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Drew University
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LIFE AND DEATH DURING INDUSTRIAL PHILADELPHIA: SKELETAL HEALTH AND PATHOLOGICAL CONDITIONS OF THE 1800s

A Thesis in Anthropology

by

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Abstract

This is an analysis of a collection of a minimum number of nine incomplete skeletal remains, discovered from the site of the cemetery of the old First Baptist Church in Philadelphia, Pennsylvania, United States, dated to the late 18th century and the early 19th century. Through close examination of this sample, it was estimated the biological profile, taphonomic changes, presence of discrete traits, and pathological conditions, including antemortem trauma. Bioarchaeological and paleopathological methods and theory were used and instrumental in this research. This was a group of mostly young individuals, with 22.2% (2/9) of the sample under the age of 10 years at the time of death. 33.3% (3/9) of the sample were young adults, 33.3% (3/9) of the sample were middle-aged adults, and 11.1% (1/9) of the sample was an older adult. The adult sample was comprised of mostly women, with 42.9% (3/7) being female, 28.6% (2/7) being probable female, and 28.6% (2/7) being probable male, while the two non-adults were of undetermined sex. Using the stature equations for an assumed white population, the mean height of the sample was 160.63 cm (range: 152.16 cm – 170.89 cm, SD ± 7.31 cm). Using the stature equations for an assumed black population, the mean height of the sample was 158.07 cm (range: 150.28 cm – 167.41 cm, SD ± 6.71 cm). Despite the effect of taphonomy and the relatively low degree of skeletal completeness (mean: 55.7%, SD ± 12.4%), we were able to observe antemortem trauma (n=1), oral pathology (n=3), os acromiale (n=1), a cystic process (n=1), as well as rheumatic (n=1), congenital (n=1), vascular (n=1), and possible infectious diseases (n=2) in 77.8% (7/9) of the sample. The individual with trauma exhibited healed

fractures of the left tibia and in one right rib. Diffuse Idiopathic Skeletal Hyperostosis (DISH), one possible case of pulmonary tuberculosis, one unspecific infection, and one case of spina bifida occulta were the pathological conditions noted. This group of individuals appeared to be relatively healthy in life, though their health ultimately ceased with death. The main restrictions of this study were the small sample size and the limited access to complementary techniques (e.g., radiology) during research.

Keywords: Antemortem Trauma, Postmortem Destruction, Minimum Number of Individuals, Pathological Conditions, Discrete Traits, Bioarchaeology, Paleopathology

Table of Contents

List of Figures and Tables

1. Introduction

1.1 Thesis Statement

This thesis is focused on analyzing indicators of disease and possibly infering about health of individuals that lived in industrial Philadelphia and investigating how their lives in an industrial environment may have affected each person. This thesis will be presented in two parts: the skeletal sample analysis and a literature review with comparative analysis. The review will concentrate on the historical research of how health was related to status and social class during this period. My hypothesis, based on the research done of the remains and the historical literature, was that individuals of a lower social class are likely to have more health problems than their higher status peers due to a lack of access to resources and healthcare, and that the First Baptist Church was in a lower socioeconomic region of Philadelphia, based on the health issues of the remains examined.

1.2 Background Information and Historical Context

In 2017, nearly 500 human partial skeletal remains were unexpectedly discovered in Philadelphia, Pennsylvania. At 218 Arch Street, construction was taking place to build the parking deck of an apartment complex nearby, when human skeletal remains were discovered in the back piles of dirt. Originally, the site was the cemetery for the old First

Baptist Church of Philadelphia, which buried individuals from 1707 until 1860, when the church relocated. At that time, the remains were exhumed and reinterred at Mount Moriah Cemetery, or so the living members of the church thought.[1] While many of the graves were exhumed and the individuals reburied, there were some that had been left untouched and still had remains within them. The cemetery was no longer a historically protected site in 2017 under national law[2] and Pennsylvania state law[3], as it had not been connected to the First Baptist Church (added, at its new location, to the Philadelphia Register for Historic Places in 1995)[4] for 57 years and thus no longer had any historical protection. Since the construction was taking place on private land with private funding, the building contractors were under no legal requirement to stop construction, as based on the aforementioned and referenced national and Pennsylvania historical public property laws. Many of the skeletal remains were damaged by heavy machinery and equipment, and were therefore commingled, before the site manager finally agreed to stop construction for a week so that archaeologists and biological anthropologists could properly remove the rest of the remains. The Arch Street Project was formed to analyze these skeletal remains and learn about the lives of these individuals: "who these early residents of Philadelphia were, how they lived, and why were they left behind."[5]

