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Old Bones in New Databases: Historical Insights Into Race, Statistics, and Ancestry Estimation in Anthropology

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ABSTRACT

This article explores the persistence of race in biological anthropology, particularly in the context of ancestry estimation using the Fordisc software. Despite efforts to move away from race-based typologies since the mid-20th century, historical notions of race continue to shape scientific methods and technologies in anthropology. By tracing the "data journey" of a skeletal collection within Fordisc's database, we reveal how early 20th-century race science shaped statistical methods used in contemporary anthropology and how typological notions of race persist today. Our interdisciplinary approach, combining history of science and science and technology studies, highlights the need to historicize and critically examine the methods and technologies that underpin anthropological practices. This analysis demonstrates that issues of race in science are deeply rooted in the material practices of data collection, analysis, and statistical methods. Recognizing and dismantling these legacies is central to creating more ethical scientific practices. We argue that addressing the trouble with race in anthropology requires a comprehensive reevaluation of scientific practices, its methods and technologies, and would benefit from interdisciplinary collaboration within anthropology and beyond.

RESUMEN

Este artículo explora la persistencia de raza en la antropología biológica, particularmente en el contexto de estimación de linaje usando el software Fordisc. A pesar de los esfuerzos para distanciarse de las tipologías basadas en raza desde mediados del siglo XX, las nociones históricas de raza continúan estructurando los métodos científicos y las tecnologías de la antropología. Mediante el rastreo del "viaje de datos" de una colección esqueletal dentro de la base de datos Fordisc, revelamos cómo la ciencia de la raza a principios del siglo XX estructuró los métodos estadísticos en la antropología contemporánea y cómo las nociones tipológicas de raza persisten hoy en día. Nuestra aproximación interdisciplinaria, combinando la historia de la ciencia y los estudios de la ciencia y la tecnología, enfatiza la necesidad de historizar y examinar críticamente los métodos y las tecnologías que apoyan las prácticas antropológicas. Este análisis demuestra que cuestiones de raza en la ciencia están enraizadas profundamente en las prácticas materiales de la recolección de datos, el análisis y los métodos estadísticos. Reconocer y desmantelar estos legados es central para crear prácticas científicas más éticas. Argumentamos que abordar el problema con raza en la antropología requiere una reevaluación exhaustiva de las prácticas científicas, sus métodos y tecnologías, y se beneficiaría de la colaboración interdisciplinaria dentro de la antropología y más allá.

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1 | Introduction

Most biological and forensic anthropologists[1] are uncomfortable using the term "race" in their work with deceased human bodies. From the 1930s onward, we can trace efforts to move away from anthropology's colonialist, racist origins and its faulty ideologies of hierarchizing people into fixed typologies. A historical narrative that may sound familiar is how scientists after World War II distanced themselves from race science by discarding racial typologies and embracing the methods and understandings of human variation of population genetics (UNESCO 1969; Lewontin 1972). However, historians of science and science and technology studies (STS) scholars have demonstrated that discarded notions of race persisted in numerous human biological practices throughout the latter half of the 20th century and continue to do so today, *regardless* of scientists' political views on race and racism (e.g., TallBear 2013; Bangham and Chadarevian 2014; M'charek et al. 2020).

The perpetuation of biological race concepts remains a concern in biological and forensic anthropology (Fuentes et al. 2019). Since the 1990s, there have been efforts to discard "race" and align anthropology's terminology with contemporary understandings of human variation. However, scholars argue that these efforts merely disguise "race" while old concepts of race persist in how anthropology is *practiced* as a science (Albanese and Saunders 2006). Recently, anthropologists have critically interrogated the discipline's ancestry estimation practices, their relation to biological concepts of race, and racial bias in decision-making within the criminal justice system (e.g., Adams and Pilloud 2021; Hughes et al. 2023; Yim and Passalacqua 2023). These publications reveal diverse and sometimes divisive opinions and approaches in forensic anthropology (Bethard and DiGangi 2020; Stull et al. 2021; DiGangi and Bethard 2021).

This article does not intend to review these discussions in anthropology. There are other sources that provide an overview of the debate as it has evolved over the past decades (Cunha and Ubelaker 2020; Ousley et al. 2018; Smay and Armelagos 2000; Ross and Pilloud 2021). Instead, we shed new light on the persistence of race in ancestry estimation practices by bringing in an *outside* perspective as a historian of science and STS scholar. We focus on scientific practices to move our attention from the input (racial bias) and outcome (discrimination) of technologies to the study of scientific methods and technologies themselves. More specifically, we aim to clarify why race science continues to haunt[2] anthropology through a historical analysis of the "data journey" (Leonelli and Tempini 2020) of a skeletal collection in the database of Fordisc, a software program used for sex and ancestry estimation based on skull and skeletal measurements. Our interest in Fordisc and its reference database stems from our research on the history of quantification in biological anthropology and practices of ancestry estimation in forensic craniofacial depiction (Clever 2023; Jong 2023). Combining our expertise in the history and social studies of science, we respond to anthropologists Michael Blakey and Rachel Watkins's (AABA 2022) call for interdisciplinary dialogue among anthropologists, historians, Indigenous scholars, and ethicists to address the ethics of using human skeletal collections. Indeed, interdisciplinary work has the potential to "reveal what disciplinary histories have rendered invisible" (Subramaniam 2014, 28). We contribute to this effort by examining the entangled histories of race and skeletal collections in anthropology.[3]

We use the Fordisc reference database as a starting point of historical inquiry, working in the opposite direction from its users. We show how 19th-century racial typologies and ideas of racial belonging were "folded" (M'charek 2014) into practices that became increasingly valued for their objectivity from the early 20th century: data collection and analysis and multivariate statistics. These data practices are less objective and "neutral" than scientists often consider them to be. The data journey we trace shows that databases and software programs like Fordisc can become conduits that allow outdated ideas of race to persist into the present. We unpack the historical relations between Fordisc and early 20th-century statistical race science, built on collections of racialized human skulls. We argue that focusing on methods, technologies, and their historical roots is crucial to understanding why ideas of race that we disregard in the present continue to shape scientific practices.

2 | Data Journey as a Method

Philosopher Sabina Leonelli (2020, 9) defines data journeys as "the movement of data from their production site to many other sites in which they are processed, mobilised and re-purposed." The concept is also valuable as a "methodological tool to investigate what happens to *data* themselves," enabling analysts to transcend rigid notions of "'disciplinary' knowledge spaces, communities and tools" (12). We adopt "data journeys" to articulate our interdisciplinary investigation into the reference data used in Fordisc.

Data journey as a method is about trailing and tracing the movement and (re)use of data—pursuing accidental findings, following hunches with intent, and embracing interdisciplinarity to uncover data practices in the past and the present. Iris first suspected a link between the "Egypt" reference data in Fordisc and the early 20th-century statistician Karl Pearson during a summer course on biological anthropology at the University of Amsterdam. She invited Lisette to investigate this together, combining Iris's expertise in the history of race and statistical anthropology with Lisette's expertise on race in contemporary forensic anthropology. Over the past 4 years, we have traced the data journey of the "Egypt" reference data by analyzing historical sources, contemporary articles, and debates in biological and forensic anthropology. We visited archives and engaged in extended, semistructured conversations via telephone and Zoom with forensic anthropologists—both those we knew and those they connected us with—about practices, ethical challenges, and potential paths forward.

