

SENATE JOINT RESOLUTION 2

By McNally

A RESOLUTION to commend Oak Ridge National Laboratory, Vanderbilt University, and the University of Tennessee - Knoxville for their contributions to the discovery of element 117 and its naming as tennessee.

WHEREAS, it is fitting that the members of this General Assembly should pause to recognize those estimable individuals whose efforts have contributed to significant scientific breakthroughs; and

WHEREAS, the recently discovered element 117 has been officially named "tennessine" in recognition of Tennessee's contributions to its discovery through the efforts of the Department of Energy's Oak Ridge National Laboratory (ORNL), Vanderbilt University (VU), and the University of Tennessee - Knoxville (UTK); and

WHEREAS, "the presence of tennessine on the Periodic Table is an affirmation of our state's standing in the international scientific community" as well as the knowledge and expertise of Tennessee's scientists and technicians, as ORNL Director Thom Mason noted; and

WHEREAS, the experiment that produced the first evidence of element 117 would not have been possible without an international collaboration among several world-class scientific facilities, including the High Flux Isotope Reactor (HFIR) and the processing facilities at the Radiochemical Engineering Development Center (REDC) at the Department of Energy's Oak Ridge National Laboratory and a unique accelerator complex in the Flerov Laboratory of Nuclear Reactions at the Joint Institute for Nuclear Research (JINR) in Dubna, Russia, using the heavy-ion cyclotron U400 and gas-filled recoil separator; and

WHEREAS, Oak Ridge National Laboratory is the only source of sufficient quantities of the radioactive isotope berkelium-249, a synthetic element essential for the experiment to create

element 117. The berkelium-249 campaign was enabled by the production of californium-252, a radioisotope used in research, industry, and medicine, at ORNL's HFIR and REDC; and

WHEREAS, the impetus behind the discovery of element 117 grew out of a 2005 meeting at Vanderbilt University in which Dr. Yuri Oganessian, leader of the team from JINR, asked Vanderbilt University professor Dr. Joseph H. Hamilton, with whom he had collaborated in nuclear research for fifteen years, to assist him in obtaining a berkelium (Bk) target to search for the new element with atomic number 117; upon visiting ORNL's HFIR, they learned that the most economical way to produce Bk was during the production of californium (Cf); and

WHEREAS, in August 2008, when Dr. Hamilton learned the production of the Bk-Cf material was underway at ORNL, he introduced, in October 2008, ORNL's Dr. James Roberto to Dr. Oganessian, who successfully pioneered the "hot fusion" approach to synthesize superheavy elements developed at JINR. This meeting formed the basis of the ongoing collaboration among the three institutions; and

WHEREAS, Lawrence Livermore National Laboratory (LLNL), which had collaborated with JINR on previous superheavy element research, also joined the team in late 2008, adding nuclear data analysis capabilities; and

WHEREAS, superheavy elements, which do not occur in nature, are synthesized by exposing a radioisotope target to a beam of another specific isotope. In rare cases, the nuclei will combine into a superheavy, and heretofore unknown, element; and

WHEREAS, superheavy element research conducted in Tennessee included the production and chemical separation of unique actinide target materials at ORNL's HFIR and REDC, the production of which contributed to the discovery and confirmation of nine superheavy elements, including element 117, the discovery of which completed the seventh row of the Periodic Table; and

WHEREAS, in the current Periodic Table, elements beyond uranium (atomic number 92) are increasingly unstable and decay rapidly into other elements; the discovery of element 117, along with elements 113, 115, and 118, provides evidence for the long sought "island of stability," a concept first proposed in the 1960s that predicted increased stabilities and much

slower rates of decay for superheavy elements with higher numbers of neutrons ( $N = 184$ ) and protons ( $Z \geq 112$ ) than those previously known; and

WHEREAS, the prerequisite phase of the experiment to create element 117 began in August 2008; the berkelium-249, essential for the discovery, was produced through 250 days of irradiation at ORNL's HFIR and ninety days of processing at the adjoining REDC to separate and purify the berkelium material; and