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[1] First Baptist Church of Philadelphia, *Our History* (Philadelphia: FBC, 2018).
[2] National Park Service, *Title 36 - Parks, Forests, and Public Property §* (Washington, D.C.: Department of the Interior, 2012).
[3] The Pennsylvania Historical and Museum Commission, *Title 37 Historical and Museums §* (Harrisburg: Pennsylvania General Assembly, 2002).
[4] Philadelphia Artifacts and Buildings, *First Baptist Church of Philadelphia* (Philadelphia: The Athenaeum of Philadelphia, 2021).
[5] Arch Street Project, *History of the Project* (Philadelphia: Welcome to the Arch St Project, 2019).

The city of Philadelphia is rich with history, having been one of the first cities founded in the colonial United States, in the year 1682 by William Penn. It is where the Declaration of Independence was signed, where the First and Second Continental Congresses were held, where the preserved Liberty Bell is located, and was a temporary capital for the United States while Washington, DC was under construction. The city of brotherly love is one of the most populated in the country and was the first industrialized city and railroad hub in the early 1800s.[6] Philadelphian anthropologists and organizations have had plenty of experience with archaeological excavations, including the unearthing of human skeletal remains, which is not incredibly surprising, as the city is the site for hundreds of years' worth of history. Most of the excavation examples to be examined in this section were cemeteries of current or former churches, like the Arch Street project. These examples were found through the Philadelphia Archaeological Forum, which has kept a detailed record of comparable archaeological excavations, whose skeletal remains and material goods were dated to the same time as the Arch Street remains. We at Drew University are grateful to have been extended the opportunity to study six boxes of these skeletal remains in the context of the Arch Street Project led by researchers at Rutgers University, the primary collegiate institution in this endeavor.

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[6] Russell Weigly, et al., *Philadelphia: A 300-Year History* (New York City: W.W. Norton & Company, 1982).

1.3 Bioarchaeological Theory and Review

Bioarchaeology is the study of human remains from archaeological contexts and is one of the subfields of biological anthropology. Though it is one of the lesser-known fields of anthropology, there are several pieces of literature written on the topic. *A Companion to Biological Anthropology* (2010) defines bioarchaeology as "the study of human remains from archaeological contexts, especially during the last ten thousand years of human evolution," and places a strong emphasis on the link between culture and biology.[7] In the early era of studies on skeletal remains within biological anthropology, the field was being used to prove superiority and inferiority between races, and that it was not until after World War II that biological anthropology started focusing more on human origin and evolution, primatology, and human osteology and skeletal biology, though the field was being used to justify racism well into the 1960s. While it is unfortunate that biological anthropology was used for such archaic and unjustified means of separating human beings from each other, it is a most impressive field and can teach us a lot about not only the health of ancient remains but the culture they were surrounded by as well. Larsen and Walker (2010) place a strong importance on how the human skeleton is an accurate record of an individual's life, in both lifestyle and health. The collection of works above uses an incredibly in-depth look into how the field of bioarchaeology helped to advance bio-cultural research as a whole and uses a plethora of detail to describe the field itself, the research processes, and how to interpret the results.

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[7] Clark Larsen and Phillip Walker, "Bioarchaeology: Health, Lifestyle, and Society in Recent Human Evolution," in *A Companion to Biological Anthropology* (West Sussex: Wiley-Blackwell, 2010), 386.

As stated in *Bioarchaeology as Anthropology* (2008), "bioarchaeology is at the forefront in documenting the evolution and adaptation of human populations and the disease consequences of changes that occur."[8] This publication states explicitly that the field of bioarchaeology is the result of the merging of methods from the studies of skeletal biology and archaeology, and that such archaeological methods were to be used to both uncover remains and cultural artifacts, followed by using the knowledge of skeletal biology to interpret the remains and how the individual may have lived and died. This work places an incredibly strong emphasis on bioarchaeology being the field of both 'new archaeology' and 'new physical anthropology' which allowed further study of both ancient human culture and ancient human health. This piece of literature accurately reflects what the field of bioarchaeology is, though it focuses more on the agricultural changes human society underwent and the nutritional markers found on the skeleton which reflect these changes and does not explore the rest of the field as a whole.

