Evidence for an Extinct Superheavy Element

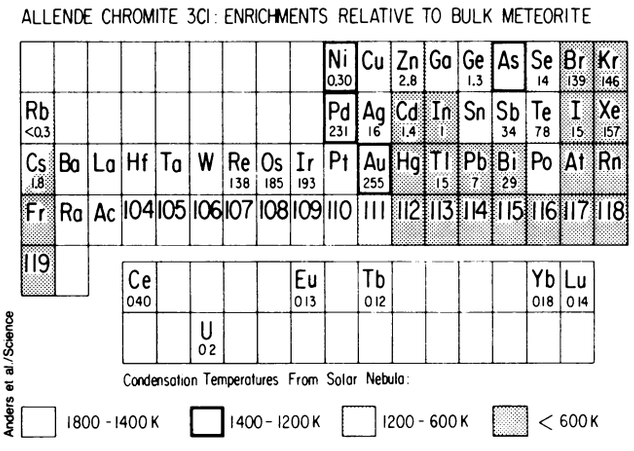
The search for the heavier transuranic elements, atomic numbers 111 to 119, is predicated on the belief that they can actually exist or could have existed in the universe. The assumption is that they are not merely clever extrapolations of the properties of the columns in the periodic table into a realm that for some reason cannot really exist. Concrete evidence of the present or past existence of one or more of the hypothesized elements would strengthen the case.

Five scientists from the University of Chicago, Edward Anders, Jacques Gros, H. Takahashi, John W. Morgan and H. Higuchi, propose that a sample of one of these widely sought elements, element 115 (or 114, 113), once existed in the Allende meteorite that fell in northern Mexico in 1969.

The geochemistry of meteorites is extremely complex, and a short presentation of the chain of reasoning must necessarily be oversimplified. Full details are given in the Dec. 26 SCIENCE.

The argument begins with the presence of a trace of xenon in certain inclusions in the meteorite, a trace up to 180 times as rich as in the bulk of the meteorite. Xenon can be a product of the fission of more than one element heavier than itself. This xenon is found somewhat anomalously in places enriched in noble metals and volatiles, which happen to be chemical congeners of elements 107 to 111 (the noble metals) and elements 113 to 118 (the volatiles), but not enriched in congeners of the actinides, among which the usual progenitors of fission-product xenon are found. So the progenitor of this xenon was most likely a noble metal or a volatile element, not an actinide, and that points to the noble metals and volatiles among the heavy transuranics.

The trace elements are found in a mineral designated Q by the researchers, and the next part of the argument depends on the chemistry and condensation history of this Q. The basic constituent of Q is apparently an iron-chromium sulfide. The history of its formation began when the solar nebula had a temperature of about 1,200 to 1,400 degrees K., and iron-nickel grains containing chromium, gold and palladium condensed on platinum metal nuclei. As things cooled down, a chain of condensations and reactions among the condensates led to a situation in which, probably near a temperature of 450 degrees K., "some part of the chromium formed a sulfide (Q) in intimate association with chromite, which trapped heavy noble gases and volatile-chalcophile elements [elements that have an affinity for sulfur]: selenium, tellurium, bromine, iodine, tantalum and the progenitor of fission xenon."



Enrichments of chemical congeners of superheavy elements 107 to 111 and 113 to 118 in one inclusion of the Allende meteorite. Numbers in the boxes are ratios of the amount of the given element in the inclusion to the amount in the bulk of the meteorite. Shading indicates range of the element's condensation temperature.

From this, the analysts conclude that the progenitor of the xenon was chalcophile and condensed from the nebula with a sulfide. Furthermore that sulfide was a rare iron-chromium sulfide (0.04 percent of the meteorite) rather than the more abundant iron-nickel sulfides (6 percent of the meteorite).

The criterion of volatility alone could point to any element from 111 to 119, but the preceding characteristics allow certain restrictions to be made. Arguments from analyses of another meteorite that shared excess xenon had thrown out elements 117 to 119, and this work adds stronger reasons for excluding them.

