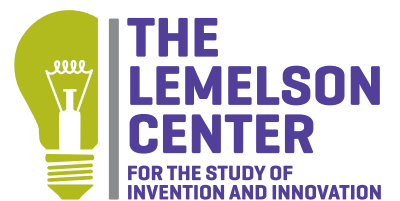




REPORT ON **BLACK INVENTORS
AND INNOVATORS:
NEW PERSPECTIVES**

**Organized by the Jerome and Dorothy
Lemelson Center for the Study of
Invention and Innovation**



 Smithsonian

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From the Director

The United States—and the world—have benefitted tremendously from new technologies, scientific breakthroughs, and artistic and creative products invented by Black Americans. But in each of these areas, the institutions and organizations that recognize achievement, offer start-up capital, and write the histories and educational materials that shape young people’s perspectives have left out Black inventors. Scholars have performed significant work in the past decade to recover these lost stories, and new voices have advanced critical insights into the makeup of invention ecosystems and the lasting impact of how we define invention and innovation.

This report summarizes a rich set of presentations and discussions on the topic of “Black Inventors and Innovators” that took place in November 2020 as a webinar series organized by the Lemelson Center for the Study of Invention and Innovation. We have outlined key findings and action steps that aspire to improve future research, public history, and educational materials.

Founded in 1995 and located within the Smithsonian’s National Museum of American History, the Lemelson Center from its beginnings has had a particular focus on less known, hidden, and even erased histories of inventors. The webinar series was an opportunity to hear directly from Black inventors as well as economists and policy studies professionals who have carried out new scholarship on the topic. One key call to action of the symposium was to use history to identify what is causing such inequality in the invention and innovation ecosystems—and to address how to bring about meaningful change.

Looking ahead, the Lemelson Center (and other museums, libraries, and archives) will do additional work to document, interpret, and share the stories of contemporary Black inventors and innovators in collaboration with their communities, even as we continue to find and tell the stories of past inventors whose achievements have remained obscured.

The insights and perspectives advanced here will help us better serve the American public, and we invite readers of this report to join us in this work. In closing, I wish to thank The Lemelson Foundation for its support of the webinar series and its ongoing efforts to encourage the development of more diverse, inclusive, and equitable invention and innovation ecosystems.

Arthur Daemrich
Jerome and Dorothy Lemelson Director

Executive Summary

How we think about invention tells us a good deal about who we are and what we value as a society. The longstanding ideal of American inventiveness—the belief that Americans are a uniquely enterprising and creative people—contains assumptions that historically functioned to exclude and discount the contributions of marginalized peoples. Dominant notions of invention, which prioritize novelty, profit, efficiency, and ownership, have too often disregarded the creations of Black inventors who worked from a different set of value propositions and with different means and resources at their disposal—people who created amid extraordinary and at times life-threatening circumstances.

From November 16 to 20, 2020, the Lemelson Center convened an interdisciplinary group of inventors, entrepreneurs, and scholars to examine Black invention and innovation in the United States. The webinar series revisited themes from a 1996 Lemelson Center workshop on technology and the African American experience (Sinclair 2004; Pursell 2005). Moderated panel discussions gave participants an opportunity to hear directly from working Black inventors, as well as from historians, economists, and policy studies professionals producing pathbreaking scholarship on Black innovators past and present.



*Clockwise from upper left: Tahira Reid Smith, Monica M. Smith, and Tyrone Grandison participate in Session 3 of *Black Inventors and Innovators: New Perspectives*, which convened online November 16–20, 2020. *Lemelson Center*.*

Museums and archives play a critical role in documenting, interpreting, and sharing the stories of Black creators. At the Lemelson Center, we also recognize that American museums themselves have contributed to this invisibility by historically privileging the stories of White inventors in their collections, exhibitions, and scholarship (Smith 1999; Catlin-Legutko 2017). We remain committed to finding and telling the stories of inventors whose achievements have been undervalued or obscured. For this series, we chose to focus specifically on Black inventors, both those working within the US patent system and those who have operated outside it. We hoped to encourage a more inclusive historical narrative and to learn strategies from our panelists for creating a more equitable innovation ecosystem. This series marked our opportunity to learn from experts across the field of Black invention and innovation.

“Every child you interact with is an inventor in the making. Treat them as such.”

—Tyrone Grandison

The timing of this conversation could not be more pressing. The events of 2020 and early 2021, including the racially motivated killings of Ahmaud Arbery, Rayshard Brooks, George Floyd, and Breonna Taylor, have continued to draw attention to systemic injustices experienced daily by Black Americans. In the invention and innovation ecosystem, structures of disenfranchisement remain significant. White children are three times more likely than Black children to become inventors (Bell, Chetty et al. 2019). Black people in the United States are less likely than other demographic groups to earn STEM degrees, receive patents, and commercialize new products and services. Black scientists and engineers continue to experience bias and discrimination in the high-tech employment sector, and Black inventor-entrepreneurs face persistent difficulties accessing venture capital, intellectual property protection, and commercial networks. Within the fast-changing technology arena, even supposedly neutral apps and algorithms can perpetuate negative stereotypes and deepen racial inequality. Despite these barriers, however, Black inventors are crafting and leading a powerful practice of resilience. These entrepreneurs regularly design, invent, and deploy new technologies—and their resulting creations encourage cathartic joy, economic empowerment, community, and resistance to injustice. What these inventors make has both local and global impact. The inventions of Black creators invite our sustained attention, especially the ways they express and honor Black culture, which includes the experiences of those for whom the struggle to survive remains a daily reality.

In the twenty-first century, the American innovation system revolves around core institutional players. As panelists throughout the weeklong webinar reminded us, each of these organizations has a role in shaping societal perceptions of invention and innovation. The US Patent and Trademark Office (USPTO), federal and private funding agencies,

preK–12 education, universities, small and large businesses, and independent inventor communities all received critical attention from our panelists—as did museums, libraries, and centers of scholarly inquiry. Panelists called on series participants to think both retrospectively and prospectively, that is, to look backward to find narratives that have been obscured or hidden while also looking ahead to identify and implement robust measures of support for the next generation of Black innovators. As inventor Tyrone Grandison stated, “Every child you interact with is an inventor in the making. Treat them as such.” The challenges facing Black inventors require a collaborative approach, one that acknowledges longstanding areas of bias and privilege while working with renewed rigor to narrow the innovation gap and achieve lasting equity in the STEM ecosystem.

Series Goals:

- **Draw renewed attention to historic and contemporary Black inventors and Black technology users.** How might we recover lost stories, develop new case studies, and celebrate Black ingenuity? How might we expand our definitions of who counts as an innovator?
- **Review and analyze current scholarship and historiography on Black inventors.** What is the “state of the field” concerning Black inventors, innovators, and technology users in American society? What challenges do they face, and what key questions motivate invention scholars and Black entrepreneurs working today? What are best practices for a twenty-first-century historiography of invention?
- **Learn strategies for advancing a more equitable innovation ecosystem.** Building from the observations of invention scholars and Black inventors in today’s marketplace, what structural changes might be needed to support and liberate Black creativity? How do we reach a place in American society where inventing for community, cooperation, and expression is just as valued as inventing for profit, competition, and efficiency? What do Black inventors need to survive—and thrive—within the commercialization space today?
- **Recommit to archival preservation as a form of equity and social justice.** The Lemelson Center team remains dedicated to finding and sharing the stories of inventors whose achievements have gone missing from the history books—even as we acknowledge the problematic history embedded in the construction of museums themselves, whose collection practices historically have excluded (and exploited) the contributions of marginalized peoples. What stories should be collected, preserved, and shared, and how might this work best be carried out? How do we broaden the search criteria for Black inventors and prevent more accounts of courageous innovation from being lost?

Panelist Findings:

- **Traditional definitions of invention and innovation are too narrow.** Conventional understandings of these terms, steeped in Western capitalistic outlooks, prioritize profitability, efficiency, autonomy, newness, and ownership. A Black view of invention and innovation, however, includes an emphasis on aiding the community, advancing artistic expression, repurposing existing resources, and promoting cooperation. There is an inherent tension between the call to move “beyond” profit and competition within the invention arena and the need to make changes to the innovation ecosystem that support Black inventors, so they *can* benefit financially from their inventions—even as many create products that are not primarily or solely profit-driven. This tension appeared in creative ways throughout the webinar series, generating rich discussion about perceptions of invention in the twenty-first century.
- **Black invention cannot be separated from Black vernacular cultural expression.** The experience of being a Black inventor, panelists repeatedly stated, includes joy *and* resistance; it entails a struggle against forces of erasure, discrimination, and fear. This struggle shapes the resulting invention or innovation. Recognizing that the creative process is tied to lived experiences in the Black community, webinar panelists described expressions of Black life and culture as living artifacts in their own right—objects such as inventor Tahira Reid Smith’s Double Dutch machine—with singular and shared stories of ingenuity, play, solidarity, and survival. Especially in the digital arena, Black user-innovators are showing themselves to be agents and creators, forging new directions for the internet. This dimension of Black invention should be preserved for future generations.
- **Archives lead to histories:** Finding, preserving, and telling the stories of Black inventors and innovators past and present will require a multi-pronged strategy across institutions, together with a commitment to redoubling preservation efforts. Panelists repeatedly noted that without more primary materials from and about Black inventors in the archives, these stories cannot be preserved or told. In today’s digital age, the internet itself is an archive, and a fragile one. Online moments of Black culture and history—including the creation of the internet itself—are at risk of being lost or degraded. Panelists shared their conviction that more must be done to preserve these records and stories, and more must be done *now*.

Panelist Recommendations:

- **Collectively, we need to develop an expanded definition of invention and who counts as an inventor.** Panelists agreed that we must help Americans broaden the way they think about invention. Alongside dominant Western capitalistic understandings of invention, which favor profitability, newness, and patenting, we need to expand our thinking to include invention from a different set of value

propositions. This expansion could include unpatented inventions that address community needs, works of art that offer cultural expression, and technologies that repurpose existing resources, rather than insisting that every invention must be new or novel to be creative. This more expansive approach could reap benefits, panelists suggested, not just for how we understand the history of Black inventors, but also for how we engage intersectionally with women inventors and other marginalized groups—including LGBTQ+ individuals; persons with physical, emotional, and cognitive differences; and immigrants navigating what it means to be considered sufficiently “American.”

- **Advocate for systematic policy change within the innovation ecosystem.** To create a more equitable invention and commercialization arena—including educational pipelines and inventor workplaces—panelists called for intentional, institution-wide policies that support diversity, equity, accessibility, and inclusion across the invention and innovation fields. Black people remain significantly underrepresented across the invention and commercialization spectrum, from STEM students to faculty members, from patentees to patent examiners, and from IP attorneys to venture capitalists. Relying on individual goodwill or “hearts and minds” alone to change the tide is not sufficient—there is no social justice without accountability. Equity policies are also good for business, panelists reminded webinar participants: diverse teams and workplaces have demonstrably better outcomes (Page 2008; Hewlett, Marshall, Sherbin 2013; Herring and Henderson 2015; Page 2018). Still, panelists cautioned that diversity, equity, and inclusion (DEI) offices in and of themselves are not sufficient—and can, in fact, sometimes impede reform by giving the false impression that enough is being done. We need concrete, measurable policies and accountability within the invention ecosystem, with DEI performance indicators built into metrics and with accountability structures in place for all players in the innovation arena. We should also expand traditional capitalistic rubrics for measuring success (standardized test scores, grant funding, patents, publications, and profit) and embrace more holistic metrics that welcome and incentivize different values—community impact, environmental stewardship, inclusivity, equity, and joy—and even play—as forms of creative resistance.
- **Museums, libraries, archives, and historians should acknowledge their complicity in historic erasure and recommit to seeking out and celebrating stories of Black ingenuity.** Panelists recommended that museums, libraries, and other archives should candidly acknowledge their role in obscuring and minimizing inventions by Black inventors and members of other marginalized communities. As part of their commitment to “decolonization” (Smith 1999; Catlin-Legutko 2017), these organizations should also work cooperatively with Black communities to gather and preserve more primary materials about Black inventors. Finding these materials will be challenging, in part because the task requires reimagining certain museum and collection practices. Museums and libraries must be creative and dogged in

their determination to find these stories in nontraditional places. As they identify previously untapped sources, historians also need to preserve more records of Black innovation in the digital arena, from the birth of the internet through today. As panelists observed, not everyone can be a Black inventor, but everyone can—and should—learn to celebrate and appreciate Black ingenuity.

We hope the ideas explored in this report and the recommendations offered by panelists will provide insights for innovation scholars, working inventors, and interested learners from all backgrounds. We also hope our panelists' stories help inspire the next generation of inventors. Studies have shown that children have trouble seeing themselves as inventors unless they can read about or meet creative people who remind them of themselves—inventors, that is, who look like they do (Bell, Chetty et al. 2019). By drawing renewed attention to Black inventors past and present, we at the Lemelson Center aim to support a more inclusive invention ecosystem moving forward. This is a “both/and” approach to the historical and historiographical project: we acknowledge that White Americans built systems that excluded, appropriated, and concealed Black ingenuity; we recognize that discrimination continues to shape the invention ecosystem today; *and* we recommit to helping build a more equitable innovation culture, one that understands the centrality and vitality of Black innovators through history and celebrates their ongoing ingenuity.

With major disparities persisting in who can access the network of social capital required to bring an idea to life, now is the time to reform the pipeline and expand the story. Together, we can develop a more inclusive narrative that reveals the astonishing breadth of creativity in American society yesterday, today, and tomorrow.

Black Inventors and Innovators: A Brief History and Literature Review

Our webinar series highlighted new perspectives on Black inventors and innovators by showcasing multiple lines of inquiry that have flourished in the new millennium. This essay provides a brief history of Black American inventors and innovators by reviewing some of the key publications since 1845. This scholarship provides a foundation for current and future explorations of Black ingenuity.

