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The Life and Career of James Andrew Harris: Let's Ask More of History

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ABSTRACT: As a member of the team that created elements 104 and 105 at Lawrence Berkeley Laboratory, James Andrew Harris [1932−2000] was the first African American credited in the discovery of an element. This factoid has been posted on social media, used in a quiz game, and repeated on numerous Web sites. The story (if any context is offered at all) is often the same—a narrative beginning with prejudice, which is overcome with perseverance, and a discovery as pay-off. It is a good story, and this article does not doubt its veracity. But there are questions that need asking. These questions can be basic: what role did Harris play in the discovery of these elements? Or, they can be complicated: what did Harris do before or after these discoveries? At present, there is a surprising lack of detailed information about James Harris's life and career that is easily discoverable. This article is both a call to chemistry students and educators to help uncover more of Harris's story as well as an example of how three simple guidelines can aid the discovery process.

KEYWORDS: *General Public, History/Philosophy, Inquiry-Based/Discovery Learning, Minorities in Chemistry*

Who was James Andrew Harris [1932−2000]? It is not hard to find short, almost heroic, accounts of a nuclear chemist that broke barriers to become the first African American credited in the discovery of—not just one, but two—elements. It is hard to find biographical details that show both the complexity and breadth of his life and career. As a hook, the heroic social media blurb is quite effective. Yet, Harris's story can hold our attention for more time than it takes to read a paragraph.

This aim here is to encourage students and educators to not only dive into the details of a scientist's biography, but also to help create this narrative. The chemistry of the heaviest elements is the purview of specialized laboratories and (often) large teams of researchers. Studying the life and career of Harris offers the chance to break through this seemingly anonymous monolithic endeavor and engage with details associated with the creation and legitimization of elements as well as the way in which science can be shaped by politics and identity.

Choosing Harris as a case study is both fascinating and an exercise in resourcefulness. A simple Internet search of his career does not reveal much beyond a top level description of two famous experiments at the Lawrence Radiation Laboratory at the University of California, Berkeley (now known as the Lawrence Berkeley National Laboratory) that created elements 104 and 105 by bombarding a californium-249 target with a beam of ions in a linear accelerator in 1969 and 1970 respectively.[1]

Harris was part of the team of five researchers that claimed to be the first to discover both of these elements, discounting the work of another research group in Dubna, Russia. The resulting priority disputes were part of the so-called "Transfermium Wars", which took decades to resolve.[2] Credit for these discoveries was split between the Soviet and US-based groups. The International Union of Pure and Applied Chemistry settled the naming dispute in 1997 by declaring 104 to be known as rutherfordium and 105 dubnium.[3]

The Berkeley team (Figure 1) was acknowledged by their Laboratory as being unique for the times, "out of the five-person team reporting their findings at Minneapolis on April 15 [1969], only two are holders of the Ph.D. degree; one of the five is a black man; one is a woman; three are recent arrivals from Europe."[4] In addition to being the only person of color on the team, James [Jim] Harris was also the only chemist. The team lead, Al Ghiorso, was an electrical engineer turned nuclear scientist who "decided not to worry about having the 'wrong' background for research". And Harris was "another scientist who, like Ghiorso, learned much of this science by doing it". The recent arrivals from Europe were three Finnish nuclear physicists with more traditional educational pedigrees. Matti Nurmia and Kari Eskola had their Ph.D.'s and Pirkko Eskola was working on completing her doctoral thesis.[5]

Despite the international attention that their research garnered, it is surprisingly difficult to ascertain the contributions of the various individuals from the Berkeley group's publications, especially those of Harris. And to this end, there is a need for subject-level expertise that not many historians have. Thus far, few chemists and chemistry students have turned their attention to such work. The rewards for doing so include

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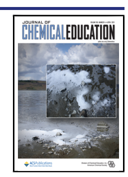

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Figure 1. A 1969 photo of the Berkeley team that reported discovering elements 104 and 105. From left to right, Matti Nurmia, James Harris, Kari Eskola, Pirkko Eskola, and Albert Ghiorso. Photo courtesy of Lawrence Berkeley National Laboratory. (https://catalog.archives.gov/id/7665749).

creating substantive information about a researcher identified as a role model and providing an engaging entrée into the chemistry of the heaviest elements. This article argues for the need for all of us to go deeper, historians and scientists both. Three guidelines for research are offered, but these are only examples for students and educators. The hope is that this is only a start.