Outdated notions of race persist in data practices as they are carried along data journeys. Drawing on anthropologist of science Amade M'charek's work, we understand data as "folded objects." M'charek argues that scientific objects, like reference datasets, carry material traces of their making and remaking over time and space. As a result, "history can be *recalled* in objects" (M'charek 2014, 31). This allows seemingly distant moments—such as present-day forensic anthropological casework and past typological race science—to be connected through the data journey's temporal folds. The data journey of the "Egypt" dataset shows how early 20th-century notions of race are folded into Fordisc's reference database and perpetuate a now-rejected typological view of biological race in forensic anthropology.

Finally, interdisciplinary work involves embracing humility as we navigate disciplines beyond our formal training and confront ethical questions that neither we nor the forensic anthropologists we consulted can readily resolve. Below, we propose normative interpretations and invitations for reform that result from researching data journeys and their temporal folds. We invite readers to embrace interdisciplinarity, join us in exploring the data journey of the E-series, and embark on new ones that may emerge from this article.

3 | Fordisc and the Concept of Social Race

Recognizing that some readers may not be familiar with forensic anthropological practice, we offer a brief and simplified discussion of Fordisc[4] and its role in analyzing human remains. One of the responsibilities of forensic anthropologists is to assist in identifying human remains in death investigations. They may create a biological profile of the skeleton, including markers like "ancestry," age at death, sex, and stature (Austin and King 2016). They may then share this biological profile, which provides generic demographic categories rather than direct identification, with death investigators or law enforcement. The biological profile helps narrow down the search population, for example, by comparing the unknown individual's profile to missing persons reports in NamUs, a database for missing and unidentified persons in the United States. Other methods, like DNA analysis or dental comparison, can further facilitate identification.

The computer program known as Fordisc automates the estimation of sex and ancestry for human remains based on skeletal measurements, including skull or "craniometric" data. Anthropologists enter up to 21 cranial measurements of an unidentified individual into their corresponding fields in the program (Figure 1) and check categories such as "white males," "black males," and "Hispanic males." When they click on "process," Fordisc compares the skull measurements to its database, focusing on the selected populations. The program then presents a screen with results and statistical probabilities, showing the likelihood that the individual belongs to one of the selected populations and how the measurements align with measurements typical for those populations.[5] These statistical tools assist anthropologists in interpreting the results, which are displayed as "current case is closest to" followed by the population category with the strongest similarity, for instance, "white males." Fordisc was mainly designed for the United States, where most users reside. Anthropologists and archaeologists in other countries also use the program, though some consider its usefulness limited outside the United States (Cunha and Ubelaker 2020). Fordisc's creators and supporters believe that the program can also aid in identifying population relations and descendant communities in bioarchaeological research and the repatriation of skeletal collections from museums and universities.

Richard Jantz and Stephen Ousley (1961–2022) developed Fordisc in the 1990s when biological and forensic anthropologists increasingly questioned the scientific validity of biological notions of race (AAPA Statement 1996; AAA Statement 1998). From the mid-1990s, forensic anthropologists began to replace the term "race" with "ancestry" and racial categories with continental categories in biological profiles (Sauer 1992; Albanese and Saunders 2006; Pilloud et al. 2021). Ancestry estimation aimed to move anthropology beyond problematic typological race determination, which anthropologists often linked to nonmetric methods. These visually evaluate and analyze an individual's morphological features, like skull shape, against typical traits believed to indicate hereditary membership to racialized groups.[6] Several practitioners in the field increasingly embraced metric methods and statistical analysis. In this context, Jantz and Ousley developed Fordisc to enhance the "objectivity" of metric ancestry estimation. They distanced Fordisc's statistical analysis from anthropology's complicated relationship with race: "FORDISC does not define, redefine, or justify any racial classification, but merely tests the relationship between these cultural categories and metric variation" (2005, 73).

How does a program that uses racial classificatory terms like "white," "black," and "Hispanic" align with the discipline's aim to distance itself from race? Like other forensic anthropologists, including Norman Sauer (1992), Jantz and Ousley understood race as a "social" reality. Practically, "social race" categories, such as the US census race categories, shape people's perception of themselves and others, and consequently inform missing persons databases (Ousley et al. 2018, 86). Moreover, "while human racial grouping is strictly a social construct with no biological basis . . . there are phenotypic differences between populations because of the heritability of skeletal features that correlate with geographic ancestry and thus social race" (Christensen et al. 2024, 227–28). In a similar vein, Jantz and Ousley (2005, 74) implied that the utility of this statistical correlation in practice outweighs the debate over the (non)existence of biological race: "Whatever the causes, this pattern can serve the needs of forensic identification very well. Biological justifications are not needed."

The view that separates race categories as "social constructs" from skeletal measurements as "biological differences" rests on the premise that the "social" and the "biological" are fundamentally different realms. The anthropologist mediates between these realms by linking social categories with skeletal features using craniometric or morphoscopic methods. Sauer took this position in 1992, which Jantz and Ousley echoed in the 2005 Fordisc manual. More recently, anthropologist Kyra Stull and colleagues reiterated this position to defend ancestry estimation in response to a call to abandon it (Bethard and DiGangi 2020): "More so than most fields, forensic anthropologists accept the race concept is far too simple for human biological variation. However, skeletal features can be used to make predictions about probable social race groups because of their correlations to local population distributions" (Stull et al. 2021, 417).

However, "social race" is not the solution but part of anthropology's racialization problem. Differences in social race terminology across census data, NamUs categories, and forensic methods create miscommunications and errors (Pilloud et al. 2021). Social race categories also fail to capture patterns of variation (Albanese et al. 2022). Moreover, uncritically using