When the first enslaved Africans arrived in colonial America in 1619, they brought centuries of technical knowledge with them. Once they reached American shores, enslaved people expanded their technical skills by learning various artisanal trades amid the brutalities and trauma inflicted by the American slavery system. They demonstrated creativity and resilience while transmitting their specialized skills to their descendants through practice and oral tradition.

Scholars have drawn on surviving artifacts and fragments from the archives to recover these stories of early Black ingenuity. Enslaved Americans built extensive water infrastructures to irrigate rice fields and introduced numerous crops, botanicals, and agricultural techniques into North America (Carney 2002; Carney and Rosomoff 2009). They deployed nets, traps, and watercraft to fish American waterways (Perry 2018). They developed homeopathic medicines and ingenious methods for preparing and preserving foods (Covey 2007; Lee 2017; Harris 2011; Twitty 2017). Enslaved Black people wove straw baskets, turned clay pots, and mined for gold (Pollitzer 2005; Goldberg and Witcoski 2006; Daly forthcoming).

These forms of “Black vernacular technological creativity” did not conform to the racist preconceptions of antebellum European Americans and failed to meet their narrow definitions of ingenuity (Fouché 2006, 640; Baraka 1971). Historians have traced the roots of anti-Black racism to ancient Greece; these attitudes and ideas coalesced in fifteenth-century Europe and were present among America’s first European settlers (Eliav-Feldon, Isaac, and Ziegler 2009; Bethencourt 2013; Kendi 2016). Therefore, both free and enslaved Black people persistently faced racist assumptions about their supposed intellectual inferiority and technical incompetence, or what Bruce Sinclair has called the “deeply ingrained and long perpetuated myth of black disingenuity” (Sinclair 2004, 2).

Practically, these assumptions functioned to exclude Black contributions from the early history of invention and technology. Among antebellum White men, “invention” generally meant building (and often patenting) a mechanical device that would replace animal or human labor, improve the efficiency of some task, or otherwise contribute some economic value. In a society where labor was rigidly divided by sex and race, the work of women (e.g., cooking, housekeeping, sewing) and enslaved persons (e.g., agriculture, various trades) simply did not count as invention under this narrow definition. Occasionally, the work of a Black inventor *was* recognized—and duly recorded—as meeting this White, Eurocentric standard

of invention. For example, John Latrobe published an early biographical account of Black astronomer, surveyor, and instrument-maker Benjamin Banneker (Latrobe 1845).



Thomas L. Jennings (1791–1856) is believed to be the first Black inventor to earn a US patent. Jennings owned a laundry business and received US patent X3306 in 1821 for a method of “dry scouring” clothes. Kreol Magazine.

The Patent Act of 1790 was ostensibly colorblind; it had no language—and thus no restrictions—limiting patentees based on gender, race, age, religion, nation of origin, or any other category. In 1821, Thomas L. Jennings became the first known Black inventor to earn a US patent for his dry-cleaning methods (Johnson 2019). While free Black citizens like Jennings were permitted to obtain a patent, enslaved Black people had no legal standing and were denied the same right. In 1858, a White Mississippian named Oscar J. E. Stuart attempted to patent the double cotton scraper invented by an enslaved artisan named Ned who worked on his plantation. However, Attorney General Jeremiah S. Black ruled that “a machine invented by a slave, though it be new and useful, cannot, in the present state of the law, be patented” (Yancy 1984; Frye 2018; Swanson 2020). White enslavers circumvented this legal barrier—and capitalized on it—by appropriating the patentable inventions of those they enslaved. For example, Angela Lakwete has documented the African and enslaved Black innovations underlying the modern cotton gin, and how Eli Whitney, a White guest at Catharine Greene’s Georgia plantation, eventually earned the patent (Lakwete 2003). With few exceptions, the antebellum inventions of free and enslaved Black people were either ignored or claimed by contemporary Whites, so many of their stories of ingenuity remain lost to history.

Following the Civil War, the Thirteenth, Fourteenth, and Fifteenth Amendments to the US Constitution abolished slavery and (ostensibly) granted full citizenship rights to all Black Americans, including the right to earn patents. Invention soon became a way for Black Americans to gain social status and economic mobility. When Black inventors earned patents—objective, government-issued proof of their creativity and ingenuity—racist arguments concerning their supposed intellectual inferiority became more difficult to

Baker subsequently published his list and highlighted the achievements of Black inventors such as Jan Matzeliger (shoe lasting machine), Elijah McCoy (lubrication system), and Granville T. Woods (telegraphy and telephony). This compilation, Baker concluded, provided irrefutable evidence to anyone who would erroneously “assert that the Negro has made no contribution to the civilization of the age” (Baker 1902, 405). An expanded search in 1913 to mark the fiftieth anniversary of the Emancipation Proclamation turned up 1,200 leads, but Baker could confirm only 800 patents as definitively earned by Black inventors. In his subsequent book *The Colored Inventor*, Baker explained that many Black inventors refused to acknowledge their heritage for fear that “publication of that fact might adversely affect the commercial value of their inventions.” Given these hesitations, together with decades of White appropriation of Black inventions, Baker believed that perhaps half of all Black patents might remain hidden forever “in the unbreakable silence of official records” (Baker 1913, 6).

Baker’s lists emerged from a growing interest among Black Americans to display the inventive genius of their community. Richmond attorney Giles B. Jackson founded the Negro Development and Exposition Company (NDEC) to capitalize on that interest. Jackson secured funds from Congress, the Virginia state legislature, and individual donors to erect a “Negro Building” for the Jamestown Tercentennial Exposition of 1907, which marked the 300th anniversary of America’s first permanent English settlement. The Negro Building showcased sculpture and handicrafts by Black artisans, books by Black authors, recitals by Black musicians, a hospital exhibit featuring Black physicians and nurses, and an operating branch of the Black-owned True Reformers Bank. Notably, the pavilion included a 1,200-square-foot Inventions Section that displayed 50 prototypes and 351 US patent specifications contributed by African American inventors. With D. Webster Davis, Jackson described these accomplishments in a combination treatise and exposition catalog, *The Industrial History of the Negro Race of the United States* (Jackson and Davis 1908). Black Americans continued to host additional expositions highlighting the work of Black artisans and inventors, including the 1908 Negro National Fair in Mobile, Alabama, and the fiftieth anniversary “Emancipation Expositions” in Philadelphia, New York, Chicago, and Washington, DC, held between 1913 and 1915 (Winton 1947; Wilson 2012). The extant catalogs, ephemera, and contemporary news coverage of these expositions provided further evidence of Black ingenuity at the turn of the twentieth century.

In general, the fiftieth anniversary of emancipation spurred Black Americans to enthusiastically explore their history and culture. In September 1915, Harvard-trained historian Carter G. Woodson and several colleagues founded the Association for the Study of Negro Life and History (ASNLH, now called the Association for the Study of African American Life and History). Through the ASNLH, Woodson established the *Journal of Negro History* (1917) and the *Negro History Bulletin* (1937). In the second week of February 1926, Woodson and his colleagues established the first Negro History Week to coincide with the birthdays of Abraham Lincoln and Frederick Douglass. Fifty years after that first weeklong celebration, President Gerald Ford recognized February as Black History Month in 1976 (Goggin 1997; Dagbovie 2007). Thanks to ASNLH, the annual celebrations of Black history inspired new research initiatives, publications, and educational content about Black inventors and innovators (Picott 1977; Yancy 1979).

As Black history grew steadily into a robust academic subdiscipline in the early twentieth century, Black inventors struggled to overcome the persistent disenfranchisement, segregation, discrimination, and racial violence of the Jim Crow era. Black students were systematically prevented from entering mainstream White institutions, so community leaders established their own historically Black colleges and universities (HBCUs), such as Alabama's Tuskegee Institute and Virginia's Hampton University (Anderson 1988; Margo 1990; Wharton 1992). Soon George Washington Carver, an agricultural scientist and inventor based at the Tuskegee Institute, joined Benjamin Banneker as an inspiration for new Black inventor biographies (Zuber 1929; Hunter 1942; Allen and Murray 1921).

Beyond the academy, Black people were also excluded from membership in professional engineering societies and technical associations such as the Franklin Institute (Slaton 2010; Lerman 2006). With limited access to wealthy backers and mainstream banks, Black inventors were forced to develop alternative networks to access the start-up capital and expertise necessary to commercialize their inventions (Cook 2011). Even worse, the specter of lynchings and extralegal violence suppressed patenting and commercialization rates for Black inventors through at least the 1940s (Cook 2014). In response, some Black inventors—including gas mask and traffic signal inventor Garrett Morgan—purposefully obscured their racial identities and featured White actors in their advertisements to avoid prejudice in the marketplace (Cook 2012).

Black inventors persisted despite these difficulties and inspired a burst of publishing activity by scholars beginning in the 1960s. Several factors propelled this new wave of scholarship. First, renewed enthusiasm for all kinds of Black history followed the reinvigorated civil rights movement of the 1960s, an energy that reverberated through the academy. Inspired by the Black Power movement, Black college students organized hundreds of protests to demand a more diverse system of higher education that was relevant to their community. In 1968, San Francisco State University introduced the first of dozens of new Black and African American Studies departments (Rojas 2007; Kendi 2012). Collectively, these departments trained hundreds of new scholars and encouraged new research on Black history. During the same period, preK–12 educators recognized the importance of providing diverse racial and gender representation in reading materials and educational programming. This impetus inspired, for example, the pathbreaking *Sesame Street* beginning in 1969 (Morrow 2006; Davis 2008). Inspired by these twin movements, historians and educators wrote masters' and doctoral theses, government reports, and curricula demanding more books featuring Black characters, including scientists and inventors (Haber ca. 1960s; Pryor 1970; Lyles 1976; Scott 1977; Walcott 1980; Hambrick 1993).

Amid these calls for change, authors of juvenile literature developed dozens of new children's books featuring Black inventors. Juvenile literature has often been in the vanguard of Black inventor biographies. Children's books tend to be short, so even with limited or fragmentary primary sources, authors could assemble a concise book that covered its subject with adequate detail for young audiences. Indeed, children's book authors are often

the first biographers for many Black inventors. They identify the most important evidence and establish the basic facts of inventors' lives, creating a foundation for subsequent scholarly research.

Beginning in the 1970s, authors of juvenile literature published several biographical collections that profiled multiple Black scientists and inventors under one cover (Haber 1970b; Klein 1971; Hayden 1972; Jenkins 1975; Williams 1978; Brodie 1993; Gibbs 1995; Aaseng 1997; Sullivan 1998; Webster 1999; Hudson 2003; Abdul-Jabbar and Obstfeld 2012; McLaurin 2016). These collections, and several individual biographies, greatly expanded the domain of Black inventor subjects beyond Benjamin Banneker and George Washington Carver. Individual children's biographies have profiled, for example, Garrett Morgan (Jackson 1993), Elijah McCoy (Towle 1993), Madam C. J. Walker (Simons 2018; Lee 2019), Lewis Latimer (Turner 1991; Dickmann 2020), Frederick McKinley Jones (Ott and Swanson 1977), William Kamkwamba (Kamkwamba and Mealer 2012), Lonnie Johnson (Barton 2016), Sarah Goode (Kirkfield 2019), and Patricia Bath (Lord 2020).

Alongside these literary developments, various federal agencies commissioned new publications to document the history and resilience of Black inventors. For example, during the Great Depression, the Writer's Program of the Works Progress Administration published a series of pieces on *Negro Inventors, Architects, and Engineers* (Writer's Program 1936–1938). In the 1960s, the Department of Health, Education, and Welfare commissioned Louis Haber to develop a report considering “The role of the American Negro in the fields of science” (Haber ca. 1960s). From these findings, Haber eventually published a biography of Benjamin Banneker and a collection titled *Black Pioneers of Science and Invention* (Haber 1970a; Haber 1970b). In the 1970s, the Department of Energy compiled a report documenting *Black Contributors to Science and Energy Technology* (Dept. of Energy 1979). In 1986, several offices of the Department of Commerce, including the US Patent and Trademark Office, the Economic Development Administration, and the Minority Business Development Agency, produced an educational film and associated study guides titled *From Dreams to Reality: A Tribute to Minority Inventors* (US Patent and Trademark Office 1986).

The Smithsonian Institution likewise encouraged a resurgence of new scholarship on Black inventors. In 1989, curator Portia James developed an exhibition titled *The Real McCoy: African American Invention and Innovation, 1619–1930*. The exhibition opened at the Smithsonian's Anacostia Community Museum, which had been established in 1967 to bring the Smithsonian directly to the predominantly Black residents of southeast Washington, DC. The exhibition and companion book interpreted three centuries of Black ingenuity and uncovered many previously unknown stories (James 1990). In 1996, the Smithsonian's Lemelson Center for the Study of Invention and Innovation hosted a workshop on “Technology and the African American Experience” at the National Museum of American History. The symposium featured papers by several historians of technology and generated both an edited volume and a critical edition of relevant primary sources (Sinclair 2004; Pursell 2005). The symposium also jumpstarted an ongoing collecting initiative to archive the records of Black inventors such as ophthalmologist Patricia Bath (Oswald 2000).