■ GUIDELINE 1: LET'S GO BEYOND "THE FIRST"

The following trivia question was posed to a group of students at the 2019 ACS National Meeting:

All right, question 5. James A. Harris was the first African American chemist to codiscover an element, actually helping to discover two elements. One is element 104, rutherfordium. What is the other element that he helped discover?

The ACS Podcast *Stereo Chemistry* used this pub quiz question as a starting off point for an episode that, in part, explores Harris's work.[6] The show's creator, Kerri Jansen, interviewed several of Harris's colleagues as well as chemists currently involved in superheavy element work, ultimately producing one of the more nuanced accounts readily available online. Rather more prevalent are accounts that cover Harris's status as "the first", and give few details.[7] Jansen's podcast illuminates Harris's personality and what he was like to work with, but the interviews with his contemporaries do not detail his scientific work.

It is known that his primary contribution to the discovery of element 104 was making the californium target (Figure 2) that was bombarded in Berkeley's Heavy Ion Linear Accelerator (HILAC). With a bit of reading, one can sketch a picture of what it took to make what Al Ghiorso called "the best target we have ever had". Amazingly it not only "withstood months of intermittent bombardment and is still good", but it also stayed that way for it to be used in the quest for element 105.[8]

Californium (element 98) is manmade, and in 1968 Harris was given 60 μg of the material, which was created primarily in a reactor at Oak Ridge National Laboratory.[9] This small quantity was almost the entirety of the californium in the world at the time. Every atom was precious. Unfortunately, the sample came with impurities, including lead. This could produce particles when bombarded in Berkeley's HILAC that resembled the same ones the team was trying to study.[10] Multiple places cite Harris using "22 successive separation processes" to remove

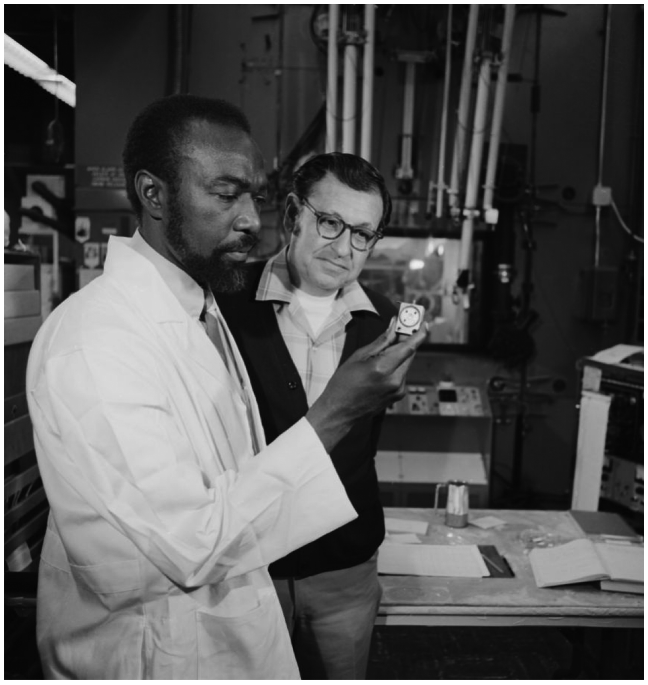

Figure 2. James Harris (left) and Albert Ghiorso with the target used to create isotopes of elements 104 and 105 in Berkeley Lab's Heavy Ion Linear Accelerator. April 21, 1970. Photo courtesy of Lawrence Berkeley National Laboratory. (https://catalog.archives.gov/id/39147040).

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impurities.[11] But that is rather like saying "he used chemistry". What processes? What equipment did he need? How long did it take? There are numerous questions that remain unanswered. Each one is an invitation for students to fill in these knowledge gaps.