An article titled *A Century of Skeletal Biology and Paleopathology: Contrast, Contradictions, and Conflicts* (2003) described bioarchaeology as "a bio-cultural approach to the analysis of skeletal remains that paralleled and supported the trends in archeology."[9] Simply put, this article also describes the field of bioarchaeology as being born of the merging of the studies of skeletal biology and archaeology. This article places a heavy emphasis on bioarchaeology being a field of scientific method and social hypotheses and

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[8] George Armelagos, *Bioarchaeology as Anthropology* (Atlanta: Emory University, 2008), 34.
[9] George Armelagos and Dennis van Gerven, *A Century of Skeletal Biology and Paleopathology: Contrasts, Contradictions, and Conflicts* (American Anthropologists, 2003), 58.

patterns, which can be performed in other fields, and does not go into detail about the specific processes of the field. Instead of looking at the field and its goals, this article calls into question the accuracy of bioarchaeological methods especially in conjunction with the social issues of the modern world. It also states that bioarchaeology is a multidisciplinary field. One thing this article does is accurately and explicitly reflect the strong link between the fields of bioarchaeology and paleopathology.

All of these published pieces of literature are able to identify the beginnings of the field of bioarchaeology and its overall basic purpose as a field of study. However, these three works all have incredibly different focuses on which aspects of bioarchaeology make it an inherently worthwhile field, or not. The first two works together offer the complete description and goals of the field, whereas the third is mostly a criticism of the field and its processes. Overall, the first piece of literature is the most detailed and accurate in its description of the field, its origin, goals, flaws, and methods, but all three works offered interesting insights into the field of bioarchaeology.

In the United States, people were growing more interested in how the environment changes a population's culture and overall health. This atmosphere is what eventually sparked bioarchaeology turning into an official field in the U.S. and earning its name in the 1970s,[10] specifically when Jane Buikstra was doing scientific research on human remains in the lower Illinois River Valley.[11] The excavation methods were taken from the field of general archaeology, and the analytic methods were taken from the fields of general

[10] Armelagos, 1.
[11] Larsen and Walker, 379.

biology and biological anthropology. The field of bioarchaeology has been able to get a more thorough look at the structure which provides a frame for the human body, as osteological study methods and technology, such as histology and radiology, progressed greatly over time. Recent technological advancements in the field include isotope analysis of bones and teeth, three-dimensional scanning, DNA analysis at the molecular level, databanks for morphological skeletal traits and comparison, and spatial scanning methods for excavations.[12]

Bioarchaeologists are able to look at bone on both the microscopic and macroscopic levels, find differing indicators of stress, determine where an individual has lived, figure out past migration patterns, and see how environments and disease changed human populations. Unfortunately, like in almost every scientific field, methods used to bioarchaeologically study populations, such as craniometry, osteometry, and anthropometry, were used in the past (up until the early- to mid-20th century) to try and prove the differences between races, though they are not biologically real.[13] However, the field of bioarchaeology has also taught us about our collective past and made exciting and insightful discoveries, like finding the remains of Nesyamun, a three thousand year old Egyptian priest who was able to "speak" due to 3D printing of his mummified vocal cords.[14] The study of past *Homo sapiens* is an exquisite process and offers frames of reference for the lives, health, cultures, and deaths of the current human population.

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[12] Mark Skinner, et al., *Guidelines for International Forensic Bio-Archaeology Monitors of Mass Grave Exhumations* (Elsevier: Forensic Science International, 2003), 81-92.
[13] Armelagos, 3.
[14] Meilan Solly, *Listen to the Recreated Voice of a 3000-Year-Old Egyptian Mummy* (Washington, D.C.: Smithsonian Institution, 2020).