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The early 2000s witnessed a flourishing of new and rigorous historical scholarship on Black inventors and entrepreneurs. For example, Rayvon Fouché published *Black Inventors in the Age of Segregation*, a deeply researched history drawn from archival sources that focused on the experiences of Granville T. Woods, Shelby Davidson, and Lewis Latimer (Fouché 2003). In 2004, Patricia Carter Sluby published *The Inventive Spirit of African Americans: Patented Ingenuity*, a synthetic history of Black inventors that was broader in chronological scope than James’s *Real McCoy* and brought the story forward into the new millennium (Sluby 2004). Sluby—a chemist, former USPTO patent examiner, and registered patent agent turned author—inherited and extended the legacy of Henry E. Baker. Her book’s appendix featured a comprehensive list of approximately 2,000 US patents earned by African American inventors between 1821 and 2003. In *The Entrepreneurial Spirit of African American Inventors*, Sluby further examined how Black inventor-entrepreneurs commercialized their inventions in the context of the racist obstacles they faced (Sluby 2011). Collectively, the books by James, Fouché, Sinclair, Pursell, and Sluby developed a strong methodological foundation and uncovered several new stories to inspire future historical work on Black inventors.

As in the juvenile literature, scholars have continued to produce individual biographies to complement their synthetic, multi-inventor collections. In many cases, these scholarly biographies provide the critical, contextual, and nuanced accounts of inventors that were condensed and oversimplified in the heroic accounts of children’s books. For example, Smithsonian curator Silvio Bedini published a definitive scholarly biography of Benjamin Banneker (Bedini 1972). A’Lelia Bundles published a biography of Madam C. J. Walker, who became a self-made millionaire at the turn of the twentieth century by marketing beauty products to Black women (Bundles 2001). In 2020, Netflix developed Bundles’s biography into a mini-series (*Self Made*) starring Academy Award winner Octavia Spencer. Since 2015, historians have also produced scholarly biographies of inventors George Washington Carver, Jan Matzeliger, and Lucean Arthur Headen (Vella 2015; Plet 2015; Snider 2020).

In the new millennium, scholars introduced several thematic studies that explored various aspects of Black technoscience and the diverse ways that Black Americans have experienced technology. For example, scholars have documented how Black people have historically been the *objects* of technologies—like Atlantic slave ships, shackles, and predictive policing algorithms—that were deliberately built to surveil, incarcerate, and account for them (Walton 1999; Browne 2015; Eubanks 2017; Rosenthal 2018; Benjamin 2019a). Moreover, digital media scholars have found that ostensibly neutral apps, algorithms, and search engines are hard coded with racist assumptions that perpetuate negative stereotypes and deepen social inequality (Noble 2018; Benjamin 2019b).

But Black people are not just passive victims of oppressive machines; rather, they are influential agents who have invented and reconstructed various technologies to express themselves and serve the needs of their communities. For example, scholars have documented how Black innovators such as Grandmaster Flash reimagined turntables and mixers as musical instruments and developed new techniques such as scratching that defined rap and hip-hop music (Rose 1989; Rose 1994; Goldberg 2004; Fouché 2006). Likewise, Black engineers, entrepreneurs, and users shaped the nascent internet, including early online communities such as Usenet and BlackPlanet.com (Burkhalter 1999; Byrne 2007; McIlwain 2020). Along these lines, scholars developed numerous critical studies in the early 2000s that considered the “digital divide” and constructions of Black racial identity on the internet, in video games, and across various social media platforms (Kolko, Nakamura, and Rosman 2000; Nakamura 2002; Banks 2005; Nakamura 2007; Nakamura and Chow-White 2012). Indeed, Black expressions of frustration, joy, community, and playful mischief have defined the norms of twenty-first-century cyberculture for *all users*—not just Black ones—on digital platforms such as Twitter, Instagram, and YouTube (Brock 2012; Brock 2020).

Scholars have also documented how Black activists have deployed various media technologies to promote the social, economic, and political interests of their communities. For example, beginning in the 1920s, community leaders leveraged Black-owned radio stations to mobilize listeners to participate in the civil rights movement (Ward 2004). More recently, Black users have deployed mobile phone cameras and social media platforms to document police brutality and protest various forms of injustice. Black advocates have also used social media to fight for voting rights, education, economic empowerment, and better health outcomes (Freelon, McIlwain, and Clark 2016; Tufekci 2017; Florini 2019; Jackson, Bailey, and Welles 2020).

Beyond specific studies of invention, innovation, and technology, scholars have used race and Blackness as critical analytical tools to study a broad range of technoscientific topics (Nelson, Tu, and Hines, 2001; Wright 2015; Jackson 2020). For example, scholars have demonstrated how traditional African knowledge and indigenous practices inform several technoscientific disciplines, from botany to mathematics and computer science (Kimmerer 2013; Eglash 1999). Scholars have also reclaimed Black people’s rightful place in studies of nature, the environment, and the great outdoors (Glave 2010; Finney 2014). Recent studies have also demonstrated how ideas about race and Blackness have literally been built into skyscrapers and other architectural structures (Brown 2017; Cheng, Davis, and Wilson 2020).

When viewed in its entirety, three distinct strains of literature emerge from 175 years of scholarship regarding Black inventors and innovators. First, scholars have assembled lists of Black patentees, individual biographies, and biographical collections to recover the stories of Black innovators. Lists of Black inventors document the enormous achievements of Black inventors and provide definitive evidence of Black ingenuity (Baker 1900; Baker 1902; Baker 1913; Sluby 2004). Narrative biographies vary in their sophistication, from short, highly illustrated books aimed at children to detailed, critical biographies geared toward academics. For young Black readers in particular, these stories provide inspirational examples

of inventors who share their same racial identity. Moreover, critical biographies provide unvarnished evidence of the many challenges that Black inventors have faced and overcome. As Rayvon Fouché noted during the webinar series, his biographical subjects—Granville T. Woods, Lewis H. Latimer, and Shelby J. Davidson—encountered different varieties of racism (ranging from fistfights to workplace discrimination) that were specific to each man’s social and professional context (Fouché 2003). As a genre, this biographical work will continue in perpetuity with the emergence of each new generation of Black inventors. The success of those efforts will depend on the continuing work of museums and archives to seek out and preserve Black inventors’ artifacts, records, and oral histories.

Black people are not just passive victims of oppressive machines; rather, they are influential agents who have invented and reconstructed various technologies to express themselves and serve the needs of their communities.

A second strain of literature has marshaled demographic data and other empirical indicators to make aggregate, statistical studies of Black inventors and their opportunities within the innovation ecosystem. Scholars have counted and analyzed the number of patents issued to HBCUs; the number of advanced STEM degrees granted to Black students; the number of federal research grants awarded to Black scientists; the amount of venture capital funding invested in Black entrepreneurs; and the number of Black technical workers employed at high-tech firms (ThePLUG 2019; Cook 2019; Ginther et al. 2011; National Venture Capital Association 2019; Nager et al. 2016). Additional studies have assessed the degree to which lynchings and extralegal violence suppressed the output of Black inventors and conversely, the estimated annual economic growth that is unrealized because Black inventors have not been fully utilized (Cook 2014; Cook and Gerson 2019). Empirical studies of IP attorneys, patent examiners, and venture capitalists have likewise highlighted the lack of Black representation across the innovation ecosystem (Lopez 2020; National Venture Capital Association 2019). Collectively, these studies document the scope of Black inventors’ participation—and underrepresentation—in the economy. They also provide measures of accountability and progress as reformers strive to make the innovation ecosystem more equitable.

A third genre includes thematic studies that analyze Black Americans’ complex relationship with technology. These studies have emerged from numerous disciplines, including history, sociology, African American studies, science and technology studies, media and communications, architecture, and political science. Collectively, these thematic studies decenter traditional White narratives and instead adopt the Black epistemological perspective. While acknowledging the digital divide and other barriers to technological access, this genre

celebrates Black technological enthusiasm, agency, and the many creative ways that Black users reshape existing technologies to express themselves and serve their communities (Banks 2005; Fouché 2006; Fouché 2011; Brock 2020). These studies also document how Black people have experienced various technologies—from the cotton gin to internet search engines—as the material expression of discrimination, oppression, incarceration, and violence (Walton 1999; Noble 2018; Benjamin 2019a; Benjamin 2019b). Finally, this genre describes how Black Americans have deployed digital technologies to advocate for social justice and economic empowerment (Ward 2004; Freelon, McIlwain, and Clark 2016; Tufekci 2017; Florini 2019; Jackson, Bailey, and Welles 2020).

Even considering the expansive literature on Black inventors and innovators, there are still many underexplored areas for future study. For example, the vast majority of inventor biographies document Black men; future scholars may wish to explore the stories of Black women inventors, entrepreneurs, and investors such as Patricia Bath, Marian Rogers Croak, Jessica O. Matthews, LaTanya Sweeney, Aicha Evans, Ruthie Lyle Cannon, Angela Benton, Candace Matthews Brackeen, and Arlan Hamilton. Future scholars may also wish to explore how other aspects of identity—including gender, LGBTQ+ status, national origin, and disability—intersect with Black racial identity to influence the experiences of Black innovators (Bell 2012; Weheliye 2014; Pickens 2019).

As researchers seek out new stories of Black technologists, they should remember that the legacy of enslavement, Jim Crow, and the Great Migration profoundly influenced where Black people lived and settled. Beyond the southern United States, twentieth-century Black innovators most likely lived in northern or western industrial cities such as New York, Chicago, Detroit, Cleveland, Philadelphia, Pittsburgh, Los Angeles, Oakland, and Seattle (McKittrick 2006; Wilkerson 2010). Locales that offered federally-funded technical employment—such as Washington, DC, military bases, and NASA installations—should also present rich opportunities to uncover the stories of Black innovators (Yellin 2009; Odom and Waring 2019). Researchers should also find Black inventors by engaging with the faculty and alumni of HBCUs, Black sororities and fraternities, Black churches, and Black social clubs such as The Northeasterns, The Links, and the Jack and Jill clubs (Lovett 2011; Brown, Parks, and Phillips 2005).

Although not comprehensive, this essay and the accompanying bibliography present a brief history and review of the literature concerning Black inventors and innovators. During our webinar series, historians, inventors, economists, educators, and media scholars generously shared their new perspectives and the latest scholarship. The session descriptions summarize their insights on this important topic while providing a roadmap for future study.

Session 1

UNDERREPRESENTATION and INVISIBILITY

Lisa D. Cook

Professor of Economics and International Relations, Michigan State University

Rayvon Fouché

Professor of American Studies, Purdue University

Moderator:

Cathleen S. Lewis

Curator, Space History Department, National Air and Space Museum

What comes to mind when we think of a Black inventor? Typically, we think of the superlatives—that list of “top ten Black inventors” that gets revisited every February for Black History Month.

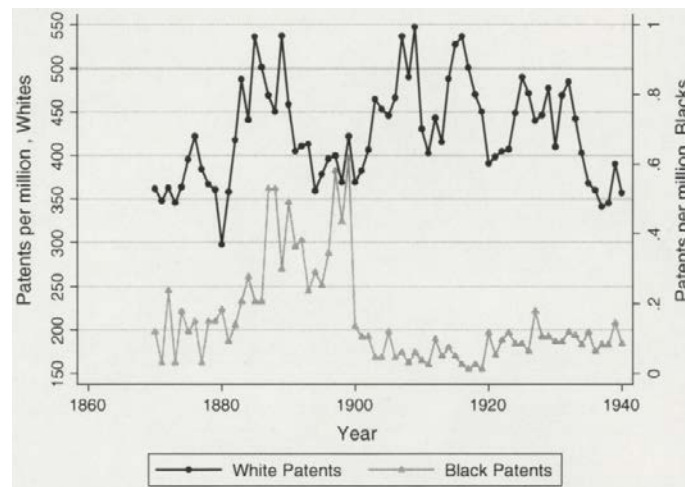
As participants in the first webinar session observed, however, this list is not comprehensive; and even those who make the cut do not always fit the traditional definition of an inventor as the recipient of a patent. In the early 1900s, Henry E. Baker assembled one of the first lists of Black patentees, a monumental endeavor that marked just the beginning of a larger retrieval effort that continues to this day. Black inventors remain underrepresented in historical narratives and in today’s innovation economy, with centuries of oppression and prejudice obscuring their contributions. Speakers in this session explored the Black innovation gap, offered insights into how we define “inventor” and “innovation,” and discussed strategies for retrieving and sharing the untold stories of Black invention—stories that challenge conventional assumptions about what it means to be an inventor in America.

Panelist Rayvon Fouché shared his perspectives on this retrieval effort, arguing that we need broader definitions of invention to record American innovation narratives with more accuracy and narrow the Black innovation gap. How can we redefine invention and innovation to create a more equitable narrative about past invention, a narrative that includes the effects of slavery? To begin with, he argued, **creation does not always result in a patent**. Patents comprise one measure of invention and innovation—an important measure, but not the only one. Fouché noted that capitalistic, often Eurocentric, proponents of invention have prioritized efficiency, improvement, dominion, and power, often overlooking those forms of invention that do not receive patents and that prioritize art, expression, morality, or spirituality. These latter creations are greatly needed, however, for they take seriously the potentially negative impacts of new technology and new materials on marginalized peoples and the environment. Such creativity persists well beyond the patent office, Fouché added, noting that before the Civil War, enslaved peoples were excluded from the patent system altogether, as seen in the case of the enslaved blacksmith Ned and his double cotton scraper invention.

Fouché shared **historical examples of the struggle for Black invention**, including the stories of Granville T. Woods (designer of railway locomotion devices), Shelby Davidson (inventor of adding machine devices), and Louis Latimer (who made important contributions in the manufacture of carbon filaments) (Fouché 2003). Each of these individuals has been mythologized and oversimplified in the years following his death, Fouché observed. **The historian or scholar of Black invention thus faces a double challenge:** he or she must demythologize the existing record of “heroic” Black inventors—revealing their individuality, faults, and humanity—while simultaneously expanding

and troubling the definition of invention itself, so that *more* names, more stories, can be retrieved both within and beyond the patent system. The scholar of Black invention thus seeks to retrieve narratives about creativity that persist outside the patent system yet also pushes back against biases and misunderstandings of those few Black inventors whose stories *are* known and recognized widely.