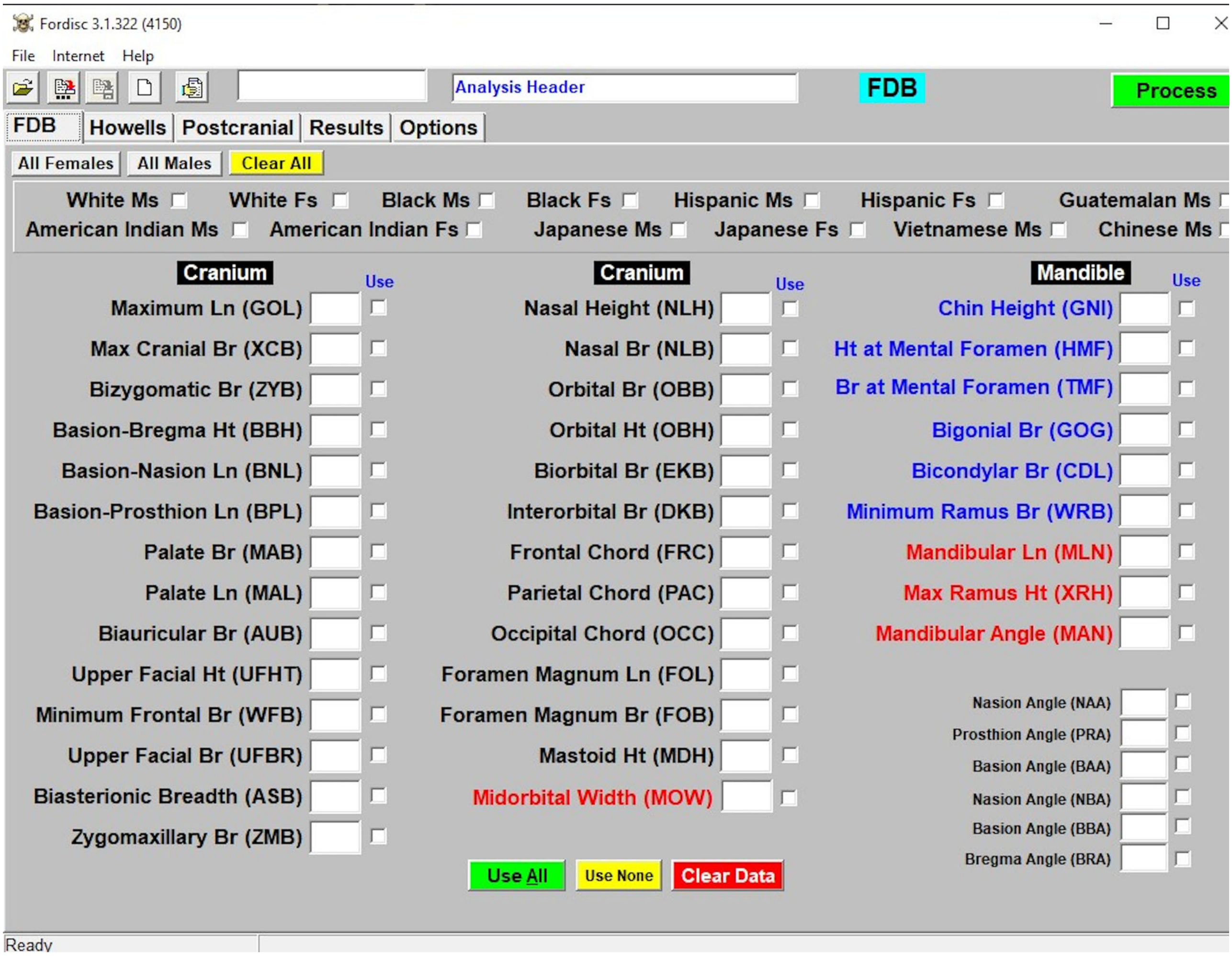

FIGURE 1 | Data entry interface in Fordisc 3.1. [This figure appears in color in the online issue]

social race categories with other ambiguously defined geographic, cultural, governmental, and linguistic terms may support the misconception that race is biological (Tallman, Parr, and Winburn 2021; Maier et al. 2021). Indeed, several biological and forensic anthropologists argue that practices of ancestry estimation provide a foundation for biological race precisely by linking social categories to biological characteristics (e.g., Smay and Armelagos 2000; DiGangi and Bethard 2021). The more recent shift from "ancestry" to the estimation of "population affinity" (Ross and Pilloud 2021) likewise risks producing race by linking skeletal measurements to local populations and ascribing predictive value to these correlations (Albanese et al. 2022). In practices of ancestry estimation and forensic identification, "issues that are conventionally thought of as scientific are connected to issues that are conventionally thought of as social. The two purportedly separate realms are inextricably interconnected and come into being together" (Reardon 2001, 381). The common "slippage" between social and biological race definitions among anthropologists exemplifies the blurry boundaries (Adams and Pilloud 2021). Thus, the separation between the biological and the social that the concept of "social race" relies on, does not hold. "Social race" acquires biological significance through the scientific methods and theories used to measure bodies and assign social race categories based on phenotypic features, despite claims that race is a social construction (M'charek 2023). From a historical perspective, these methods and theories carry the legacies of race science and racialization within them. When applied, biological race may emerge from these methods' temporal folds. As Albanese and colleagues (2022, 448) write about ancestry estimation: "Different methods, different group methodologies, alternative statistics, modified reference samples, software updates, etc. do not provide better results, since the underlying issues are theoretical problems with conceptualizing human variation and the use of [Identified Reference Collections] in most of the field of Forensic Anthropology." We need to first reckon with the historical roots of these theoretical *and* methodological problems to envision a future beyond them.

Our historical analysis demonstrates that forensic anthropological practices risk biologizing identity or race as well as perpetuating early 20th-century racial typologies that became folded into technologies such as Fordisc. Scientists created highly biased, typological skeletal reference collections and treated them as biological and statistical populations. Typological ideas and methods of racialization shaped today's craniometric-statistical identification practices. Consequently, typological race remains prevalent in forensic anthropology, stemming from its historical roots in race science.

4 | Developing the Forensic Data Bank and Fordisc

In the early 1980s, forensic anthropologists in the United States observed that most standards for constructing the biological profile of unidentified human remains were based on "old" skeletons from the two largest skeletal collections in the United States, the Terry and Hamann-Todd anatomical collections, established in the early 20th century. These collections were valued for their detailed demographic, medical, and anthropometric data (Hunt and Albanese 2005). However, forensic anthropologists feared that the collections' individuals no longer represented the US population due to secular changes (Jantz and Moore-Jansen 2000, 3). Several anthropologists considered the collections too homogeneous and called for more "ethnically variable" reference skeletons, including "Hispanic, Oriental, and Native American populations"[7] (Jantz and Moore-Jansen 1987).

The solution was not to collect more skeletons, but more *data*, as Clyde Snow urged at the 1981 annual meeting of the American Academy of Forensic Sciences (AAFS). The AAFS appointed a "data banking" committee with anthropologists John Lawrence Angel, Stanley Rhine, Richard Jantz, and later Douglas Ubelaker. Funded by the University of Tennessee in Knoxville, graduate student Peer Moore-Jansen created a computerized database of skeletal measurements. In 1984, Jantz and Moore-Jansen secured a National Institute of Justice grant to develop what came to be known as the Forensic Data Bank (FDB). In 1988, the FDB was ready for use.

The FDB then contained records of 715 individuals, including data on 432 crania, from 19 forensic labs and repositories across the United States. Jantz and Moore-Jansen (1987, 30) envisioned colleagues adding data from future cases, which must "seek to prioritize data collection strategies with the purpose of increasing sample sizes for ethnic groups other than U.S. Whites." To facilitate data gathering, they created a "standardized 'core' data set," with a recording template and guidelines for uniform measurement-taking, based on Swiss-German anthropologist Rudolf Martin's methods (1956). Recorders had to manually input the individual's race and list the source of its determination. The authors acknowledged that racial determination was "often a complex matter," and recommended using "major racial classifications followed by ethnic affiliation" for positive identification, such as "Amerindian-Navaho or Mongoloid-South Korean" (Moore-Jansen and Jantz 1990).

The filled-out recording form could be returned to the Forensic Anthropology Center at UT Knoxville, where Jantz entered the data into the computerized databank. With standardized recording procedures and new FDB data, forensic anthropologists could better estimate sex and ancestry. For Jantz and Moore-Jansen, this necessitated "better" statistical methods to identify skeletal remains, specifically discriminant function analysis and generalized distance measures. Anthropologists had modestly used these methods since the 1920s, but the work of Giles and Elliot popularized statistics in forensic anthropology from the 1960s onward.

In 1962, Eugene Giles and Orville Elliot presented multivariate discriminant functions to estimate race from cranial measurements. As reference groups, they used individuals from the Terry and Hamann-Todd collections categorized as "white" and "'Negro' by cultural standards" (Giles and Elliot 1962, 148), and individuals from the 3450 BCE "Indian Knoll" sample from Kentucky for the "American Indian" category.[8] Giles and Elliot chose eight measurements that best separated the "white," "Negro," and "Indian" skulls, such as *glabello-occipital length*. Using electronic computers, they created a correlation matrix to determine proper weights for each variable. They noted that measurements overlapped among the groups, stating that if they did not, "a single measurement would suffice to assign a skull correctly" (151).