Once the target material was purified, Harris electroplated the tiny amount of californium into a circle about 3/16″ (4.76 mm) diameter unto a beryllium−palladium foil. He balanced the width of the deposit with the thickness needed to get a reaction in the HILAC and the ability to withstand the high energy ion beam—all this precision while wearing gummy gloves.[12]

The author also had the opportunity to interview several of Harris's colleagues, including codiscoverers Matti Nurmia and Kari Eskola.[13] Both scientists spent countless long hours—often through the night—running the experiment in a cave at the end of the HILAC beam, while Pirkko Eskola studied the computer-stored data, looking for signatures of the existence of the new elements. Interestingly, neither Nurmia or Kari Eskola recalled much about the production of the target, except that it was not just one target that Harris made for the project as a whole. Eskola remembered using about 10 targets Harris created. Each was typically formed from a single isotope of the element they were bombarding. In addition to the californium target, which surprisingly lasted for both discoveries, Eskola remembers trying targets made from plutonium, americium, curium, berkelium, einsteinium, and fermium. Every target would have presented its own unique challenges (Figure 3).

Going beyond the tendency to celebrate "the first" is important in this case, as the obsession with priority, especially with rutherfordium and dubnium, obscures the chemistry part of the story. Conversations with Nurmia and Eskola highlighted the siloing of tasks and specialties. The chemists and the physicists had different roles and work products.[14] Manmade super heavy elements were no doubt a result of advances in both chemistry and atom-smashing physics, but they also mark a point where researchers increasingly had to rely on physical, rather than chemical, analyses to ultimately claim discovery.[15] In the case of elements 104 and 105, the Berkeley team mainly relied on the detection and analysis of alpha particles (a helium nucleus) ejected by the newly formed element as it decayed into smaller atoms.[16] The lifetimes of these daughter products and the energy of the alpha particles detected were used to positively identify the mother from which they were born. The problem was that there were precious few atoms of the new element produced at any one point in time, not to mention they did not hold together for very long.

Figure 3. Jean Rees (left), James Harris (center), and John Depew in May 1970 preparing a target for the HILAC. Rees and Depew were identified as Harris's assistants in a 1973 *Ebony* article. Photo courtesy of Lawrence Berkeley National Laboratory. (https://photos.lbl.gov/bp/#/search/100771909?q=James%20Harris&filters=%257B%257D).

It was one thing to make a series of detectors to register these infrequent short-lived events and another to explore chemical reactions and properties one atom at a time. But that does not mean Harris did not try. He collaborated with Matti Nurmia and Robert (Bob) Silva from Oak Ridge Laboratories to conduct what they called "first aqueous chemistry of element 104", which was reported at a conference on 17 November 1969.[17]

Alpha particles did not tell the team where 104 should sit in the periodic table. (Thinking about the typical 18-column table: Should it sit in the actinides after 103 in the f-block or should it reside directly under hafnium in the d-block?) Harris, Nurmia, and Silva decided to conduct an experiment to see if an isotope of 104 with a 70 s half-life could be shown to behave like hafnium and therefore assume its place under this element in the periodic table.

To accomplish this analysis, the team captured atoms of element 104 on a foil just after they were created. The foil was washed with ammonium alpha hydroxyisobutyrate into the top of a cation exchange column. After leaving the column, the drops were rapidly dried on platinum discs and set on detectors that recorded the number, energy, and timing of emitted alpha particles, effectively fingerprinting the products.

This setup quickly separated tetravalent and trivalent elements tested. Experiments showed that trace amounts of group 4 elements hafnium and zirconium mostly made their way through the column in the first 10 drops. Element 104 was expected to do the same if it exhibited similar chemical properties, whereas it was not expected to make it through the column nearly as quickly if it were a trivalent actinide.

With the help of automation and a computer for data acquisition, the team went from creating a particle to looking for its signature after passing through the chemical system in about 60 s. After 3 weeks of work, they produced about 100 particles of element 104. Only 10% survived the chemical analysis.

The low count did not tamper Ghiorso's enthusiastic support of these data, "These results, I believe, are completely beyond question and show that element 104 has an aqueous chemistry different from that of all the other transuranium elements."[18] So, it is interesting that the experiment concerning the chemistry of 104 is confined to professional publications and is missing from most online biographies of the chemist in the group.[19] Indeed, it is surprising that it is so hard to find the details of Harris's contribution to the discovery of elements 104 and 105.