Bioarchaeologists study human skeletal remains from approximately fifty years ago to ten thousand years ago, as remains dated more recently than fifty years generally fall under the purview of forensic anthropologists, and the remains dated older than ten thousand years go to the expertise of paleoanthropologists. Bioarchaeology is a truly spectacular field to conduct studies in, as much of human social transition (moving from a hunter/gatherer based way of life to one with domesticated plants and animals) was done within the last ten thousand years, though hominins have been on the planet for millions of years.[15] The most fascinating aspect of this is to see the health changes accompanying these culture changes that have affected several species of the *Homo* genus, but especially our own, in relatively recent times — the introduction of zoonotic diseases, along with the emergence of long-term care,[16] for example.

Bioarchaeologists have an ethical responsibility to care for the remains and to be diligent in their records, as well as to be respectful of stakeholders or any nation hosting the anthropologists, and to report back to the organizations they are working for. These are ancient individuals and cultures with important tales to tell. While respect for the remains is paramount, it is also intriguing to see the respect that ancient humans had for each other. The bioarchaeology of care is one rapidly emerging area of study. Tending for those who are impaired and can no longer take care of themselves is a defining custom among the human species.[17] It is remarkable to see individuals who have some kind of

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[15] Larsen and Walker, 386.
[16] Lorna Tilley, *The Bioarchaeology of Care* (Society for American Archaeology: The SAA Archaeological Record, 2012).
[17] Tilley, 39-41.

debilitating pathological condition live to years they would not have achieved had they been left to live without social support.

1.4 Paleopathological Theory and Review

Paleopathology is a highly specialized field, within the confines of bioarchaeology and anthropology as a whole, which studies the appearance of diseases in ancient skeletal remains. *A Century of Skeletal Biology and Paleopathology: Contrast, Conditions, and Conflicts* describes the focus of paleopathology as simply "the differential diagnosis of specific diseases."[18] This just means that there could be more than one disease that would be showing the same signs on the bones, and it must be determined which disease was actually affecting the individual in life. Paleopathology concentrates on the different possible diagnoses of the diseases, and its origin, the accompanying hassles of living life with a disease, and if the disease related to the death of the individual in any way.

Identification of Pathological Conditions in Human Skeletal Remains (2003) defines paleopathology as "the study of disease, both human and nonhuman, in antiquity using a variety of different sources including human mummified and skeletal remains, ancient documents, illustrations from early books, painting and sculpture from the past, and analysis of coprolites."[19] This is perhaps the most comprehensive description of paleopathology seen in the course of the writing of this thesis. Paleopathology is, by true definition, the study of old diseases, and this definition allows for the study of both humans

[18] Armelagos and van Gerven, 58.
[19] Donald J Ortner, *Identification of Pathological Conditions in Human Skeletal Remains* (New York City: Academic Press, 2003), 8.

and animals, using not only skeletal remains, but other ancient artifacts as well. While seeing evidence of pathological conditions on and in the remains or fossils is the only way to be definitively sure of ancient disease, documents found with or near the remains can also provide accurate representation of what occurred in the past. Ortner (2003) goes on to state that paleopathology can be helpful in diagnosing diseases in living skeletons in modern populations, and that bioarchaeologists are the most qualified individuals to study paleopathology, mostly relying on biochemists in order to get results.

As stated in *Paleopathology* (2009), this field is the study of "those diseases that affect the skeleton," as the preservation of soft tissue, where most disease symptoms are located, is rare in much of the world.[20] This definition of paleopathology does state precisely that it is the study of diseases affecting the bones, but also brings up an interesting point that the other two do not explicitly state. While some diseases leave evidence on the skeleton, most signs appear solely in the soft tissue of a human body. In a paleopathological and bioarchaeological context, the soft tissue of the remains will often decompose and disappear over time, leaving only the signs that appeared on the skeleton. This description of paleopathology both accurately defined the study and offered an extra point of insight.

These sources, while all at some underlying level identify paleopathology as the study of diseases, go into varying levels of description on the specifics of both the study and the field. One focuses solely on differential diagnoses, one gives a detailed description

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[20] Tony Waldron, *Paleopathology* (Cambridge, UK: Cambridge University Press, 2009), 1.

of the parameters allowed for this field of study, and one allows for the fact that soft tissue is often not preserved. Separately, the Ortner (2003) description of paleopathology is the most accurate and whole. Together, these three descriptions of paleopathology make up the complete picture of what the field actually is, what it studies, and how these studies are conducted.