By the 1990s, anthropologists considered the skeletal values in Giles and Elliot's formulas outdated (Dirkmaat et al. 2008, 37). Moreover, their method required all eight measurements to be present, which was often not possible for incomplete skulls in forensic cases. Investigators increasingly requested the Forensic Anthropology Center to calculate custom discriminant functions using FDB data when all eight measurements couldn't be obtained or when checking against groups outside Giles and Elliot's categories. In response, Richard Jantz and anthropologist and computer developer Stephen Ousley created a computer program to solve some of these issues. Jantz wrote the procedures with statistical analysis software, and Ousley designed the interface (Jantz and Ousley 1993, 16). They launched the disk operating system computer program "FORDISC" in 1993, available for purchase through the Forensic Anthropology Center at UT Knoxville (Ousley and Jantz 1998, 452).

Fordisc 1.0 allows users to enter data for 21 cranial measurements and select from nine reference groups. These included, per the manual: "American Indians," including known individuals from the 19th century; "American Whites" from "all over the country"; "American Blacks" from the "southeast and mid-atlantic region"; "Chinese" male cadavers from Hong Kong University, and "Hispanic Males," a group "most problematic as far as 'race' is concerned, and includes individuals born in the US, Mexico and Central America" (Jantz and Ousley 1993, 31). The final group, labeled "Vietnamese Males" from a "Killing Fields massacre site," consists of victims of the Khmer Rouge genocide.[9] The genocidal origins of this data raise ethical concerns for us about the skeletons comprising Fordisc's database and the implications of their continued reuse. Likely unaware of these origins, the user initiates Fordisc's analysis by pressing F2 (31). On the results page, the reference group that Fordisc classifies the unknown individual into is indicated by an asterisk and provides additional statistical measures to assess the classification's strength and reliability.

Interpreting the program's output requires a basic understanding of the statistics. "Discriminant analysis has become a fact of life in biological anthropology in general and forensic anthropology in particular," states the Fordisc 1.0 manual (Jantz and Ousley 1993, 14). Fordisc's 2013 manual warned against blind faith in statistics and automating estimation: "It is sometimes assumed that Fordisc absolves the user of any responsibility and simply provides the desired answer concerning sex, ancestry, or stature. Like everything about analyzing a forensic case, the ultimate interpretation is up to you" (Jantz and Ousley 2013, 256). Users should remember that questions about race are often phrased in social terms, while "FORDISC can only return biological answers" (Jantz and Ousley 1993, 14). Jantz and Ousley (2005) explained that "social race" labels based on phenotypic traits like skin color correlated with "metric variation," the clustering of "objective" measurements into biological classifications. This assumed correlation rendered Fordisc useful for ancestry estimation in forensic settings.

When Fordisc 1.0 was released, the FDB contained over 1,200 cases, including 900 with sex and race estimates and 625 positively identified (Jantz and Ousley 1993, 33). Besides processing new FDB entries, Ousley and Jantz found another way to incorporate more varied data into Fordisc. In 1995, they helped American anthropologist William W. Howells, a retired Harvard professor, move his cranial data online. This included 57 measurements of 1348 male and 1156 female "specimens" grouped into 28 specific populations, compiled between 1965 and 1980. For 25 years, Howells had shared this data upon request. Moving it online facilitated its reuse with new technologies and allowed it to be added to the Fordisc reference database (Howells 1996).

Howells's "worldwide" database was added in the second version of Fordisc, released in 1996. This addition served three purposes: to help identify unknown immigrant individuals in the United States, to facilitate Fordisc's use outside the United States, and to assist in constructing biological profiles of archeological remains. Users could now also analyze unidentified remains in the "Howells" tab (Figure 2), checking against 34 populations categorized in six groups, listed by male and female: East Asians, Native Americans, Pacific Islanders, Africans, Europeans—Howells's original groupings—and an added sample named "University of Tennessee, Knoxville." Sample names ranged from geographic labels like "Santa Cruz" to languages, ethnicities, nationalities, or tribes like "Ainu." Users unfamiliar with these names were advised to consult Howells's publications (Ubelaker 1998). Indeed, Fordisc adopted Howells's labeling practices and rationale for grouping populations, which were rooted in concepts of geographical race from the 1960s, '70s, and '80s and thereby folded into the database and the software. However, the database's history goes back much further. The next section traces the data journey of Howells's "Egypt" sample, connecting Fordisc and Howells to early 20th-century race science and the rise of biometrics.

5 | The E-Series and the Rise of Statistical Anthropology

The "Egypt" box under the Howells tab refers to a series of skulls from a cemetery south of the Giza pyramids. In 1906–1907, Egyptologist William Flinders Petrie and a team of British archaeologists and local excavators descended into Lower Egypt, then under British rule (Petrie 2011, 205). As German and American research teams occupied the pyramid region, Petrie's team went further south, uncovering a cemetery and removing 1800 skulls (Petrie 1907, 1). Petrie dated the crania from around 600–200 BCE. His team cleaned the skulls, packed them into boxes, and shipped them to the Biometric Laboratory of his colleague Karl Pearson, where they arrived in 1910 (Petrie 2011, 206, 226).

The belief in the skull as the premier site for estimating group membership dates back several centuries, and Pearson, like most early 20th-century anthropologists, used the skulls taken from Egypt to study racialized human variation. Pearson's anthropology was unconventional for its strong reliance on mathematical statistics and dismissal of morphoscopic methods. Many anthropologists studied skulls for individuality and typicality using visual methods and created racial averages with few measurements. Pearson (1903, 507), known as the founder of mathematical statistics, dismissed this work as simplistic and "unscientific." He urged the use of larger skull samples (100 per race), 30-plus measurements per skull, and calculations of means, standard deviations, probable errors, and correlations, assuming cranial features were normally distributed. These methods would produce more *accurate* racial classifications, which Pearson understood as populations with shared, heritable, biological features. Pearson's statistical anthropology was innovative as biometricians used data to show how migration and mixture negated the existence of pure races and even argued that variation within populations was bigger than between them. However, they never questioned the existence of biological races, their ability to reveal races using biometric data and statistical methods, nor the practicality of typologies to categorize and compare races (Clever 2023). From the onset, the use of statistical methods in physical anthropology did not move the discipline beyond typology. Insights about the distribution of human variation were folded into a typological-racial framework.

The Biometric Laboratory's skull collection amounted to 7000, with the 1800 skulls from Giza being its most important collection. Pearson assumed this collection was "reasonably homogeneous" since it came from a single cemetery, offering a unique opportunity to measure variability and correlation *within* a large skull sample. The "Egyptian" skulls became a standard reference in Pearson's racial classification method, the "Coefficient of Racial Likeness" (CRL), which measured the probability that two samples, representing two races, belonged to the same population. The CRL determined the statistical distance between samples. Pearson created this formula to compensate for the small skull samples that anthropologists often worked with. One could not accurately determine the "intra-racial" variability of small samples, which complicated conclusions about resemblance to other samples. Pearson (1926, 108) used variability data from the longest series of a single race for the CRL—the 1800 "Egyptian" skulls—as a standard because "the different races of men are not widely divergent in variability, [so it is] best to use the system of standard deviations obtained from large numbers." Based on this idea of a "general human variability," the within-group variation of the "Egyptian" series became the statistical standard of race for any population measured by the CRL. The lab had other skull series from Egypt, which they named after their geographical origin. Only the series from Giza received a more generalized name and became known as the "E-series," a standard reference sample. Thus, several assumptions were built into this collection: The biometricians did not interrogate the sample's variation and context; they assumed its homogeneity based on variability measures,[10] and considered its relative homogeneity representative of not only Egypt but all of humanity, as indicated by its seemingly innocuous label, which reminds us that labels are not neutral but inhabit specific, historic worldviews.