WHEREAS, on June 15, 2009, ORNL sent twenty-two milligrams of berkelium-249 to the Russian Research Institute of Atomic Reactors (RIAR) in Dimitrovgrad, Russia, which fabricated a target by applying the berkelium radioisotope to a thin film of titanium. With the clock ticking away on its 327-day half-life, the scientists had about five months to perform the experiment; the target was sent to JINR, where the experiment began on July 28, 2009; and

WHEREAS, following the first experiment that produced six atoms of element 117 at JINR, published in April 2010 in *Physical Review Letters*, additional confirmation studies were conducted by JINR, ORNL, LLNL, VU, and UTK at JINR in 2012, using berkelium from ORNL. This second observation of element 117 was presented in a *Physical Review Letters* study published in October 2012. ORNL's Krzysztof Rykaczewski and UTK's Robert Grzywacz led the development of a new detection and digital data acquisition system that was used in the follow-up experiments on superheavy nuclei at JINR; and

WHEREAS, a group of 72 scientists from 16 institutions in Australia, Finland, Germany, India, Japan, Norway, Poland, Sweden, Switzerland, the United Kingdom, and the United States conducted confirmation experiments, published in May 2014, to independently verify the discovery of element 117. This research involved the production of berkelium at ORNL and bombardment with high-power calcium-ion beams in an accelerator at GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, Germany; and

WHEREAS, in December 2015, after a year-long process, the Joint Working Party of the International Union of Pure and Applied Chemistry (IUPAC) and the International Union of Pure and Applied Physics (IUPAP) formally recognized the discovery of element 117, provisionally known as "ununseptium"; and

WHEREAS, elements are permanently named for either the person who made the discovery or for the region where the laboratories that made the discovery are located; to be so named is one of the highest honors in science; and

WHEREAS, on June 8, 2016, IUPAC published a declaration stating that the discoverers, upon the recommendation of the discovery team, had submitted their suggestion for naming the new element 117, "tennessine," with a symbol of Ts, after "the region of Tennessee." The IUPAC granted final approval on November 28, 2016; and

WHEREAS, the specific spelling of tennessine was chosen because the new element is classified as a halogen, a type of element that by convention ends in the suffix "-ine." The halogen family includes elements such as chlorine, fluorine, and bromine; and

WHEREAS, Tennessee is only the second American state to receive this distinction, which is one of the highest honors in science; and

WHEREAS, Dr. Roberto observed that "the discovery of tennessine is an example of the potential that can be realized when nations come together to lend their unique capabilities toward a scientific vision"; and

WHEREAS, the team from ORNL consisted of staff in the Laboratory's Nonreactor Nuclear Facilities Division, the Research Reactors Division, the Nuclear Science and Technology Division, the Chemical Sciences Division, the Physics Division, the Facilities and Operations Directorate, and the Prime Contract Administration, Business Management, Legal, and Nuclear and Radiation Protection organizations; and

WHEREAS, ORNL's role in adding elements to the Periodic Table began with World War II's Manhattan Project, when element 61, named promethium, was discovered during experiments with the Graphite Reactor, the world's first operating nuclear reactor; and

WHEREAS, the members of this General Assembly find it appropriate to pause in their deliberations to applaud the remarkable scientific achievements made by the Tennessee scientific community and partnering international institutions involved in the discovery of element 117, which will be forever known in science as "tennessine"; now, therefore,

BE IT RESOLVED BY THE SENATE OF THE ONE HUNDRED TENTH GENERAL ASSEMBLY OF THE STATE OF TENNESSEE, THE HOUSE OF REPRESENTATIVES

CONCURRING, that we hereby honor and commend those renowned scientists at Oak Ridge National Laboratory, Vanderbilt University, and the University of Tennessee - Knoxville for their meritorious efforts that led to the discovery of tennesseine. Through their extraordinary achievements, they have advanced human knowledge and left an indelible mark on the history of science.

BE IT FURTHER RESOLVED, that an appropriate copy of this resolution be prepared for presentation with this final clause omitted from such copy.