To further weed out unlikely candidates from the remaining range, 111 to 116, the researchers consider which of them are likely to condense as sulfides rather than as free metals, and specifically which condense as sulfides near 400 or 500 degrees K. The most likely candidates turn out to be 113, 114 and 115 with a possible slight preference for 115.

The data can be used to set an upper limit on the amount of the superheavy element that might still be present in the meteorite. This comes to 55 billion atoms per gram, appreciably less than the 3,200 billion atoms per gram that must have decayed to produce the present abundance of xenon in the sample. From this, the Chicago group arrives at a half-life of less than 770 billion years, but they caution that the figure is based on an assumed cross section of the progenitor for fission induced by bombardment with thermal neutrons. Other assumptions could lead to a higher value for the half-life. □

Our galaxy has a central radio source

A number of galaxies exhibit radio sources at their centers. Often these central sources appear to be associated with lobes of radio-emitting matter outside the optical galaxy but seemingly ejected from it. If some galaxies can have radio sources at their centers, the question arises whether they all can, and specifically can our own galaxy?

In the Dec. 1 ASTROPHYSICAL JOURNAL LETTERS four astronomers from the Owens Valley Observatory of the California Institute of Technology report the discovery of such a source at the center of our own galaxy. They used a very-long-baseline interferometer composed of a telescope at Owens Valley Observatory (near Bishop, Calif.) and one at Goldstone, Calif., to resolve the direction of the source and to place at least an upper limit on its size, 0.02 seconds of arc or a linear dimension less than 20 billion miles. The Owens Valley group say this is probably a redetection of a source that B. Balick and R.L. Brown found in March 1974 but could not resolve.

The brightness temperature of the source (the temperature that a body would have to have to generate the observed flux by thermal means) is about 30 million degrees K. The body appears to be putting out energy at a rate of 10^{33} ergs per second. Because of the high brightness temperature the observers suggest that the mechanism for production of the radio waves is in fact not thermal. The source also appears to vary its flux over time; it was undetectable to VLBI observations in June 1974.

As galactic-center radio sources go, this one is fairly small and weak. Compared to those of the really strong radio galaxies, it has about one ten-millionth of the radio luminosity and one-tenth the size. A

source like this one could not be detected at the distances of most other galaxies, so for the moment the question whether other spiral galaxies have such sources remains open. However, the wide difference between this source and those of the strong radio galaxies suggests the existence of intermediate strengths, some of which might be detectable.

Whether others are found or not, it remains an advantage to have one such source close by for study. Detailed observations may permit a selection among rival theories of galactic-center development (at least for our own galaxy) and possibly give information on the origin and evolution of radio sources in other galaxies. □

Monkey motherhood: Two for Primero

National Institutes of Health

Kraemer and first transferred primate.

Primero, the infant baboon, has two mothers. He was conceived in one mother, then transferred to another five days after conception. Although he certainly doesn't know it as he plays and develops in his nursery, he is the first step toward a mass-produced primate model for human diseases.

Embryo transfers have been achieved in rats, mice, hamsters, rabbits, pigs, sheep and cows. But Primero, as his name implies, is the first primate produced by embryo transfer. Veterinary researcher Duane C. Kraemer and co-investigators Gary T. Moore and Martin A. Kramen made the transfer last March, and Primero was delivered by Caesarean section on Sept. 5, after a normal gestation period of 174 days. "He was delivered by Caesarean," Kraemer explains, "so that we could obtain blood samples from the umbilical cord and placenta rather than from the infant itself."

The transfer, done at Southwest Foundation for Research and Education in San Antonio, is part of a project to make readily available primate models for various diseases such as atherosclerosis, diabetes and cancer. "Once we identify a female primate with a certain genetic characteristic," Kraemer says, "—the development of heart disease for example, or glucose intolerance—we could get many more offspring to study in a shorter time through embryo transfer." Rather than one infant per year, the test animal could "produce" many, raised in surrogate mothers.