It must be noted that the very nature of bones and teeth, and the fact that they do not disintegrate as easily as the rest of the body and material goods, make them most suitable for the study of pathological conditions in past populations, most often in humans, but also sometimes in animals. Paleopathologists have an advantage in studying diseases, as they have direct access to these bones, and many pathological conditions do leave their signs on the bones, such as congenital, oncologic, rheumatic, or infectious diseases (e.g., syphilis, osteomyelitis, leprosy, or tuberculosis). Environmental and funerary markers can also play a part in helping to determine which diseases or pathological conditions may have killed individuals or affected populations — such as mass graves in small European towns signaling deaths by the Bubonic Plague,[21] or sealed iron coffins being used in the burials of people who died of smallpox.[22] It is also truly fascinating to see how individuals and populations dealt with diseases, and to determine the rises, falls, and progressions of human diseases over time.

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[21] Brigit Katz, *Mass Grave Shows the Black Death's 'Catastrophic' Impact in Rural England* (Washington, D.C.: Smithsonian Institution, 2020).
[22] Mindy Weisberger, *Airtight Iron Coffin Found in Queens Held a Mysterious 19th-Century Mummy* (LiveScience, 2018).

The interest in human diseases has been around for thousands of years, as deviations from good and proper health are always a source of interest (and anxiety) to humans. It is important to once again note that paleopathologists are not in the business of figuring out strictly the health of an individual or a population, as health is multi-faceted. According to World Health Organization, health is defined as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity,"[23] and paleopathologists are focused on the causes and effects of diseases and injuries on the human body. Between the mid-19th century and the mid-20th century, human paleopathology as a term and as a field of study came into being, pioneered by a number of prominent physicians and anthropologists, who were interested in ancient diseases as they pertained to the human skeleton.[24] After the second World War, paleopathology started to be used as a tool to study past populations and the conditions they suffered from, and drew in closer towards the fields of demography and epidemiology. As technology has progressed, by the use of virtual skeletal reconstruction and the close study of both ancient and modern bacteria and viruses, so has the ability of pathologists and anthropologists to determine and understand unique skeletal abnormalities and certain causes of death in ancient populations, like the Arch Street remains.

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[23] WHO, *Constitution* (World Health Organization, 2021).
[24] Jane Buikstra and Charlotte Roberts, *The Global History of Paleopathology: Pioneers and Prospects* (New York City: Oxford University Press, 2012).

1.5 Research and Relevance

This study drew largely from the biological field of anthropology. This research was focused on the study of human remains and the pathological conditions they presented with. It is fascinating to see how one can reconstruct the past and learn about individuals and populations by studying skeletal remains. It is possible to determine how people lived, how they were cared for, and sometimes what they died from. The way to do this is by finding the different aspects of the biological profile (age-at-death, biological sex, stature, and ancestry), which is important in figuring out who the individual may have been in life. Discrete traits and pathological conditions are also important in determining how a person lived (trauma they suffered and diseases they contracted) and the health of both these individuals and their overall populations. The relevance of this in modern life is to see how the health of populations and individuals has changed over time, and to determine if what we learn can help the people of today.

The purpose of this research was to examine the health and lives of a small group of individuals from industrial-era Philadelphia, as well as to put bioarchaeological and paleopathological theory to practice. This group of people at the Arch Street location all have stories to tell, and we get to learn at least nine of those stories, as well as general information from Philadelphia, both then and now. The fields of bioarchaeology and paleopathology are both incredibly useful in the pursuit of knowledge of past humanity. In a more personal aspect, this research and thesis have been helpful in both broadening my experiences in these fields and allowing me to put my education to good practice. Now

that all of the data has been collected, the findings from this research will be shared with the project as a whole and uploaded into the Arch Street Project Database.

2. Materials and Methods

2.1 Materials

The old cemetery at the First Baptist Church of Philadelphia contained 407 burials remaining after the initial relocation of individuals to Mt Moriah Cemetery. Many bones became commingled during the construction work, due to equipment stirring up the dirt. This is why, of the six boxes received, there were a minimum of nine individuals to study. Each box contains bones marked with white ink, depicting a nomenclature of RU-XXX-XXX. RU stands for Rutgers University, which is the institution the Arch Street Project was working with to care for and organize the remains. The first set of numbers represent the labeled box they came from, and the second set of numbers represent the individual bones which are marked as identifiers.