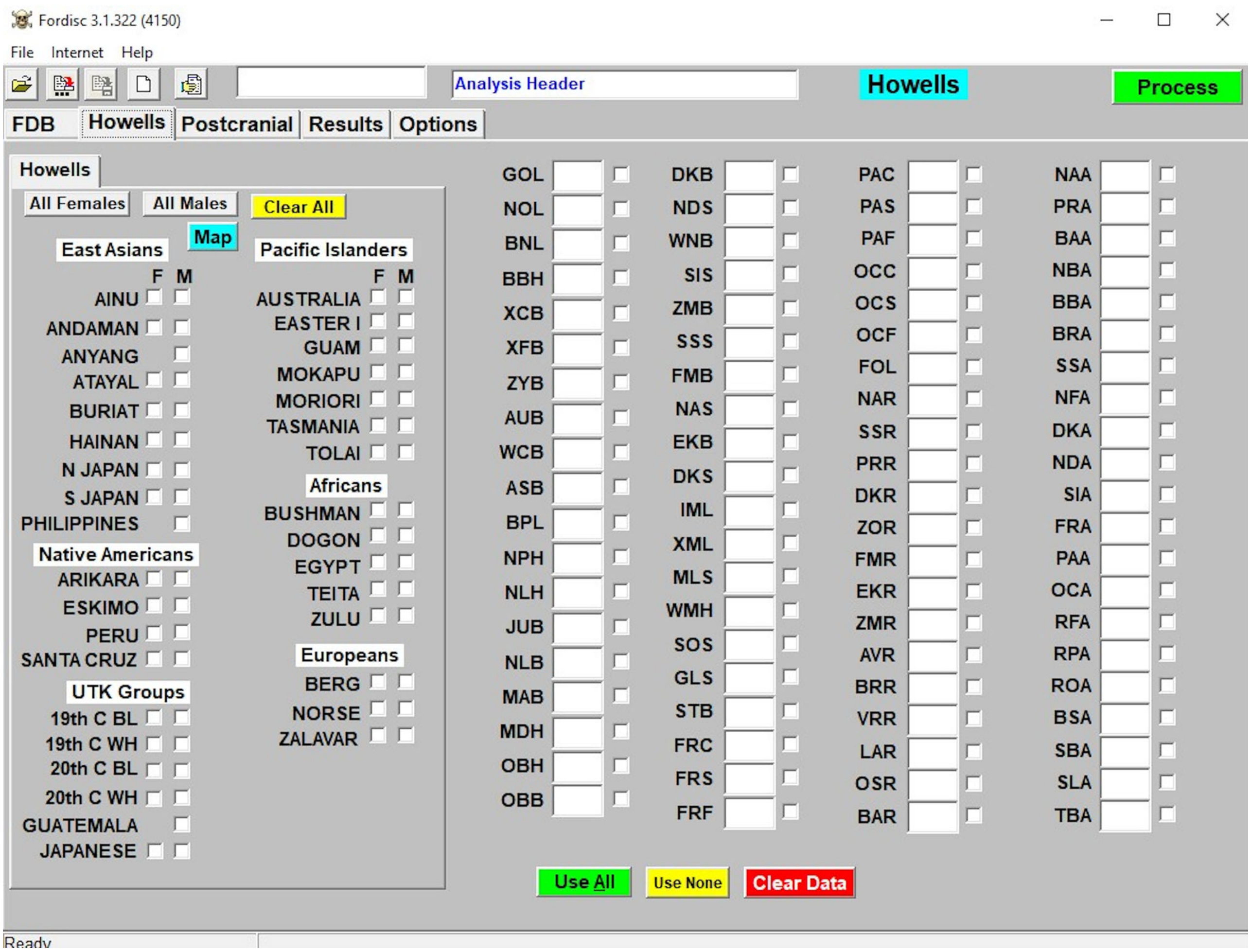

FIGURE 2 | The Howells tab in Fordisc 3.1. [This figure appears in color in the online issue]

When Pearson retired in 1933, Petrie requested that the E-series be kept together.[11] When Ronald Fisher succeeded Pearson as the Galton Professor of Eugenics and head of the Biometric Laboratory, he wanted to reorganize the space occupied by Pearson's skull collection.[12] However, the skulls were relocated in 1946 when Fisher moved to Cambridge University. The skulls, including the E-series, were stored at the University's Duckworth Laboratory of the Museum of Archaeology and Ethnology, where they remain today (Dickins 1953).

By the 1950s, physical anthropology and the study of race looked different from the discipline that Pearson tried to reshape in the early 20th century. Following UNESCO's Statements on Race and the Modern Evolutionary Synthesis, several anthropologists felt it was time for a "new physical anthropology" (Selcer 2012; Smocovitis 2012). This included dismissing the static classification of racial types in favor of a dynamic population approach that analyzed evolutionary change in human variation, inspired by genetic theory (Washburn 1951). However, there was no scientific consensus on the meaning of "race." Many researchers defended its biological existence, and statistical and typological approaches continued to coexist (Reardon 2005; Anderson 2020). One consequence of the emphasis on populations and statistical methods was the accumulation of more skeletal collections and data (Kakaliouras 2022).

American physical anthropologist William White Howells's career illustrates the shift to population approaches and data accumulation, as well as the continued relevance of typology. During his doctoral research, he realized he could not metrically validate the types he discerned visually in 198 "Melanesian" crania. He turned to Pearson's statistical anthropology, analyzing standard deviations, probable errors, and correlations (Howells 1934). In the next decades, Howells's expanding methodological toolkit paved the way for a new statistical anthropology.

In subsequent publications, Howells used data and hypotheses from Pearson's Biometric Lab and collaborated with statisticians at the University of Wisconsin, where he was a professor until 1954 (Howells and Hotelling 1936; Howells 1937). From the 1950s onward, he studied correlations between bodily measurements to understand *which* measurements were significant in human variation. This led him to multivariate statistics, which consider multiple measurements and their correlations at once instead of comparing populations one measurement at a time, as was still common in anthropology. Whereas Pearson opposed the "unscientific" morphoscopic method with his statistical anthropology, Howells (1984, 3) saw multivariate statistics as the "mathematical analogue of the visual or gestalt approach." However, like Pearson, Howells's (1943, 357) approach was unconventional: "Many of [my colleagues] object to any elaborate statistics."

Like Pearson, Howells's (1940, 265) data revealed wide individual variation and population overlap "in racial type," but he did not reject "the whole significance of race." He used the term "race" interchangeably with "populations," "nations," "types," and "racial groups." While he opposed racial hierarchies among the "White, Yellow and Black races," he considered "native Australians" "primitive" and "the most archaic of races" (Howells 1944, 221). Typological and racist conceptions of difference coexisted with his universalist statistical approach to human variation. By the 1970s, Howells embraced a genetic understanding of race, deeming racial classifications as discrete units a failure and supporting Livingstone's idea of clines. Yet he still believed that races existed and were "a most necessary object of study" (Howells 1971).