Those same “chosen few” also show up in conversations that Lisa Cook finds herself having about her research. Cook explained that when she tells people that she studies the economics of Black innovation, they typically assume she is writing about just three famous (and deceased) Black inventors: George Washington Carver, Garrett Morgan, and Madam C. J. Walker. Cook disabuses people of the assumption that only these three Black inventors existed and that there is little to be learned or gained from studying the patent records. Her work has shown that patent documents contain a host of information about American history and economics, including, for example, **the relation between patent data and lynchings**. Cook’s research has shown that a dramatic drop in Black patents beginning in 1900 correlated with rising violence against Black people (Cook 2014; Duffin and Childs 2020).



Economist Lisa D. Cook has demonstrated that patenting by Black inventors dropped precipitously after 1900, which correlated with the rise of Jim Crow laws, lynchings, and anti-Black violence (Cook 2014).

Myths about “famous” Black inventors are costly and should be debunked, she argued, because they suggest that Black invention is a thing of the past; they imply that no new archival work needs to be done; and they provide a cover or justification for permitting systemic inequities to continue in the innovation environment today. Taken together, these factors reduce invention, harm economic growth, and lower living standards for all Americans (Cook and Kongcharoen 2010; Cook and Yang 2018; Cook 2020). They also

provide a disincentive for future inventors. If you tell a Black child that all the Black inventors are long deceased and there is no replacement for them, why would that child imagine becoming an inventor?

The historian who commits to changing this narrative—a task that involves retrieving, collecting, and interpreting comprehensive data on Black creativity and invention in the United States—faces significant challenges. Cook spoke candidly about her experiences in the academy, noting the misunderstandings, barriers, and condescension she has encountered both because of her subject matter and because of her race. Her work to identify more Black inventors and patent-holders has entailed years of labor that conventional university performance metrics do not always adequately measure. Someone once told her that she would never receive tenure if she focused on Black and women inventors. **“Nobody is interested,” a colleague said.** So how can historians committed to this field move forward? Correcting gaps in the narrative about Black inventors requires persistence; it also demands deep immersion in patent data. Locating information and stories that unfolded outside the patent office remains important, also.

In a related manner, Fouché encouraged webinar participants to expand their definition of invention so that it includes Black vernacular technological creativity (Fouché 2006). We need, he maintained, to **acknowledge and highlight Black uses of technology for agency and resistance**, rather than simply focusing on how the dominant White narrative—or the dominant technology of a given era—excluded or actively oppressed Black people. He gave the example of Grandmaster Flash, one of the inventors of hip-hop, who took devices designed for audio playback and remade them into musical instruments. **If we can see Thomas Edison as an inventor, we should see Flash as an inventor, as well, even though Flash earned no patent.** Redeploying, reconceiving, or recreating with existing materials constitutes an act of creation, Fouché argued, and warrants recognition as such.



Grandmaster Flash (Joseph Saddler) at the turntables, 2014. Victor Frankowski / Southbank Centre via [Wikimedia Commons](#).

Cook affirmed this observation, noting its importance within informal educational settings such as Spark!Lab at the Lemelson Center. Skill building in an accessible environment or informal educational space can provide support beyond the traditional classroom and can share little-told stories with children in new and different ways. After all, children who are exposed to invention and innovation are more likely to feel like they can become inventors themselves. Yet the opposite is also true: Black children—and children from low-income households in general—can become “lost Einsteins” if they fail to see examples of inventors who remind them of themselves (Bell, Chetty et al. 2019).

Myths about “famous” Black inventors are costly and should be debunked because they suggest that Black invention is a thing of the past.

—Lisa D. Cook

For the historian of innovation, then, the task is not only archival and retrospective; it is also ethical and future oriented. Retrieving the stories of unknown or little-known Black inventors is “a labor of love and justice,” Fouché observed. When people say that America was born of a uniquely inventive spirit, we might ask ourselves: what do they mean by this claim? Fouché quoted from poet Gil Scott-Heron’s spoken-word poem of 1970, “**I can’t pay no doctor bills but Whitey’s on the moon,**” a searing commentary about what American society valued most at the time (Scott-Heron 1970). What gets invented—and what we valorize *as* an invention—says a great deal about who we are and what we believe in as a society.

Panelists recommended the following opportunities to create change:

- For historians or researchers interested in stories of Black invention, consider searching more broadly than the usual parameters. Dig beyond the directories; broaden patent research to include interference cases, contract disputes, and infringement cases. These are public records and can tell a story about a struggle for ownership of an idea (Cook 2014).
- Historians should also consider researching Black inventor networks. Black creators did not (and do not) work in a vacuum; they engaged with others who might have been inventors themselves. Research relationships within HBCUs; search for oral histories; contact Black churches and social/service organizations for clues and resources. Consider systematic studies to find more Black inventors—for example, by exploring geographically-based communities of invention, or the history and records of chemistry faculty members at HBCUs.
- For university deans and administrators, support Black invention and innovation by increasing funding for Black STEM faculty seeking early-career grants, which are associated with patenting. At the highest level, strategies that hold university leaders accountable for the progress of Black faculty members could serve as useful and robust incentives for positive change.
- For CEOs and business leaders, prioritizing diverse teams has been shown to produce more ideas and better results for all—which means that diversifying your team is a win-win for everyone involved (Page 2008; Hewlett, Marshall, and Sherbin 2013; Herring and Henderson 2015; Page 2018). Corporate leaders and/or state legislators would do well to hold individual firm supervisors, CEOs, and board members accountable for diversity measures and for the progress of Black team members within innovation companies. California, for example, has required that a woman serve on the board of every publicly traded company. Racial diversity expectations could similarly be put in place for boards.
- For potential inventors within the academy, find interesting people in the university—and outside it—who are willing to experiment intellectually. Find the right partners to inspire constructive collisions (dynamic collaborations and interdisciplinary learning). Build those relationships—that's where creativity lies!

Session 2

PIPELINES and PATHWAYS: INVENTION EDUCATION, TRAINING, and MENTORING

James Holly Jr.

Assistant Professor of Urban Science, Technology, Engineering & Mathematics Education, Wayne State University

Amy E. Slaton

Professor, Department of History, Drexel University

Moderator:

Yolanda L. Comedy

Science and Technology Policy Consultant

Over the last forty years, organizations such as the American Association for the Advancement of Science (AAAS) and the American Chemical Society have built programs aimed at supporting diversity among their members.

Black technologists have established their own institutions—including HBCUs, the National Society of Black Engineers, and Black Girls Code, among others—to forge additional pathways to technology careers. Yet efforts to diversify the STEM workforce have enjoyed only modest impact, as Black scientists, engineers, and inventors continue to be underrepresented at every stage of the invention process, from STEM education to high-tech employment, from patenting to commercialization. Why have these endeavors fallen short, and what might be done to change the outcome? In a wide-ranging discussion that focused on universities and briefly touched on preK–12 education, webinar panelists identified four core reasons why pipeline diversification efforts have not yet achieved full success and explored strategies for turning the tide.

To begin, efforts to diversify STEM have not fully succeeded because **scientists and engineers have failed to tackle racism itself as a problem that demands a creative solution**. As panelist James Holly Jr. observed, engineers typically see themselves as problem solvers but tend to focus on technological problems at the expense of human-centered problems. More specifically, engineers have not adequately applied their formidable problem-solving skills to the question of racism in their own ecosystem. How does one innovate for equity? How might engineers build more diverse teams whose members, in turn, create and design products more effectively? These questions are not separate from the engineer's task, Holly Jr. argued, but part of it. Until STEM experts demonstrate a sustained willingness to tackle inequity within their own fields—a problem that requires brainpower, resolve, and ingenuity to solve—we will not see the type of diversification numbers needed to make STEM a truly equitable environment.

A second reason why diversification and equity efforts within STEM have fallen short involves leadership at the highest levels. Panelist Amy Slaton argued that diversification endeavors have not achieved sufficient gains because **universities, scientific organizations, and legislatures must implement STEM policies mandating equity from the top down**. Leadership actions count far more than leadership statements of empathy or good will, she observed. The responsibility for supporting the next generation of Black inventors and engineers should not lie solely or even primarily with individual professors and teachers, who lack the power to force systemic change (although, to be sure, those individuals can be powerful forces for good in a student's life). Structural change is required, that is, policy mandates and commitments at an institutional level. Leaders in positions of power within the academy, including university presidents, must do more, Slaton urged, to step up and make the case for equity—and then follow up with actions that go beyond establishing DEI offices. Those institutional programs

function, in part, to make White people feel more comfortable, Slaton explained, encouraging racial reconciliation without addressing the sweeping changes that could make a tangible difference for marginalized people. White people need to be *less* comfortable, she concluded, as they fight against inequities in the innovation arena.

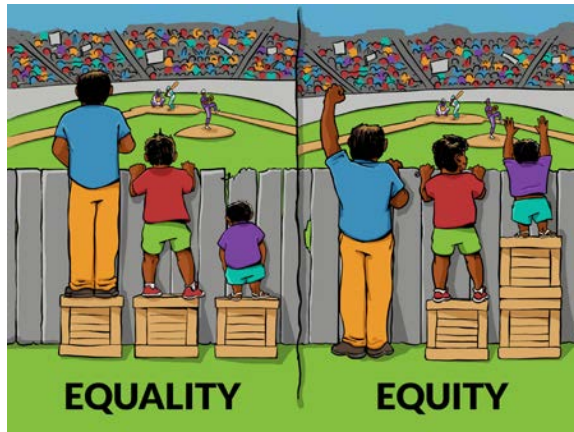
A third reason why diversification efforts have not achieved full success involves contributing factors from beyond the academy. **Centuries of entrenched racism and exclusionary policies have created enduring structures of inequality and disenfranchisement**, Holly Jr. noted in his remarks. Sharing his personal story, he observed the discrepancy between what people from his hometown of Detroit thought he ought to do with his engineering degree—namely, get a good, stable job, at Ford Motor Company, for example—and what his own aspirations quietly included: a career focused on youth development, helping urban Black youth achieve full expression of their gifts and capacities. He described the ongoing tension to reconcile two sets of priorities: his family background, which urged him to pursue survival and feeding one's family, and his personal aspirations, which summoned him to a vocation that included more creative risk taking and innovative pursuits (Holly Jr. 2020a, Holly Jr. 2020b). A new Black lens is called for, he argued, one that understands both the inherent creativity or drive within Black youth today and the realities of poverty, violence, and exclusionary practices that too often stifle creativity (Holly Jr. 2018; Engineering Education Research Briefs 2020). Because of their circumstances, many of these bright young people cannot imagine or see themselves as the next inventor, the next creator or problem solver; they simply stop trying. Indeed, Holly Jr. continued, many of these young Black men and women will never receive a degree, never land the R&D job, and never enjoy the opportunity to innovate and repair what might be broken in their communities. When we talk about why STEM diversification efforts have fallen short, we cannot ignore this larger socioeconomic reality, **a glaring lack of opportunity that can extinguish creativity before it has time to take root and germinate** (McGee 2020).

A fourth reason why efforts to diversify STEM have not achieved full success turns on a familiar big-picture question: **how do we define invention and innovation? Slaton pointed out that we should be asking *who* is invention, and *who* is engineering**, because these words are historically situated—that is, rooted in American, largely White, industrial and capitalist values. These words take their meanings from a stratified and inequitable society that on the surface offers opportunity but in reality perpetuates differences, including racism and sexism. The implication? While we can certainly redefine invention more broadly as simple creation, and while we can expand our notion of innovation so that it includes modifying or doing something in a new way, both terms remain freighted with ideological undercurrents not easily excised from conventional Western—and White—thinking. Industrial and profit-driven systems have failed to recognize many of the contributions of Black and other marginalized peoples as inventions, Slaton and Holly Jr. both pointed out. These systems have simultaneously failed to address or acknowledge the very real power differential that has historically controlled who is and is not allowed to create in the United States.

Pushing back against these damaging legacies, Holly Jr. engages his students by asking them to **think about what Black innovations can be identified within Black culture**—the Underground Railroad, soul food, the Black church, African American vernacular English (AAVE), and other dynamic ways of thinking and knowing that we sometimes forget when we talk about invention. These innovations all share certain traits in common. They make the most of limited resources, they emerge from needs within the community, they operate under oppressive structures, and they support resistance and survival. While we often pair invention with the idea of something new or changing, many Black creators, Holly Jr. explained, have applied their formidable creativity to enriching and deepening what already exists—that is, to what already possesses value within their heritage. **An Afrocentric notion of innovation thus includes the idea of cultural expression to meet specific needs within the community**, and it defines problem-solving, at least in part, as a communal endeavor. Rejecting the centrality of instrumental or economic outcomes, this Afrocentric understanding asks what the impact of a given invention might be on vulnerable humans and on the Earth—a question Indigenous peoples have also asked for centuries. **How do we use what we already have?** And why do so many people assume that the only inventions that matter are new or novel ones (Wisnioski, Hintz, and Kleine 2019; Vinsel and Russell 2020; Godin and Vinck 2017)? It is worth exploring, Holly Jr. suggested, how such valorizations of what is new, novel, and profitable function to perpetuate existing privilege and power systems.

An institutional commitment to measurable action—whether reparations, restorative justice, or affirmative action—remains essential to STEM diversification.