Boxes RU-009, RU-022, RU-029, and RU-037 had only individual skeletons, confirmed by the similarity of age-at-death markers, taphonomy, and anatomical characteristics. However, boxes RU-002 and RU-019 had the remains of more than one individual within them, and thus were assigned a nomenclature of A, B, or C for the purposes of this research. The box labeled RU-002 had a minimum number (MNI) of two individuals, based on the repetition of the same anatomical area for the same side. In this

instance, it was impossible to determine which specific bones belonged to which individual, though we were able to determine that there was one young adult, probable male (RU-002-A), and one adult female (RU-002-B). The box labeled RU-019 had a minimum number of three individuals. The first individual (RU-019-A) was a non-adult who was age 36-38 weeks in utero at death, estimated by the length of the fetal humerus. The second individual (RU-019-B) was a probable older male adult, and the third individual (RU-019-C) was a young adult female. Due to the presence of epiphyseal lines in the long bones and other age-at-death indicators, it was possible to separate most of the bone elements from RU-019-B and RU-019-C.

Drew University was granted access to six boxes of the remains by the Arch Street Project and Rutgers University, in order to aid in the documentation and analysis of these individuals. This sample served as the basis for the completion of this thesis.

2.2 Methods

2.2.1 Methods for Excavation by the Arch Street Project

In a report for the Arch Street Project, prepared by Architecture, Engineering, Construction, Operations, and Management (AECOM), the methods for excavation and project protocols are thoroughly outlined. The top protocol for the excavation team was to treat the burials and remains with the highest possible respect, and to ensure that every individual was identified and recovered with any of their artifacts. All skeletal remains were shielded from the public through the use of privacy screens and the prohibition of unauthorized photos or recordings. All funerary artifacts were maintained in order to be reburied with their associated individuals.

The actual excavation itself took place over one week, from March 7th to March 13th, 2017. A site grid was created first, then a backhoe was used to remove dirt from the disturbed burial sites. After the removal of the upper soil strata, the anthropologists began to manually remove the exposed subsoil so as to not damage any remains and to identify *in situ* burials as they had been for hundreds for years. Each distinct occurrence of skeletal material was assigned a grave number, even if there was more than one individual in said grave. First came the exhumation of defined graves — those few with headstones or intact coffins. Interments were drawn onto the grid map in order to keep track of them, and once human remains were exposed, high-resolution photographs were taken for documentation. In order to not damage the remains further, no analysis or identification was done in the field. The remains and their accompanying funerary objects were manually removed from

each grave with care and placed into properly labeled individual boxes or bags. A detailed log was filed for every box and bag, so that AECOM could keep track of where every set of remains was headed after exhumation.[25] The Arch Street Project hopes to have all skeletal remains and their funerary materials reinterred in the Mount Moriah Cemetery, which houses the rest of the First Baptist Church remains, by 2023.

2.2.2 Laboratory Analysis

Upon arrival to the lab at Drew University every day, a large swath of fabric and a cork cranial holder would be placed on a table, in order to keep the bones clean and protected. The remains were handled with the utmost care, and every bone was felt and looked over in great detail. The first objective was to take a complete inventory of the remains, cataloguing them by their RU-XXX identifiers. Next the minimum number of individuals (MNI) of the collection was determined, by totaling how many of the same bones were under the same identifying number, and then determining the minimum number of individuals there could be with those multiple bones.[26] There were a minimum of nine individuals in the collection we received. Every section of the skeleton was taken note of separately, usually in the following manner: skull, thoracic region, vertebrae, shoulders/arms, pelvic girdle, legs, and finally hands/feet. The length of the bones and size and distribution of the pathological conditions were measured with a sliding and spreading

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[25] AECOM, *218 Arch Street/First Baptist Church of Philadelphia Cemetery Relocation Project* (Philadelphia: PMC Property Group, 2017).
[26] Bradley Adams and Lyle Konigsberg, *Estimation of the most likely number of individuals from commingled human skeletal remains* (American Journal of Physical Anthropology, 2004).