Howells (1970, 126; 1973, vii) believed that multivariate statistics could revitalize skeletal studies as "a primary means of analyzing biological material, including human crania, in populational terms." In 1965, Howells (1973, 6) started a world crania study, measuring 17 collections[13] that represented "real population units . . . of narrow genetic origin." He selected collections representing Europe (3), Africa (5), Asia (2), Oceania (4), North America (2), and South America (1). His selection of skulls relied on preexisting collections and typologies: Howells visited departments, museums, and institutes housing cranial collections arranged and classified by anthropologists in previous decades. Collection managers at these sites helped with selecting skulls. One of the collections Howells measured was Pearson's "Egyptian" E-series at the Duckworth Laboratory at Cambridge University. Of the 1,800 skulls, Howells (1973, 14) selected 58 male and 53 female skulls, "at random, from the most convenient part of the stacks, any skulls in sufficiently good condition." This diverged from Pearson's law of large numbers, where objectivity required enormous samples. Howells introduced a new kind of objectivity in statistical anthropology, shifting from many skulls to many measurements, analyzed with multivariate statistics. He took 70 measurements of each of the total 1972 skulls, creating a voluminous craniometric database, which was computed by the Harvard Computing Center.

Howells published the results in *Cranial Variation in Man* (1973), where he reiterated that multivariate analysis of 70 cranial measurements per skull allowed him to make "objective statements" about "the relative importance of . . . [cranial] shape in differentiation of human ethnic types" (1, 47). He also used a method that measured the distance between two groups of measurements in a dataset, the Mahalanobis D^2 distance. Indian statistician Prasanta Chandra Mahalanobis developed the measure in Pearson's lab in the 1930s as an improvement of Pearson's Coefficient of Racial Likeness. He used skull and body measurements to determine statistical-biological relations between racial groups and caste groups in India (Mahalanobis 1927; 1949).

Howells used multivariate statistics to relate individual variation to population variation in skull shape and concluded that population differences were extensions of individual differences. (Howells 1973, v–vi). However, clustering the findings produced outcomes that were "almost banal in its conformity to standard ideas of race and geography: Africans, Australoids, Caucasoids, and Mongoloids; or preferably, a coherent arrangement by geographical areas" (61). About the "Egyptian" skulls, he wrote: "There is nothing surprising in the position of the Egyptian E population, basically European but converging on sub-Saharan Africans either through genetic contribution or environmental adaptation" (155). Despite Howells's innovative approach, these conclusions echoed those of biometricians 70 years earlier, who found Egyptian skulls from Naqada, a few hours south of Giza, "in some characters ... resemble the Negro, in others the European" (Fawcett and Lee 1902, 464). Howells's work illustrates that advancements in statistics did not dismantle typological understandings of human variation but instead reinforced them. Typological race became folded into the database through the selection and labeling of skulls, drawing on and perpetuating old anthropological practices rooted in race science. Moreover, his research questions presupposed racial distinctions tied to geography. By folding typological understandings of race into the research design, the statistical analysis produced answers that reaffirmed those typological understandings.[14]

Howells's statistical anthropology inspired other anthropologists to apply multivariate statistics to cranial data. He was the PhD advisor of Giles and Elliot, who developed the racial classification formula commonly used before Fordisc. Howells retired in 1974 but continued to publish and extend his worldwide cranial database until the mid-1990s. Howells may have anticipated the usefulness of his database and methods for archaeological research and forensic identification, writing in 1973 that the database could "meet the problem of assessing single individuals (crania) relative to known populations" (3).

In 1996, Howells announced in the *American Journal of Physical Anthropology* that his entire database, including the E-series, was available online in compressed zip files. This move made the data easily accessible to institutions all over the world. Stephen Ousley and Richard Jantz integrated Howells's database into Fordisc, where it remains active today in statistical analyses for ancestry estimation using methods like Mahalanobis distances. Today, anthropologists reject the concept of biological races, but typological race persists in anthropological practice through the reuse of historical skeletal collections and data. Statistical rigor alone cannot overcome the problem with race. The work of Pearson, Mahalanobis, and Howells exemplified cutting-edge advancements in human variation research and statistics, not a form of "pseudoscience" we can easily dismiss and leave behind. This historical entanglement of race science and statistics remains embedded in anthropological collections, data, methods, and debates.

6 | The Trouble With Fordisc

When Fordisc was launched, US-based anthropologists quickly embraced the program, and forensic anthropology textbooks began to recommend it (Williams et al. 2005). Subsequent inquiries into Fordisc's usefulness focused on estimation *accuracy*. For example, Ubelaker et al. (2002) used Fordisc to classify 95 individual skulls from a 16th- and 17th-century Spanish church community. Fordisc classified the skulls into 21 groups, with "Egypt" being the most assigned category. The authors attributed this outcome to the lack of a Spanish sample in Fordisc: "additional and more complete samples from different geographical regions and groups are needed to augment the existing databases.

Such additions would improve an already useful forensic tool and make it more applicable to international forensic cases" (2002, 2). Manthey and colleagues (2018, 263.e1) reached a similar conclusion in 2018, claiming that "Fordisc's unsatisfying performance on non-US individuals" could be solved "by adding more population samples to its dataset." These authors confirm Ousley and Jantz's (1996, 19) warning against applying Fordisc to individuals whose "race or ethnic group is not represented in the reference sample" and echo Pearson, Howells's, and Snow's earlier calls for more data on more populations to solve problems of racial classification.

However, several anthropologists stress that this focus on accuracy overlooks two things. First, the practical problem that the correct reference population for unidentified individuals is unknown makes it impossible to know beforehand if the software should be applied (Albanese and Saunders 2006, 287). Second, problematic assumptions about human variation underlying the methods and reference database persist, requiring users to critically interpret the results. Williams et al. (2005) analyzed why Fordisc classified only eight out of 42 crania from northeast Africa as closest to the "Egypt" sample. They concluded that Fordisc fails because it uses cultural classifications as proxies for biology, categorizing racially rather than clinally, and assumes cranial form is an immutable "racial" characteristic. Additionally, Elliott and Collard (2009) warned against the uncritical use of Howells's cranial database because his skull selection methods were not random. They stress that Howells (1995, 3) "carefully selected" crania he considered typical of each group and excluded crania "morphologically unusual for the population as a whole" (Howells 1989, 89). Only a small percentage of individuals were measured; just 50 from nearly 1800 ancient Egyptian skulls, for instance. "Thus, the degree of overlap among the reference populations is likely to be artificially low," and "given that classification success in discriminant function analysis is inversely related to the degree of overlap among groups," FORDISC's ability to attribute ancestry is likely overestimated (Elliott and Collard 2009, 851).

Selection for typicality thus produces homogeneity within populations and increases differences between them. Although Howells acknowledged greater variation within human populations than between them, his typological selection of skulls prioritizes variation between populations. Howells's selection methods show how typological and statistical approaches informed each other and perpetuated a racial mode of classification. The selection of 50 skulls from the E-series, treated as a population in Howells's own and later in Fordisc's statistical analyses, exemplifies the flawed use of skeletal collections for building methods for ancestry estimation in forensic anthropology (Albanese et al. 2022).