Given these challenges, what can be done to encourage change in the right direction? The task should not be left to individual teachers or faculty members, Slaton stated, who are often doing as much as they can already. System-wide or structural reforms are needed—and more specifically, **changes to the incentive and accountability structures in the academy and in workplaces**. DEI initiatives should do more than merely assuage White guilt, Slaton proposed: they need to be linked to decisions and measures that offer tangible support—grant funding for Black STEM faculty, publication support, and help with patenting processes. Administrators could offer these aids not only out of good will but also out of self-interest, for evidence has shown that diverse teams produce better outcomes (Smith and Schonfeld 2000; Gurin, Biren, and Lopez 2004; Roberge and Van Dick 2010). Slaton gave the example of NASA tailoring its grant program to accommodate the specific needs and historic positioning of HBCU grant applicants, with significant positive results (Slaton 2010). **An institutional commitment to measurable action—whether reparations, restorative justice, or affirmative action—remains essential to STEM diversification.**



To promote greater equity and inclusion, institutional interventions must be sensitive to the specific circumstances of the diverse communities they serve. [Angus Maguire](#) for the [Interaction Institute for Social Change](#).

Such a commitment would not be a handout and would not represent a lowering of “standards.” Indeed, appeals to standardization and meritocracy have always been freighted with exclusionary practices, Slaton said. Instead, institutional commitments of this type could serve as an acknowledgment that creativity and ingenuity take multiple forms and evolve along a path that includes historic disparities uniquely affecting the Black community. We need *all* voices in the innovation sphere to begin tackling the environmental, social, and health challenges of the coming generation.

Both Holly Jr. and Slaton agreed that individual teachers should not have to bear the burden of increasing STEM diversity rates. However, they also argued that **those who are engaged in STEM education should invite the whole student into the classroom**—including acknowledging and engaging their experiences of racism, suffering, and embodied knowledge. Programs that recruit and invite Black students into STEM fields often implicitly require these students to leave aspects of their identity at the door. This subtle (or not so subtle) messaging can make it difficult for Black students to bring their knowledge and ideas into the classroom, because that knowledge comes with lived experiences they might not be comfortable sharing. For preK–12 classrooms in particular, Holly Jr. and Slaton noted, instructors should work to recognize and honor differences in learning styles wherever possible. There is no “one size fits all” approach to teaching creativity and critical thinking. Appeals to merit and requirements of standardized testing should be critically reexamined at a national level.

Both panelists concluded that outcomes will not change significantly in the STEM arena until more leaders in the invention and innovation domains learn to see the problem differently—and **redefine what problems need addressing**. We need to rethink what types of change we are willing to count as progress, Holly Jr. said. In engineering design, framing the problem is critical to one’s future success, and it is just as critical to success in the movement to foster equity in STEM settings (Slaton 2010; McGee and Robinson 2020).

Panelists recommended the following opportunities to create change:

- Within preK–12 education, teachers, administrators, and policymakers could advocate for more inclusive ways for students to demonstrate their knowledge. Race-positive STEM curricula serve as helpful resources here, including the example of Michigan State University and the utilization of Indigenous knowledge systems (Lachney 2017; Lachney et al. 2019; Eglash 1999). Teachers could make it a practice to ask what the student brings to the table, rather than starting out by asking what the student lacks. Instead of taking a standardized test, for example, what if Black students could use a more expressive form of communicating the knowledge they have gained?
- Within higher education, university leaders could take a closer look at the labor and socioeconomic conditions experienced by Black employees (including adjunct faculty) and graduate students. Better labor standards would support Black and other marginalized faculty struggling for stability, as would recognizing the real-world issues that employees and graduate students regularly face.
- For deans and provosts, consider challenging the divide between what counts for tenure or for success academically (publication, grant funding, patents) and what community members often ask Black STEM faculty to provide (engagement, solutions, time). The academy's incentive system would benefit from more support for community-centered practice—innovation practiced on the ground in real time.
- For funding agencies, consider ways to make grant programs more agile and sensitive to institutional differences, especially at HBCUs. Building in accountability structures could help ensure that robust diversity is part of a university's requirement for receiving grant funding. Some philanthropic organizations are starting to fund projects that encourage university-community partnerships around reparations: these could be a model for other funders.
- Museum professionals and textbook writers could explore Black inventors' visibility *and* invisibility—that is, make the processes of representation and erasure part of what is curated or studied. Similarly, they could research the *lives* of Black inventors, not just their inventions or invention narratives. Understanding the complicated stories of Black inventors enhances our understanding of their contributions; it also prompts us to ask who is valued and what has value—essential questions for broadening the historical conversation.

Session 3

BLACK INVENTORS and INNOVATORS at WORK

Tyrone Grandison

Chief Technology Officer, Pearl Long Term Care Solutions

Tahira Reid Smith

Associate Professor of Mechanical Engineering, Purdue University

Moderator:

Monica M. Smith

Head of Exhibitions and Interpretation, Lemelson Center for the Study of Invention and Innovation, National Museum of American History

Throughout the history of US technology, Black inventors and innovators have developed pioneering inventions, from Elijah McCoy’s automated lubrication system for locomotives (“the Real McCoy”) to Grandmaster Flash’s turntables and mixers.

Along the way, they have navigated challenges at work and in the marketplace. Panelists Tyrone Grandison and Tahira Reid Smith discussed their respective journeys from creative children to accomplished inventors, sharing the support they received and the obstacles they faced along the way. Reminding webinar participants that every child possesses inherent creativity, Grandison persuasively stated, “Every child you interact with is an inventor in the making. Treat them as such.” This session also considered strategies for diversifying the high-tech workforce and for building workplace cultures that provide meaningful support to Black inventors.

Grandison grew up as an imaginative and shy child who wanted to solve problems in his community. He thrived under the support of caring adults and mentors who encouraged his confidence. Grandison described the impulse to create as something that emerges from an experience of dissatisfaction. He invents because **a given problem troubles him so much he cannot let it rest**—he feels compelled to devise a solution. Often the problem he identifies derives from constraints he finds himself living within, so that his life experience shapes both the initial question and the invention process that follows. These experiences include Grandison’s specific journey as a Black inventor navigating discrimination and bias. He recalled encountering people who discounted his potential and organizations that dismissed his insights before they belatedly recognized the value he brought to the table.

Grandison’s latest invention is a technology platform to help people find long-term care options for loved ones. He shared the development of Pearl Long Term Care Solutions as an example of his creative process, which began with the identification of a problem: how to find a long-term care facility for a senior relative, a process that is often confusing, time-consuming, and frustrating. **He then noted the constraints** aggravating the problem: the existing referral model is terrible, the long-term care provider space is not standardized, and costs can be prohibitive. Next, **Grandison applied his personal experience** (trying to care for senior relatives) to the problem. As a solution began to take shape in his mind, he took steps to define what a viable plan should look like. How could a new technology platform focused on senior care referrals create value for people in his community? The result—a user-friendly booking platform built on trust and empowerment between consumers and providers—is currently in the patenting process.

But inventors do not create in a vacuum. Grandison noted how important it is to **build high-trust, inclusive cultures and innovation teams within the invention workplace.** We need teams that are truly diverse and provide high levels of psychological safety, he maintained, pointing out times he has participated in workplace environments that discounted his own gifts and ideas. In the absence of acceptance and trust, creative people cannot create, at least, not to their full potential. Accordingly, those engaged in the innovation ecosystem, whether educators, inventors, or investors, should consider moving to a “liberation model,” Grandison suggested, one where inventors can create without fear or discrimination for the sake of a more equitable future (Grandison 2018).

Reid Smith similarly called for a “systematic liberation of Black creative thought” as she shared her journey into invention and academic engineering. As a third grader, she conceived of an automated Double Dutch jump rope machine: she loved that neighborhood game and was frustrated that she could not play it by herself when her friends weren’t around. She came up with an inventive solution—and won a poster contest for her idea. Years later, in college, she received support for her childhood plan from a professor named Burt Swersey. Like Reid Smith, Swersey was from the Bronx, so he understood the cultural significance of Double Dutch and the potential of Reid Smith’s project. He made the classroom a safe place for her to experiment and think outside the box, encouraging her to take her design to the next level. In 1999, Reid Smith received a patent for her automated Double Dutch machine. She went on to receive national coverage for her invention (Riordan 2000).

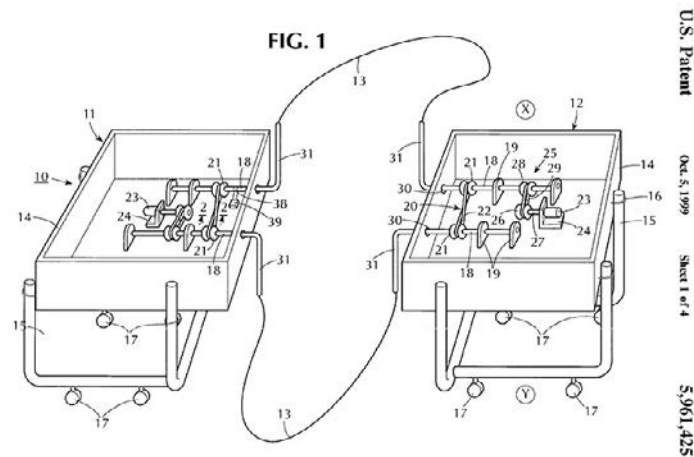


Figure 1 from US Patent 5,961,425, “Jump Rope Device,” issued to Tahira Reid in 1999. USPTO.

Today, as a mechanical engineer and tenured faculty member, Reid Smith pursues her research and teaching with an eye toward her lived experiences as a Black woman. **She applies her engineering training to aid the Black community** and has done so since graduate school. During her PhD program, she began researching new methods of hair care for Black women that could minimize heat damage and provide a close analysis of component interaction for hair products. When she completed her PhD and took her first academic job, colleagues advised her to wait to research Black women's hair products until she had earned tenure. "But I think this helped me *get* tenure," she said, reflecting on those conversations. "I'm a Black woman, I'm an engineer . . . I see the world differently." Today, in her classroom, the hair salon becomes an opportunity to teach engineering principles and their real-life application, with the styling chair offering lessons in hydraulics and mechanisms, the hair dryer exemplifying thermodynamics, the curling iron demonstrating heat transfer, and combs and conditioners offering lessons in friction (Fu et al. 2013; Seshadri and Reid 2015; Hahn et al. 2015; Hahn et al. 2020).

"I'm a Black woman, I'm an engineer . . . I see the world differently."

—Tahira Reid Smith

Both Grandison and Reid Smith drew from their personal experiences to identify problems, acknowledge constraints shaping those problems, and create solutions that make a difference for their communities. What can others do to support this type of innovative work? More specifically, how do we create workplace cultures that better support Black creativity? First, they suggested, we can look for ways to **make the engineering classroom—and the workplace—a genuinely welcoming environment**. Teachers should be encouraged to invite students into the classroom as they are, Reid Smith said, with their full selves and their complicated array of life experiences. This commitment to a welcoming atmosphere holds just as true for the workplace. We need to do everything we can to make these spaces genuinely inclusive and safe, Grandison noted, so that Black innovators can work without anxiety or mistrust, both of which can hamstring creativity.

Fostering a culture of Black creativity also means mentoring. **Good mentors can help children see themselves as capable of creating something meaningful and useful**, both panelists said. Every child possesses natural curiosity and creativity, but as the years pass, that inherent imagination can be dimmed or even suppressed. Grandison noted a study that found **creativity has decreased among American children in recent decades**: since 1990, children have become less able to produce unique and unusual ideas, and they are less imaginative (Kim 2011). Where Black children are concerned, the challenges can loom even larger. Disparities and bias within the educational system can lead Black children to doubt themselves, forfeiting their natural creative energies before having had a chance to test them in the world.

And although Grandison recalled being shy as a child, there was always *someone*, he added, often a teacher, who saw his potential—who glimpsed possibilities for his future that he couldn't yet see for himself. His parents also believed in him and wanted to see him succeed academically. "People paid attention," he said. In a similar way, Reid Smith remembered being singled out for positive encouragement as a student. Even in elementary school, she always seemed to have at least one teacher who noticed her work, offering specialized attention and encouragement. When she met Swersey, her undergraduate engineering mentor, she began to understand that becoming an inventor was a real option for her future. And by "paying it forward," or coaching and mentoring their own students and team members in later years, this cycle of positive change continues. Good mentors can make all the difference for children who exude that creative spark but don't yet know or believe what might be possible for their lives.

Mentors alone, however, are not enough to narrow the innovation gap. Reid Smith put this problem succinctly: "**There will not always be a Burt Swersey in the classroom.**" Policies and systems must be put in place, both panelists stated, so that supportive measures do not depend on individual goodwill alone. These structural supports need to be built in from preK programs through graduate education. Standardized testing remains limited in its ability to measure and encourage inventive thinking and creativity in the preK–12 arena, Reid Smith observed; consequently, school administrators should consider more inquiry-based learning models to supplement or replace standardized measures, which can hinder some children from reaching their potential. Within higher education, deans and presidents should work to implement policies that prioritize equity and liberation. Faculty can also go about this work on their own, of course: Reid Smith described the formation of a group of Black engineering faculty shortly after the May 2020 killing of George Floyd. This group's members have put out a call to action for sustained anti-racist work in STEM workplaces and at research universities. Black STEM faculty and inventors are "survivors," Reid Smith stated, "who happen to still be here, and we're thriving, but not widely enough."

Both Grandison and Reid Smith described the experience of being labeled a "unicorn," or that "rare" Black person, endowed with extraordinary talent and abilities, who somehow manages to succeed despite the odds. This labeling experience is frustrating, they said, because while the term does suggest the enormity and difficulty of the challenges successful Black individuals have overcome, it can also be used to minimize those same challenges—especially when someone asks, "You did it; why can't person X (or your race in general) do it, also?" Grandison stated that **he no longer engages in the "unicorn conversation"—it is simply not worth it, he explained.** As a form of argument reflective of White fragility (DiAngelo 2018), the unicorn conversation has no positive practical outcome.

In considering the inequities written explicitly into the US Constitution, Grandison concluded that the American experiment was not designed for Black people or for women. Today, the work of building a more equitable innovation ecosystem must not be left to hearts and minds alone. Policies and standard practices must take priority. "I prefer to correct the system," he said, "to legislate better behavior through policy."