Part of this oversight might be due to a rather heated and prolonged priority dispute over these elements. With so few laboratories in the world capable of this kind of work, the Berkeley and Dubna teams needed each other to verify findings. Scientific results are supposed to be reproducible. But this relationship, like so many others, was bound to be fraught in a time when national positioning and pride ruled the day. The

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Figure 4. James Harris (left), Jack Hollander (middle), and Stanley Prussin (right) with their germanium−lithium gamma ray detector used for detecting impurities with neutron activation analysis, 1965. Photo courtesy of Lawrence Berkeley National Laboratory. (https://photos.lbl.gov/bp/#/search/4605505?q=James%20Harris&filters=%257B%257D).

Russians also used chemical and physical methods to back their claim, but ultimately the heart of the argument boiled down to Berkeley doubling down on their measurements of alpha particles and the Dubna team's measurements of spontaneous fission events.[20] So, it was different types of particle decay—not the chemical experiments—that got the most play in the dispute. And as a result, this is what gets the most attention in the written record.

There are many lines of inquiry in Harris's career that require knowledge of chemistry. More so, this expertise is needed to translate his work for the general public. What were the "22 successive separation processes" that Harris used to make elemental targets heavier than plutonium? Despite the reductive nature of the few extant scientific papers and proceedings of the topic, is it possible to create a fuller account of what the group claimed was the "first aqueous chemistry of element 104"?[21] Going beyond our celebration of "the first" to accomplish something, means engaging with the processes and people that created some desired endgame. It is an invitation to students to dig into the details of a discovery and find relevance in the short-lived products of Big Science.

■ GUIDELINE 2: LET'S EMBRACE A NONLINEAR PATH

Many of the published accounts of Harris focus on aspects of his life that are clearly tied to his involvement in the discovery of elements 104 and 105 at Berkeley Lab. Like wayward points that do not fit a trend-line, the parts of his story that do not quite mesh are often omitted. A typical narrative includes his BS in chemistry from Huston−Tillotson College, his difficulty finding a job as a chemist in the mid-1950s, a 5-year stint working for Tracerlab, Inc., and proceeds with him joining Berkeley Laboratories and the team that would go on to make element discoveries. Some extracurricular activities might be included, like visiting schools and encouraging minorities to become engaged in science, extensive involvement in professional societies, and his love of golf.

Any biographical sketch is necessarily selective. The problem at present is that the years preceding and succeeding the discovery are not well represented in the written record. How would Jim Harris describe his life and work given the chance? A 1988 retirement announcement kept by one of his daughters is probably the closest one can come to answering that question (barring the discovery of the book manuscript, "Black man and the Atoms", which he worked on after leaving Berkeley Laboratories). The announcement was "approved by Jim" on 21 June 1988 and was split into sections on his family, education, employment, scientific works, personal/organizational affiliations, honors and awards, and future plans.[22]

Reading this document offers a number of life experiences that do not clearly fit into a logical succession of steps leading up to his fabrication of superheavy element HILAC targets. For example, Harris initially entered Huston−Tillotson on a music scholarship (trumpet and French horn) and switched his major to chemistry part way through.[23] After college, he was drafted and served two years in the U.S. Army as a personnel supervisor specialist before taking a position at Tracerlab, Inc. Some six years after the discovery that would earn him fame, he left the laboratory for an appointment in Berkeley Lab's Office of Equal Opportunity. Two years later, he would transition again to an administrative role as Assistant to the Division Head for Facilities Management and Technical Services Division.