Kraemer was the first researcher to apply embryo transfer to the commercial production of genetically superior cattle. "This technique allows us to produce 'litters' of superior cattle, taken from an individual female and raised in several." Kraemer presented his primate results to the American Association for Laboratory Animal Science in November and has submitted an account to SCIENCE.

Primero was transferred by a somewhat complicated series of surgical procedures—exposure of the donor uterus through abdominal incision, flushing out of the embryo from the oviducts, introduction to the uterus of a second baboon in exactly the same stage of the menstrual cycle. But nonsurgical methods must be developed for removing the embryos, Kraemer says, before primates with the desired traits can be produced cheaply and in greater numbers. □

Beating developers at their own game

Across the Chesapeake Bay from mainland Virginia runs a narrow peninsula completely disconnected from the rest of the state, called the Eastern Shore. A long string of marshy barrier islands shields the strip from the Atlantic Ocean, and for the past half-dozen years, environmentalists have fought to prevent development of these islands into the high-rise resorts that cover so many other coastal areas. Their success—and their increasingly sophisticated methods—were dramatized last month with the donation of the 13th island to the Nature Conservancy, which now controls a virtually uninterrupted 60-mile stretch of Eastern Shore coastline.

The Nature Conservancy is a group that specializes in preventing overdevelopment by acquiring land outright—either through direct purchase or by donation (usually as someone's tax writeoff). Previous coups have included acquisition of Great Dismal Swamp as a wildlife refuge (SN: 3/3/73, p. 132). But resistance to such efforts has been growing among property owners, who realize they may be able to make more money by selling part of their holdings to developers, while retaining nearby land for its probable appreciation.

To attack this problem, the Nature Conservancy worked with other environmental groups to discourage potential developers, while simultaneously trying to acquire land without raising suspicion. The Sierra Club, for example, conducted studies that illustrated possible environmental damage development would cause, as well as several practical business problems that had not received public attention. (For example, most of the islands lack fresh water, and builders would have had to provide it through even more extensive development.) Meanwhile, an obscure company called Offshore Islands, Inc., began buying land at depressed prices as formerly enthusiastic developers started backing off.

When the company donated the 2,000-acre Metomkin Island for conservation last month, its true nature was uncovered—rather than being just another land speculation company, Offshore Islands, Inc., was a wholly owned front for the Nature Conservancy. Its donation had helped create what is now billed as one of the largest protected salt marsh systems in the United States. □

Military lasers

Considering the popularity of "death rays" in science fiction, the general press has been surprisingly quiet about recent advances in laser weaponry reported in SCIENCE NEWS and other journals over the last couple of years (SN: 2/2/74, p. 74; 3/29/75, p. 211; 9/20/75, p. 191). That silence has now been broken with wide press coverage of the announcement by the authoritative *Jane's Weapons Systems 1976* that the United States and the Soviet Union are "locked in a costly 'super-scientific' struggle" to develop the first practical laser weapons.

The announcement contained little new information, quoting an estimate that the two countries are basically running neck and neck, but that the United States leads in fabrication techniques, structures and materials. In a follow-up story, the London Observer quoted a highly placed NATO source as saying laser weapons are now considered feasible. □

Energy bill passes

After much haggling over the politically explosive issue of oil price controls, the stalemate between Congress and the President ended with enactment of an energy bill that will roll back crude oil prices, at least temporarily. The bill also included substantial increases for energy research, with total ERDA authorizations of $2.6 billion. The breeder reactor received the largest slice of the pie—some 20.7 percent—with fossil fuel research closely following with 18.9 percent. Fusion research received 11.4 percent; environment and safety, 9.8 percent; solar, 6.6 percent; conservation, 5.9 percent; other fission, 2.9 percent; and geothermal, 2.1 percent. □