Our critical engagement with Fordisc took the E-series along a different route. Tracing the data journey of the E-series back to Pearson reveals links between early 20th-century colonial practices of extraction and appropriation, race science, and modern statistical methods. The E-series is not the only data source in Fordisc that holds such histories. While researching the sources of Howells's database, we made a difficult realization. In *Cranial Variation in Man*, Howells (1973, 19) describes the dataset that comprises the "Bushmen" category as including the skulls of "41 males" and "49 females," one of which he identifies as the skull of Sara Baartman. Born circa 1789 in South Africa, Sara Baartman was brought to Europe in 1810 and performed as the "Hottentot Venus" until her death in 1815. Against her will, French naturalist George Cuvier dissected her body, made casts, and preserved her brain and genitals. Her skeleton was displayed in the Musée de l'Histoire Naturelle and later the Musée de l'Homme. In the mid-1970s, a feminist campaign fought to remove her remains and cast from display (Qureshi 2011). Curators put her remains in storage and allowed researchers like Howells to study them upon request (Tobias 2002).

On September 19, 1967, William Howells measured Sara Baartman's skull at the Musée de l'Homme in Paris. On the measurement recording sheet that we found in Howells's archive at Harvard University, he wrote her name and "Hottentot Venus" under the formal entries for "collection" name, "catalogue number," and "condition."[15] Howells transformed the measurements on the datasheet bearing her name into digital data and included them in his World Cranial Database. In 1995, while Jantz and Ousley moved these measurements online and into Fordisc's database, South African president Nelson Mandela requested the repatriation of Sara Baartman's remains and cast to South Africa on behalf of the Khoisan people (Tobias 2002). The 2002 burial of her remains and body cast on the banks of the Gamtoos River, the area where Sara Baartman grew up, was intended to end the abuse of her body by colonial and scientific extraction, appropriation, and objectification. An attendant of the ceremony expressed that "now, finally, she is free."[16] However, the measurements taken from her skull do not rest but are put to work any time someone runs Fordisc and includes the "Bushmen" sample. Through the Howells cranial database in Fordisc, Sara Baartman's remains continue to be enrolled in racializing practices.

Having studied the history and legacy of race science, we were familiar with Sara Baartman's disturbing history. Seeing her name on the datasheet made a profound impact on us, leaving us shocked and angered. Iris promptly brought the datasheet bearing her name to the attention of the archivist, who acknowledged that its presence in the archive could conflict with the Peabody Museum's established policies limiting access to sensitive anthropometric data. As of this writing, the Peabody has informed us that they are reviewing whether additional restrictions should be applied to Baartman's datasheet. The South African National Policy on the Repatriation and Restitution of Human Remains and Heritage Objects (Republic of South Africa 2021) defines unethically acquired human remains as encompassing "all documentation and data associated with unethically collected human remains." According to this policy, such documentation and data should be made available to claimants. However, restituting the datasheet does not conclude the data journey of Baartman's skull measurements, as these continue to have an afterlife in Fordisc.

Understanding the origin and provenance of human remains in skeletal collections historicizes and potentially rehumanizes them as unique individuals. Our emotional reaction to finding Sara Baartman's skull measurements in Fordisc contrasted with our reaction to the anonymized individuals in the E-series. Their individual trajectories will likely remain unknown. But does the absence of such knowledge make using those remains or their data less problematic? What about the other two individuals categorized as "Bushman" that Howells measured at the Musée de l'Homme? Howells notes that both were "presents" from the South African Museum, with one skull from the Colesberg Cemetery in Cape Town and the other from Beaufort West. At the University of Edinburgh, he selected four out of eight skulls "from acceptable areas" for his "Bushmen" sample, including one known individual who died "in captivity." He also noted that of the 20 individuals in the sample "reportedly or actually known to be Bushmen by life," some did "not look 'typically' Bush," making the sample less than "ideal" (Howells 1973, 19). These archival entry points reveal how histories of racial typology, colonialism, enslavement, and institutionalization are folded into the datasets that constitute modern technologies.

Debates in anthropology about the ethics of reusing skeletal collections address how these collections embody the violent history of acquiring bodies from vulnerable, marginalized people who died in institutions like hospitals and prisons, or under colonial power (e.g., Blakey 2020; Kakaliouras 2014; Watkins 2018).[17] Collecting, preparing, and anonymizing human bodies stripped them of their histories, turning them into depersonalized teaching and research objects. As Carlina de la Cova (2022) noted about the Terry, Hamman-Todd, and Montagu Cobb collections: "These collections have provided the 'samples' in which our forensic identification methods are based. They are the most published collections in the US. The discipline was literally built on their bodies." Provenance research can transform these from "working" to "unique" collections by adding distinctive histories to the individuals (Jardine et al. 2019). It also aids in the repatriation or restitution of human remains to communities of origin (Meloche et al. 2020).

However, provenance research methods can sometimes conflict with the antiracist and decolonial goals of restitution projects. Despite acknowledging that "typological methods have reinforced false perceptions about 'race'" and that "skeletal features are often ambiguous, continuous and over-simplify ancestry," Sabrina Sholts explains that the Smithsonian National Museum of Natural History nevertheless uses such methods to prioritize African American remains for repatriation (Sholts and Lawrence 2022). They consider the potential harm of leaving a case unresolved greater than the harm caused by the method, that is, reifying biological race. Similarly, anthropologists at the Field Museum in Chicago involved in the restitution of human remains told us that they recognize the problems with ancestry estimation methods but continue to use them. One said, "The only reason I run Fordisc is because I want to get someone home."

However, the ongoing use of measurements from Sara Baartman's skull shows that repatriation or restitution of human remains does not end their use. Data extracted from bodies in skeletal collections have afterlives as numerical entries in research databases, as reference data for new technologies, and in scientific publications. Reusing these datasets can perpetuate (settler) colonialism, alienating bodies from their personhood (Radin 2017). Data journeys make their continued use in technologies like Fordisc visible. Ethical issues not only pertain to the bone collections but also to the data taken from them. For instance, the 2017 Vienna Protocol, which provides recommendations for handling Holocaust-era human remains, includes guidelines for bodily data, drawings, and photographs (Hildebrandt 2022; Polak et al. 2021).[18] Similarly, the 2024 report by the Commission for the Ethical Treatment of Human Remains of the American Anthropological Association emphasizes that "images and other digital materials" derived from human or ancestral remains "should be considered as part of the respectful treatment of those whose actual remains are used" (Agarwal et al. 2024, 37). As skeletal collections become increasingly digitized for scientific use, the ethical consideration of human remains and data grows more urgent.[19]

7 | Conclusion

We want to stress the importance of historicizing the methods and technologies that underpin anthropological sciences and highlight three central issues that require attention. First, issues of race and racism in the discipline not only concern *ideas* but also critically involve *practices*. Viewing biological race solely as a concept or a relic of past thinking obscures how race is embedded in the materialities and practices of data organization and analysis, such as reference collections, databases, statistical techniques, and algorithms (e.g., Hopman 2023; Nieves Delgado 2023; M'charek and Van Oorschot 2019). While understandings of race have changed in science, medicine, and society in the past 100-plus years, typologies and prejudices remain embedded in statistical methods and the reuse of cranial collections and datasets. Our case study of Fordisc, specifically the "Howells tab"[20] and the data journey of the E-series, demonstrates that collections and methods are *intertwined*, both in their developmental histories and in producing racialized understandings of sameness and difference. Responding to recent calls in biological anthropology to historicize skeletal collections foundational to research, teaching, and casework, we recommend historicizing collections *in relation to* methods and technologies.