An interview with Jim Harris's friend and former colleague, Benjamin Pope, offered more insight into the latter two roles he held at Berkeley Lab.[24] Pope headed the nascent Office of Equal Opportunity. Together, they set out on a mission to entice more women and minorities to work at Berkeley Lab. This recruitment effort included a significant amount of travel. The duo specifically concentrated on outreach at Historically Black Colleges and Universities (HBCUs) and the formation of partnerships with engineering colleges. They not only wanted to increase access to scientific disciplines for minority students, they wanted to create a pipeline of talent for Berkeley Lab. In yet another career transition, Harris moved into administration after a few years. He paired this with a new degree, a Masters in Public Administration from California State University, Hayward.[25] His rise in the Lab's organizational chart was accompanied by new responsibilities for hiring and the promotion of staff.[26] Benjamin Pope noted that this was not an easy change for Harris to make. Not only was he a scientist-turned-administrator, he was a Black man in a position of power. The resulting distrust, according to Pope, took both time and charm (which Harris was said to have in abundance) to blunt. Through both his position in the Office of Equal Opportunity and his role as an administrator, Harris influenced the work of Berkeley Lab. This latter part of his career is not captured in publications and it is therefore hard to explore the overall impact on the Lab's staff, research agenda, and output.

It is not just his nonchemistry related experiences that get ignored. His scientific endeavors before 1969 receive short shrift. Mention of his early work (ca. 1960) in the Beta Spectroscopy Group in the Berkeley Lab's Nuclear Chemistry Division studying beta decay has thus far only been found in his retirement announcement. Only slightly more attention is paid to his involvement in a project with Berkeley Lab chemists Jack Hollander and Stanley Prussin on the improvement of neutron activation analysis with germanium semiconducting detectors (Figure 4). By exposing a sample to a source of neutrons in a reactor, the team created radioisotopes through neutron capture. The study of γ rays produced through their subsequent decay, specifically the energy of this radiation, allowed the team to analyze minute impurities in their samples. Hollander, Prussin, and Harris estimated the development of their new detector improved the nondestructive analysis technique 10-fold.[27] Expertise identifying trace impurities could have proven useful in the purification and preparation of targets for the HILAC. But it is also important to realize that Harris did not develop his target-making experience out of nowhere. He was a member of the Heavy Isotope Production Group under Robert [Bob] Latimer, codiscoverer of elements 102 and 103, in the years before the work began on element 104 and 105.[28]

There is also a dearth of publications that explore Harris's research post-element-105. An article in *Ebony* magazine in May 1973 gives some small insight. He is described as beginning work on targets for the discovery of 114, "leaping past" other undiscovered elements in the hunt for the theorized island of stability in which superheavy elements that have lifetimes long enough to hope for more than discovery for its own sake, but for useful applications.

Leaps and shifts—all the data points in Harris's life do not form a straight line to (and from) the discovery of rutherfordium and dubnium. His path is nonlinear and the more interesting for it. Embracing the variety of his experiences acknowledges the adaptability he needed to thrive as a researcher and scientific administrator. It is a lesson that a lot of students do not learn until entering the STEM workforce: succeeding in science depends on far more than just science.

■ GUIDELINE 3: LET'S ACKNOWLEDGE MORE VARIABLES

The 1973 *Ebony* article describes as a man "clearly on the brink of discovery," who "talks about his role as a chemist with an enthusiasm matched only by a baseball fan anticipating the grand slam."[29] So why did Jim Harris completely give up research in the span of two years? Why would a young, successful chemist, just embarking on another experimental program, leave it all behind? Did something happen?

The answer lies with politics and money—funding dried up and priorities changed. The Vietnam War and an energy crisis brought on by the 1973 oil embargo were just two of the events that forced the U.S. to take a hard look at its support of scientific programs and energy policies. The Atomic Energy Commission—the body responsible for funding most of Berkeley's element hunting work as well as nuclear energy research—was broken up by congress in 1974 and split into the Energy Research and Development Administration and the Nuclear Energy Commission.[30] The vast expense of creating new elements, which only existed for seconds, was likely a hard sell at this time.