Panelists recommended the following opportunities to create change:

- For teachers, remember that every child you interact with is “an inventor in the making.” Pay special attention to that child who might be shy but has good ideas and a desire to create; consider inviting that child to participate in a research project or other special opportunities. Recognizing that children are the sum of their life experiences, encourage students to bring those lessons and experiences into the classroom. (This opportunity also holds true for inventors’ workplaces.)
- For university deans, department chairs, and other higher education administrators, consider how to support STEM faculty engaged in culturally relevant, community-focused problem-solving. This support could entail rethinking incentive structures, so that projects about Black hair care and Double Dutch are valued and counted within the tenure process. Encourage partnerships with community members outside the university, as well, for they can bring much-needed knowledge and context to academic DEI efforts.
- Within the broader innovation ecosystem, business owners could focus on building high trust, high safety workplaces and durably diverse teams. Prioritizing empathy and transparency from the top down helps build stronger teams and better products. Encourage team members to talk about their mistakes and questions—creativity can flourish within this type of accepting environment.
- For corporations and potential funders, consider increasing funding for invention ideas and programs that help Black communities. Corporations with such investments in the innovation arena will have more credibility when they talk about diversity as part of their broader communications. The decision to invest does not have to be based on profit alone: are there ways to balance the need for profit with the desire to solve problems that are not about the bottom line?
- For curators and archivists, consider ways to scale up efforts to document the history of Black inventors, such as the “Recovering Diverse Voices in the History of Invention” initiative at the Lemelson Center. Brainstorm ways to showcase more stories of Black inventors (this also requires work to find those narratives) and to share them widely, especially with children. Create new opportunities for children and living Black inventors to have conversations.

Session 4

COMMERCIALIZATION and INSTITUTIONS

Shontavia Johnson

Associate Vice President for Entrepreneurship & Innovation, Clemson University

Kara W. Swanson

Professor of Law and Affiliate Professor of History, Northeastern University

Moderator:

Crystal Marie Moten

Curator of African American History, Division of Work and Industry, National Museum of American History

How have Black inventors and entrepreneurs navigated the patent and commercialization processes in the United States?

If you had walked into the display room of the US Patent Office in the nineteenth century, you would have come away thinking that White men were the only inventors in the country. Both before and after the US Civil War, Black Americans faced barriers to accessing the patent system. Enslaved inventors were unable to receive patents, leaving their inventions to be patented by their enslavers or to circulate without patent protection. At the same time, some free Black inventors purposefully concealed their identities to avoid prejudice at the Patent Office and in the marketplace. The challenges have changed since then, but obstacles remain. Panelists Shontavia Johnson and Kara W. Swanson considered how institutions within the invention ecosystem have responded to Black inventors past and present. They also explored contemporary Black entrepreneurs' access to networks of capital and expertise and asked what reforms might be needed to improve patenting and commercialization rates for Black innovators moving forward.

Opening with an overview of the US Patent Office and its history, Swanson explained that **the patent system historically has hidden or erased Black invention**. The antebellum Patent Office denied patents to enslaved Black people, and Whites routinely appropriated and stole the patentable ideas of the Black persons they had enslaved. As Swanson noted, it is important to distinguish between the formal legal barrier issued in 1858 that denied enslaved people the right to patents and the reality—long predating the 1858 statement—that systematic and widespread barriers to patenting existed well beyond the patent office. To date, no enslaved person is known to have sought out a patent—though given the wide range of their experiences, Swanson observed, it is theoretically not impossible that someone might have done so. And while free Black people, at least in principle, *could* obtain patents, the process remained fraught with difficulties, leading some inventors to obscure their own identities to avoid prejudice. Black carpenter Henry Boyd invented a bedstead in the 1830s but chose to hide his role, for example, by allowing a White man, George Porter, to pretend to be the inventor for the purpose of securing a patent (James 1990). Similarly, Black inventor Ellen Eglin reportedly sold her clothes wringer design to a White investor, who commercialized it (Smith 1891). Even when Black inventors did overcome discriminatory barriers and obtained patents in their own names, the records in the Patent Office remain silent as to the racial identity of the named inventors (Baker 1902; Baker 1913). Despite the ongoing Herculean efforts of researchers today (Cook 2007), we will never know the full extent of Black invention and creativity in the history of North America.

While it erased or hid Black identities, **the patent system also helped reveal and draw attention to Black inventors**. Swanson here observed that White supremacists had long believed Blacks lacked the capacity for original thinking and could only imitate, and they had used this argument to deny Black people the right to vote. But early civil rights activists turned

this claim on its head, holding up examples of Black patentees as government-certified proof that Black people could indeed think independently.

From this perspective, then, the patent system functioned as a powerful refutation of arguments that sought to deny Black people voting and other civil rights. Patents provided evidence that a given individual was capable of original thought and had contributed to society. **In the hands of civil rights activists, patents served as tools of persuasion**, Swanson argued, helping Black people gain ground in the struggle for equity, respect, and economic opportunity. She pointed out how W. E. B. DuBois and his employer, the National Association for the Advancement of Colored People (NAACP), put their energies behind Henry E. Baker's *The Colored Inventor* (1913), a pamphlet discussing the history of Black inventors in the United States. They understood just how persuasive these examples of patentees, however incomplete, could be in the argument for Black equality (Swanson 2020).

More recently, Patricia Carter Sluby, a Black chemist and former USPTO employee-turned-researcher, spent decades working to identify Black and woman patentees—critically important work that she undertook so that the world might learn “of African American problem solvers who beat the odds and turn obstacles into opportunities” (Sluby 2004; Sluby 2011; Swanson 2020).

The patent system thus served both to hide *and* to reveal Black invention, Swanson stated: it both hindered *and* helped efforts to achieve civil rights and equity. Even today, she added, a link can be drawn between patents and civil rights, as what it means to be American is debated within national immigration discussions. **The ideal American continues to be associated with the trope of inventiveness** (Akcigit, Grigsby, and Nicholas 2017; Bernstein et al. 2019). She concluded that any meaningful reforms to the patent and commercialization processes must keep in mind both the obstacles that patenting has posed to Black and other marginalized inventors *and* the difference that patents have made by allowing many of these same inventors to be seen as models of their race or demographic group, summoning White institutions and powerbrokers to grant these communities their due civil rights.

Panelist Shontavia Johnson opened with a story about her grandmother, one of the many Black Americans who invented without a patent. As the mother of twelve children, Janie Williams Jackson designed and made teething necklaces for babies, helping to solve a parenting challenge that she and other mothers regularly faced: teething babies in pain. **Commercialization was not her goal when she invented these necklaces**, Johnson recalled. Jackson just wanted to solve a common parenting problem.

Johnson offered this example as an entry into a discussion of the commercialization process as Black inventors today experience it. How we define invention, innovation, and commercialization affects who is perceived as an inventor and which communities receive support and investment. Noting that the Department of Commerce in her own state of South Carolina defines innovation as “the relentless pursuit of transformational ideas,” Johnson suggested that traditional definitions of these terms could benefit from expansion or revision. The Lemelson Center's definitions are not above criticism, either, she noted.

“To invent is to create a unique material, device, process, or method; to innovate is to answer an important customer or societal need. An invention is a way of doing something differently, while an innovation is a way of scaling up one or more inventions in a way that creates value.”

From the Lemelson Center’s Strategic Plan, 2016–2020, p. 4.

What do definitions like these mean for a woman like Janie Williams Jackson? Not enough, Johnson suggested. With their focus on creating value, these definitions—and the Western capitalist assumptions that underlie them—tend to obscure the contributions of inventors who created, designed, and produced not for profit (or not primarily for profit) but to help their communities survive. Innovation defined in a narrowly capitalistic sense is not just expensive and inequitable, Johnson argued. It also leaves us with a limited definition of what counts as a societal contribution and of who should be regarded as creative or entrepreneurial.

Even when we define innovation in more expansive terms—one definition might be “an answer to an important customer or societal need,” Johnson suggested—Black entrepreneurs still encounter roadblocks when they seek to commercialize their inventions. Lack of representation is one barrier. **Only 1.7% of all intellectual property (IP) attorneys in the United States today are Black** (American Intellectual Property Lawyers Association 2019). Black inventors will likely have difficulty finding an attorney who understands the cultural realities they face or fully appreciates the value of inventions inspired by lived Black experiences. Within the venture capital arena, Johnson continued, Black entrepreneurs are dramatically underrepresented as well. **Just one percent of venture capital-backed company founders are Black, and Black women receive even less: only .0006% of all venture capital funding between 2009 and 2017 went to Black women**—even though they provided a high return on investment (Kniggendorf 2019; Digital Undivided 2020). Clearly, more intersectional data in this area is needed. Johnson noted that while she can find innovation data about Blacks and about women, data on Black women and their unique experiences are harder to come by and represent a major gap in current analyses.

The patent numbers at universities do not paint a rosier picture. Between 1969 and 2012, HBCUs received a total of just 101 patents combined. By comparison, the University of California received 524 patents in 2017 alone (ThePLUG 2019). Diversity metrics for scientists and engineers at high-tech firms such as Google and Microsoft are similarly dismal, Johnson observed (Nager et al. 2016; Cook 2019). At every stage of the commercialization process, Black entrepreneurs face lack of representation and disparities in opportunity.

A related roadblock is cost. As Johnson pointed out, innovation in the twenty-first century is expensive. For both phases of commercialization (phase one: invent and protect; phase two: manage, exploit, and police), costs can rise prohibitively high, discouraging inventors who lack access to capital. **The average cost from start to finish for a solo-individual invention in Phase 1 is nearly \$60,000. For a corporation or large entity, the cost is around \$120,000** (American Intellectual Property Lawyers Association 2015). Some support is available for inventors who make it onto the faculty at major research universities, where technology transfer offices can provide aid; but becoming a faculty member at one of these institutions is a highly selective and competitive process, out of reach for all but the most elite and well-connected candidates. Within phase two, the average cost to start a new small business is \$30,000, another potentially prohibitive amount (Scott 2009). Additional costs accrue along the way, adding to the financial burden. And inventors who must defend their IP in court face almost insurmountable financial burdens: **the average cost of patent infringement litigation in 2019 was between \$700,000 and \$4 million**, according to the American Intellectual Property Law Association.

Historically, the patent system served both to hide and to reveal Black invention. It both hindered and helped efforts to achieve civil rights and equity.

–Kara W. Swanson

The one place where financial support for commercialization *does* exist, Johnson noted, namely the venture capital (VC) arena, does not provide sufficient help to resolve the broader disparity. The VC field remains focused on profit above other measures of success, with most funders seeking projects that have the potential for 100 or 1,000 times the return on investment (ROI). **This focus on extreme ROI means that Black inventors with community-focused inventions attract few funders.** Exceptions to this trend exist, of course; Johnson noted Magic Johnson's investments in the technologies of Black inventors, as well as his work planting Black-owned entrepreneurial businesses in Black neighborhoods. But funding gaps continue to pose obstacles to many Black inventors across the commercialization spectrum.

What can be done? Panelists agreed that **reparations should be part of some discussions about barriers to commercialization.** Johnson and Swanson noted that the patent and judicial systems allow us to ascertain with some accuracy how much money the Black community lost when their inventions were stolen or otherwise appropriated. A conversation about reparations could begin with the acknowledgment that putting a price on historical inequities is, at least in the patent space, truly possible. "We can calculate the dollar value of that technology," Johnson said.



An 1860 advertisement for the “Stuart Double Plow and Scraper,” which plantation owner Oscar J. E. Stuart appropriated from his enslaved blacksmith, Ned. *Oscar J. E. Stuart and Family Papers, Archives and Records Services Division, Mississippi Department of Archives and History.*

Swanson gave the example of “the NED project,” a student-led restorative justice effort at Northeastern University Law School. In the 1850s, slave owner and Mississippi lawyer Oscar Stuart tried to obtain a patent on a double cotton scraper invented by his enslaved blacksmith Ned. Attorney General Jeremiah Black denied Stuart’s claim, building from the Dred Scott decision of 1857 to argue that “a machine invented by a slave cannot be patented.” Stuart still profited from Ned’s invention, advertising it as the “Stuart Double Plow and Scraper” and putting it on sale for \$40 per plow (Johnson 2017; Frye 2018; Johnson 2019; Swanson 2020).

What would restorative justice look like for blacksmith Ned’s legacy? We could explore awarding a posthumous patent to Ned, Swanson suggested: this gesture would have symbolic importance but would not help the Black community in a material or concrete way. Or we might think, instead, about a reparations fund for contemporary marginalized inventors in the community. This money could provide tangible help with patent and commercialization costs.

Johnson voiced her support for reparations discussions in these instances as well, noting that the theft of intellectual capital is one area where restorative justice could be an idea whose time has come. We need to begin thinking about how to award grants or funding back to the Black community in the invention space, she said. But the process will never be simple. Inequities past and present continue to dominate the innovation ecosystem, and sometimes the search for justice can seem overwhelming.

