected doses of 5-thio-D-glucose, an analogue of the common sugar glucose. (An analogue is a chemical that has the same chemical and physical properties as another but a different structure and origin.)

Whistler and colleagues John R. Zysk, Alfred A. Bushway and William W. Carlton made the compound by substituting a sulfur atom for the oxygen atom in the six-membered glucose ring structure. The compound, they found, inhibits the active transport of glucose across the cell membrane and thus deprives the interior of cells of this carbohydrate.

The link between the analogue and fertility control is this: The male testes require proportionately more sugar and are more susceptible to sugar deprivation than any other tissue in the body. When the sulfur sugar analogue is fed to mice, sugar is not transported into the sperm-producing cells and sperm production is arrested. The cells switch over to burning fat and protein for energy and this leads to another of the compound's interesting effects—moderate weight loss.

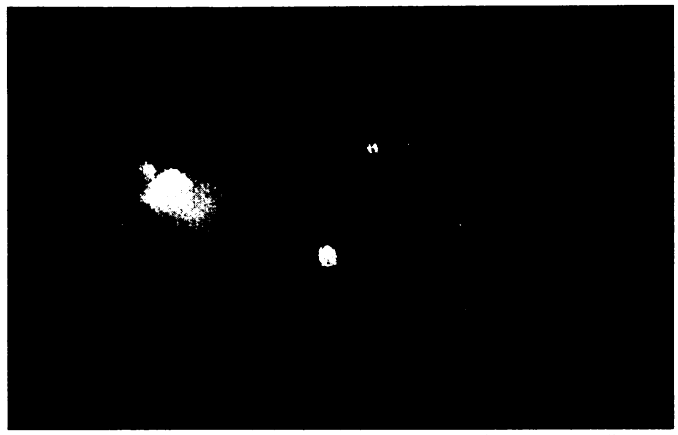
"At first," Whistler says, "we thought we had discovered a reducing drug. With a compound that could shut down a person's uptake of glucose, theoretically, a person could eat all of the carbohydrates—spaghetti, bread, etc.—that he wanted, then after dinner take a dose of this analogue" and he would not absorb the sugar or calories. Whistler's team experimented with this idea and found that mice did indeed lose weight. But further investigation showed that a slight elevation in blood sugar was occurring and this led to a loss of hunger and the subsequent weight loss.

But the team is concentrating their energies on the analogue as a sperm control agent. They fed it to mice for up to two months and found in every instance that sperm production was halted at doses at or above 33 milligrams per kilogram of body weight. Sperm production is reinitiated about four weeks after withdrawal from the chemical, and the mice can then successfully inseminate and impregnate females. The offspring, monitored for three generations, were completely normal. Also the analogue did not affect mice libidos.

"This represents the first time male fertility has been under the control of a chemical which is not a hormone or a toxic substance," Whistler says. The idea is not totally new, however, because other researchers have shown that diabetes in the human male can markedly affect sperm production. Sugar levels in the blood do rise slightly in the test animals after analogue ingestion but decrease after the chemical is metabolized and excreted.

Whistler has informed several pharmaceutical companies, which were "very interested" in pursuing the chemical as a sperm-control and perhaps a weight-control agent. Says Whistler: "You must understand that this is an extremely preliminary investigation. Something may turn out to be wrong with it as happens with so many hopeful things. But it is interesting and exciting and we are pursuing it as rapidly as we can." □

The largest objects in the universe



Willis, Strom, Wilson/Nature

DA240 in a "radiophotograph." This is an image constructed to show what the object would look like if radio waves were light. It gives some idea of the extent and brightness variations.

Much of recent progress in astronomy consists of elucidating ever finer details of small compact sources. This is especially true in radio astronomy, where quasars and pulsars have been major topics, and larger and larger arrays of radio telescopes are built in the hope of resolving the internal structure of such objects. Yet the opposite question is important too. How large can a radio source be? How much space can be occupied by a collection of matter that is physically and dynamically interconnected?

The answer is not as obvious as it may at first seem because there is a problem of distinguishing the forest from the trees in a question like this. It is hard for telescopes to see very large objects whole and to separate them from the confusion of unrelated sources that may be near them or behind or in front of them. An answer to the question is important for at least two large reasons: It could help determine what the mechanism is that replenishes the energy radio sources send out, and it could indicate whether there is any large amount of matter in the space between galaxies and clusters of galaxies. Data on the latter point could help select among the various cosmological theories that propose to describe the history and future of the universe.

The answer is that radio sources can be bigger than anybody used to think. It is one of the first fruits of a survey undertaken with the Westerbork Synthesis Radio Telescope located at Westerbork, the Netherlands, by A. G. Willis, R. G. Strom and A. S. Wilson of the Leiden Observatory. In the Aug. 23 NATURE they report two sources whose size goes well beyond the one megaparsec that used to be considered the upper limit.

The biggest is denominated 3C236. Located in the constellation Leo Minor, it is 5.7 megaparsecs (almost 19 million light-years) across, bigger than a cluster of galaxies. (For comparison the longest dimension of our galaxy is about 100,000 light-years.) The second that the Leiden investigators have so far found is somewhat smaller, two megaparsecs (7.5 million light-years) across. It is called DA240 and is in the constellation Lynx.

Contour maps reveal that the sources are complex objects with compact bright spots surrounded by fainter material. The ratio between the brightest and faintest parts of 3C236 is more than 1,000 to 1. Although their densities are small, on the order of a few particles per hundred thousand cubic centimeters, their enormous volumes, assuming that they are about as deep as they are broad, give the objects significant masses. Just two parts of DA-240, the "intense eastern compact component" and the "extended eastern low brightness area," are estimated at 800 million and 100 billion times the mass of the sun respectively.

Objects of this sort tend to take the shape of lobes on either side of a central optical object, usually a galaxy. Theories generally regard the radio sources as matter ejected by the central object. Various models have been put forth to explain their development and whether and how much their expansion is hindered or stopped by the counterpressure of supposed intergalactic gas. As a result of these findings some parts of those models may have to be dropped, others perhaps retained or revised. The question is still in flux because it is not yet known whether these two sources are anomalous or typical of the class.

The search for others continues. ". . . It seems most improbable that these two are the only radio sources of moderate strength whose large-scale structure has been overlooked," the three observers conclude. "Before long we may know if 3C236 is atypical, or whether it must relinquish its distinction of being the largest known object." □