According to Pope, Harris would have stayed in research until the day he died, but he saw the writing on the wall. It was either retool or leave Berkeley Lab altogether. Without knowing more about Harris, his transition to the Office of Equal Opportunity would seem like a radical shift in what he did day to day. But there was more to his life than the lab.[31]

Conversations with Jim Harris's friends and family all touched on the importance of his membership in Alpha Phi Alpha (AΦA), an African American fraternity founded in 1906.[32] Upon joining AΦA, he became part of a powerful network of Black men. His local chapter (Gamma Chi Lambda) included influential doctors, lawyers, and politicians in the San Francisco Bay Area. Benjamin Pope was not just a friend and colleague, but a fraternity brother. Pope described the regular meetings and social events as an elite gathering of successful professionals. "The brilliance of these guys" still inspires him today.[33] Harris was proud to be part of the fraternity, but it is clear that the feelings were mutual. The organization's magazine, *The Sphinx*, featured several pieces about Harris and the discovery of elements 104 and 105 in the late 1960s and early 1970s, including a full reprint of the Berkeley team's 1970 *Physical Review Letters* article.[34] The discoveries came so fast that *The Sphinx* led the article about the discovery of 105 with, "SCIENCE... Again, It Is Brother Harris".[35]

Together, the Bay Area fraternity brothers realized social and political programs. They advocated for low-income housing and fundraised for scholarships to support young Black men in college. So when Harris joined Pope in the EEO office, the two already had a history of mobilizing resources to support marginalized individuals. Harris left the lab, but he did not venture far from the work that energized him.

As to the racism that Harris encountered in his life, just one experience is often quoted and repeated, likely sourced from the 1973 *Ebony* article:[36]

> *"I could write a book on my job-hunting experiences when I got out of the Army."*
>
> *If Harris were to write the book, it might include the half-dozen or so shocked expressions of prospective employers when he first walked into their offices. It might also include the half-dozen secretaries who refused to believe he was applying for a job as a chemist rather than a janitor. "At one point," he recalls, chuckling now at an old wound, "I was even given a job test simple enough for elementary schools kids—basic addition and subtraction... I told the secretary I didn't need a job that badly."*
>
> *The job-hunting ordeal, however, had a happy ending when Harris found work as a chemist at a local Bay Area commercial laboratory in 1955.*

The *Ebony* text is quoted to show how a narrative arc was applied to make a good story: conflict, climax, resolution—or in this case a "happy ending". This is not to denigrate the article,

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which happens to be one of the most informative publications about Harris's life. Rather, it is to recognize that as this story gets retold, that so too is the triumphalist narrative. Harris persisted for certain, but he did not quash racism in one fell stroke. It likely shaped a great deal of his life and career. It no doubt shapes how he is remembered today.

During one interview with a former Berkeley researcher, the author asked if the individual knew the details of Harris's involvement in the discovery of elements 104 and 105. They were not familiar with his work but knew that Harris was not much involved with the "practical research" with the accelerator, specifically the fabrication of particle detectors and the analysis of their data, which confirmed signatures of the newly created particle. It was their opinion that Harris was included in the discovery team because he was African American and the lab was actively recruiting and incorporating minorities at this time.[37]

This individual believed that the critical part of the experimental work happened at the end of the HILAC beamline. The chemistry that came before (to make the HILAC targets) and after (confirming eka-hafnium behavior) was viewed as ancillary. The lack of detailed knowledge of what Harris did, paired with his involvement in diversification initiatives might have led to this assumption that he was included because of his skin color. However, it is highly doubtful that Harris led the Heavy Isotope Production Group without qualifications, or that he was given credit in the discoveries because of his race. Recall the precedence set by the discovery of elements 102 and 103 at Berkeley lab in which the previous lead of the Heavy Isotope Production Group, Robert Latimer, was similarly credited. To be clear, this article does not attempt to assess the value of each individual's contribution to Berkeley Lab's element hunting effort (which are each arguably different). Rather, it argues for the need to find the details of Harris's contribution.

There are more subtle ways that Harris is remembered differently from his colleagues. Take for example the fact that he did not have a Ph.D. This is often highlighted, as in the brief ACS bio made for students and educators:[38]

> *James Andrew Harris is the first African American to participate in a major new-element identification program. He was also a co-discoverer of elements 104 and 105. Unlike his colleagues, Harris did not have a doctoral degree, however, he was later awarded an honorary Ph.D. from Houston–Tillotson [sic] College in 1973 and two Merit Awards—one from the Mayor of Richmond, CA, and the other from the National Urban League.*

Albert Ghiorso, the Berkeley team leader, and codiscoverer of 12 elements, did not have a Ph.D. either—something rarely singled out for attention.[39]

A more useful exercise for students and educators is to move past both the triumphant job-hunting narrative and the perpetuation of surprise that Harris succeeded in spite of his lack of an advanced chemistry degree and consider the variety of barriers that could have prevented him from pursuing a Ph.D. or finding employment. Was it likely he would have an "in"—an ally—already working in a Bay Area Lab? What were the spoken and unspoken requirements for enrolling in a doctorate program? Who got research and teaching assistantships?