Second, statistical methods offer no "objective" safeguard against typological or biological race making. The data journey of the E-series reveals how the historical collections and concerns of race science are folded into new statistical methods and technologies. Statisticians like Mahalanobis and Pearson developed their statistical tools in service of racial classification. They researched skulls as both an object of study (to understand racialized variation) and as a tool to develop statistical methods (to understand distributions of sameness and difference). This embeds racialized notions of sameness and difference in the foundation of modern statistics. This history of statistics and race science is not about the development of pseudoscience, but rather the rise of a scientific methodology that significantly influences present-day research, *including* the way it is shaped by racializing understandings of human variation. Today, the Mahalanobis distance measure is part of popular statistical and programming packages like R and Python, used for classification and cluster analysis across various scientific projects, ranging from building a classification tool for oral precancer (Kumar et al. 2019) to detecting anomalies in wind turbines (Liu et al. 2022). Although kept in its folds, the Mahalanobis distance does not always invoke race. How the historical entanglement of race science and statistics affects current classification practices in statistical research where race is not evidently at stake, and how we should address the legacy of these methods, merits further exploration.

Third, the intertwined history of race science, anthropology, and the rise of datafication reveals new connections and pathways for change. Our historical investigation shows that the reification of race in biological anthropology is not confined to one method or technology but is spread across skeletal collections, databases, archives, software packages, and recording standards. This means that the issue of "race" in biological anthropology is not solved by repatriating racialized bodies out of institutions, dismissing the concept of race, or even abandoning ancestry estimation. Instead, meaningful change requires a continued deep commitment from anthropologists to rethink and reorganize the discipline, critically examine existing methods and sources, and explore new ways of identification, while engaging in interdisciplinary collaborations. Moreover, historical research shows that issues with racialized data are not unique to forensic anthropology. The problem with race in science runs deep. Datafication was deeply tied to racism, colonialism, and slavery in the rise of the medical sciences (Braun 2014; Kowal 2023).

Anthropology itself is no exception. These foundational issues constitute a shared history and therefore a shared responsibility across all branches of the discipline, including the so-called "four fields" of anthropology. We must remember that these divisions are historical constructs and that individuals central to their creation, including cultural anthropologists, were deeply engaged in colonial and race-making practices (Darnell 1982; Visweswaran 1998; Conklin 2013; Gil-Riaño 2023). As Ryan Jobson (2019, 261) provocatively suggests, it may be time to "let anthropology burn" to create space for envisioning "a future for the discipline unmoored from its classical objects and referents," such as race. Critically examining how anthropology's history with race has shaped its present is key to imagining a different future for the field. As more and more scientific disciplines begin to uncover and contend with the historical roots of their data practices, biological anthropology's critical discussions and journey of the past years can contribute to deconstructing racializing scientific practices across the wider scientific community to create more equitable and ethical scientific approaches in the future.

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Endnotes

[1] We use "biological anthropology" to encompass the various subdisciplines of anthropology that rely on human skeletal remains for producing knowledge, including bioarcheology and forensic anthropology. While forensic anthropology is a specialized subfield that applies anthropological methods to legal and criminal investigations, this article emphasizes the shared methodological and analytical foundations across these areas.

[2] On race as a "ghost variable," see Karkazis and Jordan-Young (2020).

[3] The term "collections" stresses the scientific value ascribed to assemblages of remains of deceased persons in museums and universities. However, it obscures and neutralizes the often-unethical ways in which the remains of people, frequently ancestors, were acquired and stored. While we use the term in this article, we acknowledge that it is rightfully contested and warrants critical reconsideration (Kakaliouras 2014).

[4] The formal name is FORDISC 3.1 Personal Computer Forensic Discriminant Functions. This is the program's most recent version.

[5] For more on Fordisc's statistical methods and output, see Ousley and Jantz (2012).

[6] Non-metric, morphoscopic methods were never abandoned in biological anthropology. Instead, anthropologist Joseph Hefner (2009) introduced a statistical framework to quantify trait scores and error rates, aiming to distance morphoscopic trait analysis from typological thinking and preserve its relevance to the field.

[7] We use historical terms as they appear (including capitalization) in the archival materials and documents consulted for this article, with brackets indicating they are actors' terms, not our own. Acknowledging their colonial roots and offensive nature, we include these outdated descriptions to show how such labels reflect the prejudices of their time and persist through uncritical reuse of data and measuring and naming practices.

[8] "Indian Knoll," an archaeological site in Kentucky, holds ancestral remains excavated in the 1930s and 1940s, now housed at the University of Kentucky's William S. Webb Museum of Anthropology. Labeled "culturally unidentifiable" in 1996, they were rendered ineligible for restitution under NAGPRA. Since 2020, the museum has imposed a research moratorium on Native American and Hawaiian remains. The 2023 removal of the "culturally unidentifiable" category from NAGPRA now encourages opportunities for restitution. See https://projects.propublica.org/repatriation-nagpra-database/institution/university-kentucky-william-s-webb-museum-anthropology/. Accessed December 19, 2024.

[9] Per the Fordisc 1 manual (1993), anthropologist Michael Pietrusewsky provided data from the 51 skulls. Pietrusewsky measured the skulls in 1989 and identified them as belonging to "war massacre victims of the 1978 invasion of Viet Nam by Khmer Rouge troops from Kampuchea." He selected the 51 skulls "from among the approximately one thousand currently on display in a memorial" in the village of Bachuc in the western Angiang Province (Pietrusewsky 1992, 13). This data journey warrants further investigation.

[10] Pearson and Davin (1924, 330) note that they excluded "broken, abnormal and non-adult crania" from his analysis and measured the sample's variability as smaller than that of a sample from a known location, a "London plague pit" sample. In other studies, the biometricians frequently used standard deviations, Pearson's coefficient of variation, and comparisons to the data of other "known" and presumed homogeneous samples to assess a sample's homogeneity.

[11] Karl Pearson Papers, University College London, Box 260, 11/1/16/94, Correspondence with Flinders Petrie, 24.11.1932.

[12] Ronald Fisher Papers, Adelaide University, Correspondence with G.M. Morant, July 21, 1933.

[13] By 1995, the dataset had grown to 28 populations due to subsequent research (Howells 1989, 1995).

[14] Deborah Bolnick (2008) similarly shows that genetic ancestry clustering programs will identify as many clusters as the user tells them to identify.

[15] William. W. Howells papers, 995.15.00/1, folder "South Africa—Bushman," Peabody Museum of Archaeology and Ethnology, Harvard University, Archival Paper Collections.

[16] https://www.washingtonpost.com/archive/politics/2002/08/10/after-186-years-human-rites/e601c499-2f8a-4b51-aa44-a9f2f8a44191/. Accessed July 5, 2024.

[17] These conversations build on long-standing campaigns, such as those that led to the Native American Graves Protection and Repatriation Act (NAGPRA) in the 1990s. NAGPRA became a call for institutional and disciplinary accountability for the role of anthropology, archeology, and museums in US colonial history and politics (Kakaliouras 2019).

[18] The protocol particularly addresses the reproduction and use of the Pernkopf Atlas of Human Anatomy, a classic reference work that controversially includes illustrations of dissected bodies of victims of the Nazi regime. The protocol outlines a religious and ethical evaluation procedure that balances the Jewish prohibition against deriving benefit from the dead with the potential use of the deceased for saving lives.

[19] See, for example, the case of the Pretoria Bone Collection (L'Abbé et al. 2021).

[20] It is plausible that one can run Fordisc solely using the FDB. As one reviewer aptly observed, the creation and application of the FDB warrants an investigation in its own right.

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