Johnson concluded by advising webinar participants to “pick a struggle,” that is, to take on just one part of the larger battle for equity and see that one goal through to fruition, building from your personal passion. **Achieving lasting equity is a monumental task, she said. “But you eat an elephant one bite at a time.”**

Panelists recommended the following opportunities to create change:

- For thought leaders and scholars in the invention arena, think about expanding definitions of “invention” and “innovation” so that these terms are not solely bound to patents, efficiency, and the bottom line. Include more vernacular knowledge in the discussion, as well as engagement with marginalized communities—Magic Johnson’s investments in Black-owned businesses offer examples of what might be done to encourage more inclusive understandings of invention.
- Funders in the innovation space could revisit what scalable entrepreneurship looks like and how success might be newly measured. Venture capital firms have figured out how to fund unpatented inventions in software and blockchain technology; they should be able to invest in unpatented community-based inventions, as well.
- For researchers and scholars of invention, consider ways to collect more data on Black inventors and their contributions, including demographic and intersectional data on patent applicants, patent examiners, patent attorneys, judges, venture capitalists, and start-up founders. Measure who receives—and does not receive—venture capital dollars.
- Once collected, this type of data could be used to encourage legislators and corporate leaders to devise regulatory frameworks and incentive structures that funnel more venture capital dollars to Black inventors. Deploying this aggregate data carefully at the firm and institution levels would help ensure equity and accountability while encouraging company safeguards and preventing discrimination in individual patent cases and other funding decisions—all within the rapidly changing commercialization space.
- For business leaders and CEOs, consider the intersectional challenges and issues within your employee culture—including the experiences of Black women, immigrants, LGBTQ+ individuals, people with disabilities, and more. Diverse teams produce better ideas and outcomes, so embracing greater inclusivity makes good business sense while helping address equity issues.
- More broadly, for leaders and investors at every stage of the commercialization process: consider how to create or strengthen your own DEI incentives and accountability measures for the institutions you support or oversee. This suggestion applies equally to university technology transfer offices, research and development corporations, venture capital firms, and philanthropic funders. The potential for earning 100 times the return on investment should not be the only metric for investing in an idea. At the same time, those Black inventors who want to pursue significant profits should have the support and partners they need to do so. Opening the funding pipeline to more Black entrepreneurs can help local communities, in part, by creating new business opportunities.

Session 5

HOW HAVE BLACK INDIVIDUALS & COMMUNITIES EXPERIENCED TECHNOLOGY?

André Brock

Associate Professor, School of Literature, Media, and Communication, Georgia Institute of Technology

Charlton McIlwain

Vice Provost for Faculty Engagement and Development, New York University

Moderator:

Eric S. Hintz

Historian, Lemelson Center for the Study of Invention and Innovation, National Museum of American History

How do Black individuals and communities engage with technology? For centuries, technological advances have been used to try to control and exploit Black people—from slave ships and shackles to predictive policing algorithms and other racially based surveillance.

As panelist Charlton McIlwain said in his opening remarks, Black people understand the troubling history of technology; they recognize that “things were not made for us.” Yet Black individuals and communities also have technological agency; they drive innovation and deploy technologies to promote community, create art, build businesses, and seek justice. Within the history of the internet, Black user-innovators have played an especially important role, creating what we think of today when we talk about digital community. Speakers in this session examined the so-called digital divide, discussed Black technological agency, and shared how Black technology users create and reshape technologies to express themselves, enact resistance, and build connections.

McIlwain opened his remarks by reminding webinar participants that these innovators were active as far back as 1995, when **5.2 million Black people had access to the nascent internet**. Why does this number matter? While it still represents far fewer users than the number of White people online during the same period, the number remains striking because it counters traditional deficit narratives that characterize Black people in terms of technologies they could *not* access. These deficit accounts, McIlwain observed, leave little to no room for Black agency in creating and building the internet. The true story is vastly different than such accounts suggest: Black users shaped the internet from its earliest days, bringing cultural insights, technological passion, and agency to their involvement (Burkhalter 1999; Silver 2000).

Who were these 5.2 million users? McIlwain shared stories of Black individuals who charted new territory during the internet’s infancy, describing how these user-innovators carved out new spaces for invention, play, resistance, and expression. For example, **Kamal Al-Mansour, lawyer and scientist at NASA’s Jet Propulsion Laboratory (JPL), founded the software company AfroLink** after undergoing an epiphany: looking around at his JPL colleagues, Mansour listened to them discussing the latest innovations in software and realized that he did not see anyone like himself involved in the conversation. Determined to change that fact, he designed AfroLink to place Black people and Black culture at the center of the technological enterprise. Mansour’s new company explicitly rejected a profit-dominated model of invention in favor of preserving and helping the Black community.



Kamal Al-Mansour's trademark for AfroLink Software, 1992. [USPTO](#).

During the same period, the user group **Afronet** launched with the aim of fostering a **distinctly Black community**. Created by computer users who decided to form a shared network, Afronet built systems and hubs with uniquely Black nomenclature—Kinky Kumputers, AfroConnections, Nefertiti, and Online in D’hood, to name just a few. Developers wanted to help connect Black computer users within a shared space for private community, McIlwain explained; this ability to build virtual connections is an important Black invention and constitutes a key contribution of Black creators to the digital technology space. Additional examples include **E. David Ellington and Malcolm CasSelle, who invented NetNoir**, a portal for Afrocentric music, sports, business news, and education. Offering entertaining and meaningful content unavailable through traditional media, Ellington and CasSelle lured new users to the internet, helping to fuel the rise of online marketplaces, news sites, and entertainment portals. McIlwain also noted the contributions of **Anita Brown, who built Black Geeks Online**, a website that helped connect Black people digitally and made use of Brown’s formidable email list of Black contacts.

What does Black innovation look like in the digital age today? For these innovators, invention is often about expression: the Black impulse to create, McIlwain argued, is artistic and not simply utilitarian or strategic. Scholars of Black digital culture occasionally fall into the trap of presenting Black digital life as *necessarily* political, he said. But sometimes Black digital life is all about the joy of the artist. McIlwain cited Derrick Brown, engineer and entrepreneur, who wrote about **innovating because it gave him joy and pleasure as a writer**. “I’m a writer, that’s my lane—I want to take these tools and make them beautiful, and make them do beautiful things” (McIlwain 2020, 16). Rejecting the idea that invention is always about making money, Black coders, user-innovators, and other technology experts “take these tools and make them beautiful,” creating new forms for the articulation of Black culture (Rose 1994; Banks 2005; Fouché 2006; Byrne 2008).

This culture, of course, is not one-dimensional. Panelist André Brock defined Black cyberculture as a diverse collection of digital practices, online spaces, racial enactments or performances, and cultural online phenomena expressed by Black people (Brock 2020). He explained that Black innovators refute and refuse the condescension that deems their artistic or technological contributions as “uncultured.” They do so by making the internet a

distinctly Black space whose contours become visible through practices such as the Twitter hashtag (#), all while decentering Whiteness as the default online identity. Black people, Brock argued, have a “natural affinity” for the internet and digital media. We see the world and the internet differently when we step away from a White or Eurocentric perspective and adopt a Black lens or lenses in its place.

What do we see from this Black vantage point? Black cyberculture reveals, among other insights, that **productivity and efficiency are not universal norms but are constructs of White identity** (and some Black conservative identities). In lieu of these norms, Brock continued, Black cyberculture creates room for expression, joy, community, play, and movement. This isn’t naïve joy; it is cathartic joy—or “jouissance,” as Brock described it. On Twitter and other social media platforms, for instance, Black users create memes, images, and video clips that express their frustration with racism, poverty, and injustice in humorous ways that push back against the ongoing pain of their experiences. Brock gave the example of **CaShawn Thompson, creator of the #BlackGirlMagic hashtag on Twitter**. The diverse articulations of Black girls’ experiences, inspired by Thompson, helped express a new kind of embodied Blackness within the digital space. This embodied Blackness includes the capacity to “invent something out of nothing,” Brock said, or the formation of a distributive community space that resists erasure, oversimplification, and bias. Inventiveness here is not primarily about economic gain. It is about the beautiful mundane, the everyday, and about inventing to meet specific needs within marginalized communities. In the digital realm, Black people have found freedom from some of the enduring barriers and constraints that were (and are) imposed on them in other areas and institutions.

Black inventiveness is not always concerned with economic gain. It is often about the beautiful mundane, the everyday, and inventing to meet specific needs within marginalized communities.

Brock described his research methodology as critical technocultural discourse analysis, or the exploration of how meaning is constructed through different interfaces and how it relates to the users of technology—their articulations and expressions (Brock 2018). A critical technocultural discourse analysis might analyze, for example, how Black Twitter can enact joy as a cathartic response to racism, and it might see that enactment, at least in part, as an empathic yet critical take on Black culture itself, which is not monolithic. This communal, embodied epistemology allows Black users to reject invisibility and become visible on their own terms.

How does Black cyberculture translate in the classroom? Brock encourages his students to question their language choices and their assumptions about what makes a given technology useful or valuable. One common belief emanating from Silicon Valley—and readily adopted

by much of American society—is that digital technology must be productive and forcefully new to count as valuable, he said. But sometimes technology is *not* disruptive; sometimes it is delightfully ordinary, emerging from and pointing back to everyday life experiences. **Brock invites his students to question Eurocentric views of technology in order to create a space for “distributed Blackness.”** Analytically, this means adopting a Black epistemological standpoint. And despite the myriad challenges the Black community continues to endure, Brock encourages his students to strive for “Afro-optimism,” an attitude that will help them better appreciate the heterogeneous range of Black technological creativity—the countless small and large and wonderful ways that Black people express themselves through technology today.

In the end, Brock encourages students to explore not just *what* people do with their technology, but *why* they do it. We need to think about how we understand *ourselves* when we use technology, he concluded, including—importantly—whether we position ourselves to view Black people as actors or acted-upon in the technological realm. The default narrative suggests that Black people have some deficit when it comes to technology. But if we regard Black people as owners and agents in this area, new possibilities and new narratives blossom.

What about the so-called digital divide? In a wide-ranging discussion with the moderator, Brock and McIlwain noted the tension between socioeconomic disparities that historically have limited Black access to technology—or worse, harmed them directly (Walton 1999; Browne 2015)—and the more optimistic outlook that Black user-innovators, in many ways, birthed the internet. **Can both perspectives be true—is it possible for both a digital divide and a narrative of Black centrality to exist within technoculture? Yes, McIlwain said.** We can acknowledge the realities facing many Black people in American society today—the minimum wage (currently \$7.25/hour), for example, has stayed flat for years, even as the monthly costs for smartphones and internet access have steadily risen—while also noting that Black creators have made and continue to make vital contributions to the digital arena. And yes, Black people are sometimes cynical and distrustful of technological systems, McIlwain noted; they understand that such systems have historically served to suppress and exploit them. At the same time, they have used these systems to survive, innovate, and even thrive. In the process, they have bypassed traditional gatekeepers to enjoy a freedom that other institutions might not always grant so readily.

What about the future? McIlwain and Brock both argued **that we need a robust commitment to preserving the stories and contributions of Black creators within the digital technology arena**—and we need this commitment *now*. The internet is an archive, and a fragile one at that, often lasting only as long as a given platform remains in operation. Black stories are being lost every day, McIlwain noted. In many cases, Black voices from the internet’s first years have already been forgotten (McIlwain 2020). Accordingly, retrieving what we can, and taking additional steps to preserve the Black content being created today, remains essential. Otherwise, we risk perpetuating the assumption that Black people were absent from the internet’s creation, and we miss the chance to tell the children of tomorrow how Black lives shaped and defined the internet of today.

Panelists recommended the following opportunities to create change:

- For leaders in the commercialization arena, using connections and relationships to encourage more venture capital funding in the Black-owned technology arena would provide important support for Black digital businesses, which require access to capital to survive. Encouraging venture capital partners to expand their sights beyond a profit-only mentality—or expanding some of the measures typically used to define that profitability—could create more opportunities for Black vernacular creativity and artistic expression online.
- For scholars across disciplines, think about ways to acknowledge that popular expressions of Blackness online—such as #BlackGirlMagic—can be as valuable as the canonical texts of James Baldwin or Marcus Garvey. What might this acknowledgment look like if applied to a specific course syllabus? Consider how to expand the academic canon to include more diverse forms of Black expression and creation.
- For students and artists in general, stay focused on Black creativity and Black ingenuity. Find joy in these expressions. As McIlwain said: “They will empower you.”
- For historians and museum archivists, consider expanding historical preservation and retrieval efforts to include more Black history of the internet. Keeping in mind that only a select few (and often well-known) Black people will have records stored in traditional archives and libraries, archivists might think about how to preserve vernacular stories from everyday Black life, most of which are now recorded online. Museums and libraries could strategize to collect and save these digital contributions, paying special attention to “born digital” content as a record of mainstream Black culture.
- For fundraisers at museums and libraries, consider soliciting technology companies to finance and help curate these broad preservation efforts. The task of preserving Black digital history far exceeds the operational and financial capacities of academic libraries and museums. A sustained effort conducted in partnership with corporate America could provide much-needed dollars and expertise—while offering PR gains for corporate funders.

Conclusion: A Call to Action

Poet Amiri Baraka observed in 1971 that “machines have the morality of their inventors.” He warned against technology that degrades human beings, marginalizes the poor, kills plants and animals, poisons the air, and degenerates or enslaves Black people (Baraka 1971). His statement still rings true almost fifty years later. The discussion of American inventiveness is more than just a historiographical project; it is also an ethical endeavor. How we think about invention, *who* invents and *why*, and what we value as a meaningful contribution to our world—these considerations mean that the historian’s task today entails working both backward *and* forward, or retrieving narratives from the past *and* thinking constantly about how to engage the children and inventors of tomorrow.

Panelists in the weeklong series effectively delivered a charge to the Lemelson Center, the wider Smithsonian Institution, and other organizations working in this field: the study and teaching of American invention must be undertaken hand-in-hand with a commitment to self-reflection both as individuals and as institutions—and with a willingness to advance the structural and policy reforms that are essential to building STEM equity on a national scale. Who and what is a given invention for? Profit or need? Individual or community? What have we chosen to preserve in our invention archives, and why? What do venture capital funds prioritize? Do we want to continue living in a world where, as Gil Scott-Heron put it, “I can’t pay no doctor bills but Whitey’s on the moon”? If we want to expand the notion of invention and innovation to bring in more Black creators and engineers, this change must carry through to all corners of the innovation ecosystem, from aerospace engineering to the kindergarten classroom and those informal learning labs within museums that offer programs for young children.