Even more powerful is to take those probing questions about Harris's past and ask them today. Or, use his experience as a springboard to invite students to analyze and voice barriers unique to their situation and identity that might prevent further studies or landing their first chemistry job. Harris benefited from a network of fraternity brothers and an ability to adapt to shifts in laboratory funding by retooling his work and roles. What kind of support do today's students feel they need to adapt to the vast number of variables affecting their lives and work?

■ THE DESIRED OUTCOME

Engaging with the past and creating a fuller picture of Harris's life and career not only improves the historical record. It provides aspiring chemists and scientific administrators the opportunity to consider, through one man's experience, the complex forces that might similarly shape their future.

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(12) (a) Brother James A. Harris, Nuclear Chemist. *Sphinx Magazine*, 1969, *55* (7) 22. (b) See ref 4, p 7. (c) An image of Harris electroplating a target while wearing large gloves can be found at Berkeley Lab Photo Archive. https://photos.lbl.gov/bp/#/search/4633301?q=James%20Harris&filters=%257B%257D (accessed 2021−01−19).
(13) (a) Matti Nurmia (personal communication 2019−08−28). (b) Kari Eskola (personal communication 2019−12−19).
(14) The plural "chemists" is used purposefully. As the group leader of the Heavy Isotope Production Group, Harris likely had direct reports. The author has not yet found a source listing the assistants involved with the target preparation and chemistry experiments relating to the discoveries of 104 and 105. However, Jean Rees and John Depew were identified as two of Harris's assistants in a later 1973 article. See ref 11a.
(15) Glenn Seaborg predicted in 1959 that by the time 104 and 105 were discovered "the present criteria for the discovery of a new element, chemical identification by traditional methods and separation from all previously known elements, will have to be changed at some point." Seaborg, G. The Transcalifornium Elements. *J. Chem. Educ.* **1959**, *36* (1), 42.
(16) See ref 9, pp 258-299.
(17) (a) A streamlined discussion of the experiment and results is found in the following: Silva, R.; Harris, J.; Nurmia, M.; Eskola, K.; Ghiorso, A. Chemical separation of rutherfordium. *Inorg. Nucl. Chem. Lett.* **1970**, *6* (12), 871−877. (b) See also: Ghiorso, A. The Berkeley HILAC Heaviest Element Research Program. In *Proceedings of the Robert A. Welch Foundation Conferences on Chemical Research. XIII. The Transuranium Elements—The Mendeleev Centennial, Houston, Texas, November 17−19, 1969*; Milligan, W. O., Ed.; The Welch Foundation: Houston, TX, 1970; pp 133−140. (c) The aqueous chemistry of element 104 is discussed briefly in a paragraph in the following: See ref 9, pp 274..
(18) (a) See ref 17b, p 140. (b) It was not until the late 1980s that Berkeley Lab would again tackle the chemistry of the transactinides. Hoffman, D. C.; Lee, D. M. Chemistry of the Heaviest Elements—One Atom at a Time. *J. Chem. Educ.* **1999**, *76* (3), 342.
(19) (a) The National Academies, African American History Program. http://www.cpnas.org/aahp/biographies/james-a-harris.html (accessed 2021−01−19). (b) OUPBlog. https://blog.oup.com/2019/05/james-harris-black-scientist-discover-two-elements/ (accessed 2021−01−19).
(20) (a) Robinson, A. E. The Transfermium Wars: Scientific Brawling and Name-Calling During the Cold War. In *Distillations*; Nov 2019. https://www.sciencehistory.org/distillations/the-transfermium-wars-scientific-brawling-and-name-calling-during-the-cold-war (accessed 2021−01−19). For a listing of additional points of contention, including impurities, data uncertainty, and experimental system design, see: (b) Ghiorso, A.; Nurmia, M.; Harris, J.; Eskola, K.; Eskola, P. Defense of the Berkeley Work on Alpha-emitting Isotopes of Element 104. *Nature* **1971**, *229*, 603−607.
(21) Interviewing modern day researchers can help with this endeavor. For example, the C&EN Stereo Chemistry Podcast team interviewed Clarice Phelps, a nuclear chemist at Oak Ridge National Lab and the first African-American woman who participated in the discovery of an element (117), to elucidate the difficulty in making radioactive targets. While only briefly covered, her perspective raises awareness of the tight timeline for making and using these materials. (a) See ref 6. (b) IUPAC Younger Chemists. https://iupac.org/100/chemist/clarice-phelps-es/ (accessed 2021−01−19).
(22) James A. Harris retirement announcement, 1988 (courtesy of Hilda Harris). The last sentence of the document, under "Future Plans", reads "But more importantly, he plans to complete his book "Black man and the Atoms."."
(23) According to his daughter, Hilda Harris, James Harris decided that the traveling and instability associated with a music career was unappealing (personal communication 2020−07−23).
(24) Benjamin Pope (personal communication 2019−07−30 and 2020−01−14).
(25) See ref 22.
(26) (a) Lawrence Berkeley Laboratory, November 1977 Organizational Chart, LBL_ORG_CHARTS_1977-11.pdf, p 29. https://drive.google.com/drive/u/0/folders/1d4Sl66yI35OGyyQJM8rbeURiHet-xHsN (accessed 2021−01−19). See ref 22.
(27) (a) *The Magnet*; Lawrence Radiation Laboratory, 1965; Vol. *9* (5), pp 1 and 3. (b) Prussin, S. G.; Harris, J. A.; Hollander, J. M. Application of Lithium-Drifted Germanium Gamma-Ray Detectors to Neutron Activation Analysis. Nondestruction Analysis of Aluminum. *Anal. Chem.* **1965**, *37* (9), 1127−1132. (c) Lamb, J. F.; Prussin, S. G.; Harris, J. A.; Hollander, J. M. Application of Lithium-Drifted Germanium Gamma-Ray Detectors to Neutron Activation Analysis. Nondestructive Analysis of a Sulfide Ore. *Anal. Chem.* **1966**, *38* (7), 813−818.
(28) See ref 10, p 243.
(29) See ref 11a, p 145.
(30) Congress.gov H.R. 11732 - Energy Reorganization Act. https://www.congress.gov/bill/93rd-congress/house-bill/11732?s=1&r=44 (accessed 2021−01−19).
(31) The importance of Harris's family should also be noted. He had five children with his wife Helen Harris, whom he met at Huston−Tillotson College. They remained connected with their Alma Mater, raising funds and returning to the annual commencement until their passing. James and Helen Harris traveled extensively and were involved in their children's extracurricular activities. (Hilda Harris personal communication 2020−07−23).
(32) Alpha Phi Alpha History. https://apa1906.net/our-history/ (accessed 2021−01−19).
(33) Benjamin Pope (personal communication 2019−07−30).
(34) See ref 1b.
(35) (a) See ref 12a. (b) Brother Jim Harris... Again. *The Sphinx Magazine* 1970, *56* (2) 15. (c) SCIENCE... Again, It Is Brother Harris: The New Element Hahnium, Atomic Number 105. *Sphinx Magazine* 1971, *57* (4) 15−17.
(36) See ref 11a, p 148.
(37) Anonymous source interviewed in 2019.
(38) See ref 7a.
(39) (a) C&EN Albert Ghiorso. https://cen.acs.org/articles/89/i4/Albert-Ghiorso.html (accessed 2021−01−19). It is also worth noting that nuclear chemistry mid-century was a niche discipline. Learning on the job might have been the best course of action. A 1951 article concerning nuclear chemistry at the University of California explains absence of laboratory classes. Students were encouraged to engage in research starting the first year, as the "instruction by the research directors and staff members of the Radiation Laboratory are much better than could be provided in a formal course." (b) Perlman, I.; Seaborg, G. T. Nuclear chemistry at the University of California. *J. Chem. Educ.* **1951**, *28* (1), 13.

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