As webinar panelists consistently expressed, museums and libraries have a particularly urgent calling. They are tasked with collecting, preserving, and telling the stories of little known and forgotten Black and marginalized inventors. What is more, they are being asked to do so, at least in part, as a corrective to their *own* historical processes: the traditionally Eurocentric nature of these institutions has meant that for many years, Black histories and stories were not sought out for preservation. This negligence had the effect of reinforcing and perpetuating the false assumption that few or no such stories existed in the first place. Today, museums, libraries, and centers of scholarly inquiry that set about recovering the stories of Black inventors engage this work both as a commitment to rigorous scholarship and as a pledge to civil and human rights. We need this archival research into Black lives, now more than ever. Simultaneously, we need a readiness to engage in the broader conversation that challenges the notion of inventiveness as uniquely American.

Several participants in the weeklong webinar underscored that the success they have achieved in their own careers meant that others now regard them as “unicorns”—rare and mystical exemplars who succeed despite the barriers they have faced. Their experiences, in this sense, echo that of Black inventors from past generations who faced discrimination and outright erasure. It is telling that, on the one hand, we need to find *more* of these so-called unicorns,

to lift up their stories and teach the next generation about their successes; while on the other hand, we also should recognize that the existence of these success stories is too often cited as an excuse for not making the systemic policy changes that drive equity forward. Holding up “unicorns” as exemplars is thus a double-edged sword. Sweeping structural reform is the *only* way, panelists maintained, that the United States can make substantial progress toward narrowing the Black innovation gap in the coming decade.

What are the best directions moving forward? As Shontavia Johnson stated, there are many struggles yet to overcome, and for those entrepreneurs, engineers, and scholars in the trenches, the work within the invention and innovation ecosystem can at times seem overwhelming. But every one of us can play a role, finding a specific cause or problem that needs to be solved, identifying the constraints, and putting our imaginations to work. Together, we can shape a new story about American inventiveness. This new story leaves room for invention as a creation that serves the community, sustains the Earth’s resources, and honors artistic expression as central to human experience.

The discussion of American inventiveness is more than just a historiographical project; it is also an ethical endeavor.

There is work to be done, both for us as individuals and for museums and institutions like the Lemelson Center. We join others in this conversation, and we remain committed to our founding conviction—that children who can see inventors who look like them will begin to see *themselves* in a new way, to stand a little taller, to raise their hands more often, to speak with more confidence and imagination.

This is quiet work, and it will not revolutionize our innovation ecosystem overnight. But it is our center’s mission—a renewed commitment to the creative spirit that exists in every child, an ongoing attention to archival preservation of marginalized voices, and a willingness to engage in the difficult ethical conversation that underlies the notion of what it means to be an American in the twenty-first century.

APPENDIX 1

PANELIST BIOGRAPHIES



André Brock

**Associate Professor, School of Literature, Media, and Communication,
Georgia Institute of Technology**

André Brock is an associate professor of media studies at Georgia Tech. He writes on Western technoculture, Black technoculture, and digital media. His scholarship examines Black and White representations in social media, video games, weblogs, and other digital media. He has also published influential research on digital research methods. His first book, *Distributed Blackness: African American Cybercultures*, was published with NYU Press in 2020 and theorizes Black everyday lives mediated by networked technologies.



Yolanda L. Comedy

Science and Technology Policy Consultant

Yolanda L. Comedy is an independent consultant working on science, technology, engineering, and mathematics (STEM) policy issues, including the STEM workforce, cybersecurity, and business strategy. Previously she was the director of the American Association for the Advancement of Science (AAAS) Center for Advancing Science & Engineering Capacity, where she directed several programs, including the AAAS-Lemelson Invention Ambassadors Program, Mason Award, and Mentor awards. Comedy previously worked for the White House, serving as a Senior Policy Analyst for both the President's Committee of Advisors on Science and Technology and the President's Information Technology Advisory Committee. She also worked for IBM in strategic philanthropy, governmental programs, and business consulting on issues such as K-12 education reform, high-performance computing and US competitiveness, and business strategy. Comedy obtained her PhD from Indiana University in political science, specializing in public policy and international development.



Lisa D. Cook

Professor of Economics and International Relations, Michigan State University

Lisa D. Cook is Professor of Economics and International Relations at Michigan State University. She earned a PhD in economics from the University of California, Berkeley, with fields in macroeconomics and international economics. Among her current research interests are economic growth and development, innovation, financial institutions and markets, and economic history. Cook is a research associate at the National Bureau of Economic Research and is the author of several published articles, book chapters, and working papers. Currently the director of the American Economic Association Summer Program, she was recently named an Edison Fellow at the US Patent and Trademark Office. During the 2011–2012 academic year, she was on leave at the White House Council of Economic Advisers under President Obama.



Arthur Daemmrch

Director, Lemelson Center for the Study of Invention and Innovation, National Museum of American History

Arthur Daemmrch is the director of the Lemelson Center for the Study of Invention and Innovation at the Smithsonian Institution. He has led research projects into the history of pharmaceutical innovation and regulation, chemical risk, and healthcare systems, and is currently researching the history of industrial revolutions. Daemmrch has published in the fields of science and technology studies, history of technology, medical sociology, and business policy. Previously an associate professor at the University of Kansas, assistant professor at Harvard Business School, and a visiting professor at the China Europe International Business School, he holds a PhD from Cornell University and a BA from the University of Pennsylvania.



Rayvon Fouché

Professor of American Studies, Purdue University

Rayvon Fouché is Professor of American Studies in the School of Interdisciplinary Studies at Purdue University. His work explores the multiple intersections between cultural representation, racial identification, and technological design. He has authored and edited several books, including *Black Inventors in the Age of Segregation* (Johns Hopkins University Press, 2003), *Appropriating Technology: Vernacular Science and Social Power* (University of Minnesota Press, 2004), *Technology Studies* (Sage Publications, 2008), the 4th Edition of the *Handbook of Science & Technology Studies* (MIT Press, 2016), and *Game Changer: The Technoscientific Revolution in Sports* (Johns Hopkins University Press, 2017).



Tyrone Grandison

Chief Technology Officer, Pearl Long Term Care Solutions

Tyrone Grandison works at the intersection of technology, data, and social good. He has spent the last two decades developing and deploying data-driven, impact-focused, people-centered products and services that improve the lives of under-represented, and often ignored, American communities.



Eric S. Hintz

Historian, Lemelson Center for the Study of Invention and Innovation, National Museum of American History

Eric S. Hintz is a historian with the Lemelson Center for the Study of Invention and Innovation at the Smithsonian Institution's National Museum of American History. Hintz co-curates exhibits, including the award-winning *Places of Invention*; produces the center's annual symposium series, *New Perspectives on Invention and Innovation*; coordinates the center's fellowship and grant programs; and assists in the collection of historically significant artifacts and documents. With Matthew Wisnioski and Marie Stettler Kleine, he is the co-editor of *Does America Need More Innovators?* (MIT Press, 2019), and he is the author of *American Independent Inventors in an Era of Corporate R&D* (MIT Press, 2021). He earned his MA and PhD in the history and sociology of science from the University of Pennsylvania.



James Holly Jr.

Assistant Professor of Urban Science, Technology, Engineering & Mathematics Education, Wayne State University

James Holly Jr. is a native Detroit, educator, and researcher who is focused on mitigating anti-Blackness in P-20 STEM education. He is currently Assistant Professor of Urban STEM Education in the Teacher Education Division at Wayne State University. His research explores the complexities of teaching the STEM disciplines in an urban context in pursuit of equity and justice, the process of developing engineering literacy among pre-service science and mathematics teachers, and how the personal narratives of Black people with STEM degrees can inform equitable STEM education.



Shontavia Johnson

Associate Vice President for Entrepreneurship & Innovation, Clemson University

Shontavia Johnson thrives at the intersection of law, entrepreneurship, and culture. Twice named one of the top lawyers in America, Johnson serves as Associate Vice President for Entrepreneurship and Innovation at Clemson University. She has also founded LVRG, a company giving women of color an entrepreneurship formula that allows them to make impact and income by leveraging intellectual property. She has spoken on stages at TEDx, SXSW, and Google, and she has appeared in *TIME*, the *Washington Post*, the *Los Angeles Times* and on NPR and Hear to Slay. Johnson is a widely published writer who also loves extreme sports and traveling.



Cathleen S. Lewis

Curator, Space History Department, National Air and Space Museum

Cathleen Lewis is Curator of International Space Programs and Spacesuits at the Smithsonian Institution's National Air and Space Museum, specializing in Soviet and Russian history. Lewis has completed both a bachelor's and a master's degree in Russian and East European Studies at Yale University and completed her PhD in History at The George Washington University. Her current research project is a reexamination of cosmonaut culture in the last six decades. She also studies and curates the histories of astrobiology as well as Black people in aviation and spaceflight in the United States and abroad. Lewis has written about artifacts in the Smithsonian's collection and published articles comparing the Soviet and American approaches to exhibiting and portraying spaceflight. She is planning to write a history of the development of spacesuit gloves.



Charlton McIlwain

Vice Provost for Faculty Engagement and Development, New York University

Author of the book *Black Software: The Internet & Racial Justice, From the Afronet to Black Lives Matter* (Oxford University Press, 2020), Charlton McIlwain is Vice Provost for Faculty Development & Engagement at New York University, and Professor of Media, Culture, and Communication at NYU Steinhardt. His work focuses on the intersections of computing technology, race, inequality, and racial justice activism. He has served as an expert witness in landmark US Federal Court cases on reverse redlining/racial targeting in mortgage lending, and in 2019 he testified before the US House Committee on Financial Services about the impacts of automation and artificial intelligence on the financial services sector. He writes regularly for *The Guardian*, *Slate's Future Tense*, *MIT Technology Review*, and other outlets about the intersection of race and technology.



Crystal Marie Moten

Curator of African American History, Division of Work and Industry, National Museum of American History

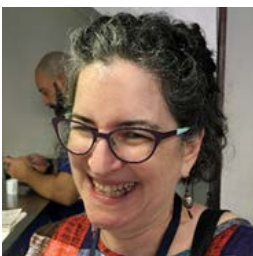
Crystal M. Moten is curator of African American History in the Division of Work and Industry at the Smithsonian's National Museum of American History, where she specializes in African American business and labor history. Previously, she was an assistant professor of history at small liberal arts colleges on the east coast and in the upper Midwest. Her current research centers on the intersection of race, class, and gender, and specifically Black women's economic activism in the civil rights era Urban Midwest. Her work has appeared in several journals and edited collections.



Tahira Reid Smith

Associate Professor of Mechanical Engineering, Purdue University

Tahira Reid Smith is Associate Professor in the School of Mechanical Engineering at Purdue University and a NASA Visiting Scholar for Fall 2020. Her research involves the quantification and integration of human-centered considerations in engineering systems and/or the design process. Her research program has received funding from the National Science Foundation, Procter & Gamble, Air Force Office of Scientific Research, and many others. Her projects that involved the intersection of diversity and mechanical engineering have been featured in media sources, including *National Geographic*, NBC's *Today Show*, *Essence*, Reuters, and National Public Radio. A highly sought-out role model for the younger generation, Reid Smith is featured in two children's books describing the story of her Double Dutch jump rope invention. That story was also featured in the 2017 New York State English and Language Arts Common Core Exam administered to over 100,000 fourth graders. Reid Smith obtained BS and MS degrees in Mechanical Engineering from Rensselaer Polytechnic Institute and a PhD in Design Science from the University of Michigan, Ann Arbor.



Amy E. Slaton

Professor, Department of History, Drexel University

Amy E. Slaton is a historian of science, technology, and engineering at Drexel University. She holds a PhD in the History and Sociology of Science from the University of Pennsylvania, and she has written on the ways in which instrumentation, metrologies, and standards reflect historical conceptions of human difference in technoscientific education and labor. She is the editor of *New Materials: Towards a History of Consistency* (Lever Press, 2020), and is currently writing a critical history of "STEM diversity" in the United States as a project of racial reconciliation rather than redistributive or reparative action. She is also co-editor, with Tiago Saraiva, of the journal *History + Technology*.



Monica M. Smith

Head of Exhibitions and Interpretation, Lemelson Center for the Study of Invention and Innovation, National Museum of American History

Monica M. Smith is the Head of Exhibitions and Interpretation for the Smithsonian's Lemelson Center for the Study of Invention and Innovation. She oversees conceptual and logistical planning for exhibitions, including serving as project director, principal investigator, and co-curator for the *Game Changers* exhibition, the award-winning *Places of Invention* exhibition, and the previous award-winning *Invention at Play* traveling exhibition, all three of which received prestigious \$1.5–3M grants from the National Science Foundation (NSF).



Kara W. Swanson

Professor of Law and Affiliate Professor of History, Northeastern University

Kara W. Swanson is Professor of Law and Affiliate Professor of History at Northeastern University, Boston. Her scholarship focuses on the historical intersections among law, science, medicine, and technology, concentrating on the United States patent system, the regulation of reproduction and the body, and issues of race, gender, and sexuality. Her first book, *Banking on the Body: The Market in Blood, Milk and Sperm in Modern America* (Harvard University Press, 2014), is a history of property in the human body as understood through the twentieth-century history of bankable body products. Her book in progress is tentatively titled *Inventing Citizens: Race, Gender, and Patents*.

APPENDIX 2

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About the Lemelson Center

The Lemelson Center was established at the National Museum of American History in 1995 through a gift from the Lemelson Foundation. Jerome Lemelson (1923–1997) was an independent inventor who earned more than 600 patents, representing one of the largest patent portfolios in the nation's history. The center's mission is to document, interpret, and disseminate information about invention and innovation, to encourage inventive creativity in young people, and to foster an appreciation for the central role invention and innovation play in the history of the United States.

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