caliper and osteometric board. All notes were neatly recorded into a journal, including sex estimation, age-at-death estimation, stature, discrete traits, and pathological conditions, before transferring the data into the Numbers software on a MacBook Air. Photographs of the remains were taken with an iPhone XS, with a ruler and an identifying number in each shot. At the end, the individualized skeletal remains were anatomically laid out. The RU-002 (MNI of two) skeletal remains were difficult to accurately individualize due to a similar age-at-death profile. The RU-019 (MNI of three) were individualized, at least partially, as described in section 2.1. After completely processing an individual or set, their bones were very carefully wrapped up and placed back into their boxes, which would then be moved out of the way.

2.2.3 Methods: Biological Profile and Paleopathology

Most of the methods for the identification and siding of the skeletal elements applied in this research were published in the manual authored by White and Folkens (2005). The methods for data collection and biological profile were mostly based on the guidelines in Buikstra and Ubelaker (1994).[27] These methods were used to estimate the approximate stature of these individuals, as well as their biological sex and age-at-death. It was important to determine biological sex first, because it can help determine the age-at-death of the individual. This comes second, followed by the stature of the person, as that is also dependent upon the sex estimation, as well as their age-at-death, in certain cases. In

[27] Tim White and Pieter Folkens, *The Human Bone Manual* (New York City: Elsevier Academic Press, 2005).

this research, we refrained from trying to determine ancestry. That aspect of the biological profile is always the most difficult to determine, as the accuracy of an individual's place of origin, based solely on skeletal remains, is usually poor.[28]

2.2.3.1 Biological Sex Estimation

Buikstra and Ubelaker (1994) [29] summarized and described the morphological methods used for determining the biological sex of the individuals in the present study. Regarding the traits of the pelvis, the subpubic region (ventral arch, subpubic concavity, ischiopubic ramus ridge) were evaluated and scored from one to three, where one corresponds to female morphology, two corresponds to undetermined sex, and three to male morphology (Phenice, 1969 *in* Buikstra and Ubelaker, 1994). The presence of preauricular sulcus was also evaluated. The shape of the greater sciatic notch was scored from one to five, where one corresponds to typical female morphology and five to typical male morphology, as indicated below in Figure 1.

[28] Elizabeth DiGangi and Jonathan Bethard, *Uncloaking a Lost Cause: Decolonizing Ancestry Estimation in the United States* (American Journal of Physical Anthropology, 2021).
[29] Jane Buikstra and Douglas Ubelaker, *Standards for Data Collection from Human Skeletal Remains* (Fayetteville: Arkansas Archaeological Survey, 1994).

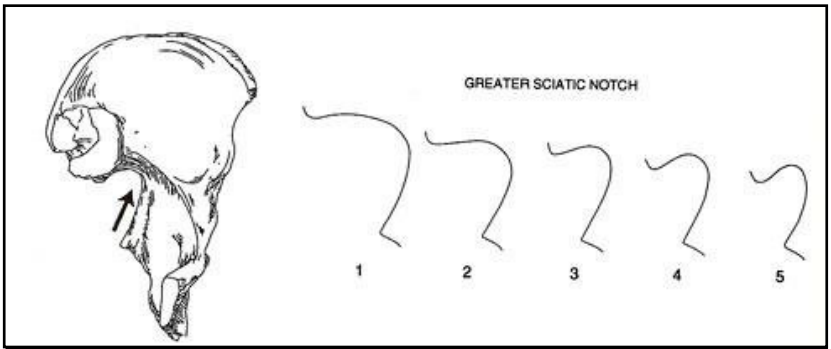

Figure 1. Illustration of the variation of the greater sciatic notch from Buikstra and Ubelaker (1994).

Additionally, the overall shape of the pelvis was observed. The female pelvis is low and wide, with an oval-shaped pelvic inlet, a wide pubic arch, and a relatively straight sacrum. The male pelvis is tall and narrow, with a heart-shaped pelvic inlet, a narrow pubic arch, and a sacrum that curves inward. The bones that make up the pelvis are the most accurate in the body to use for determining biological sex, as seen below in Figure 2.[30]

[30] Henry VanDyke Carter and Henry Gray, *Male vs female pelvis* (1918).

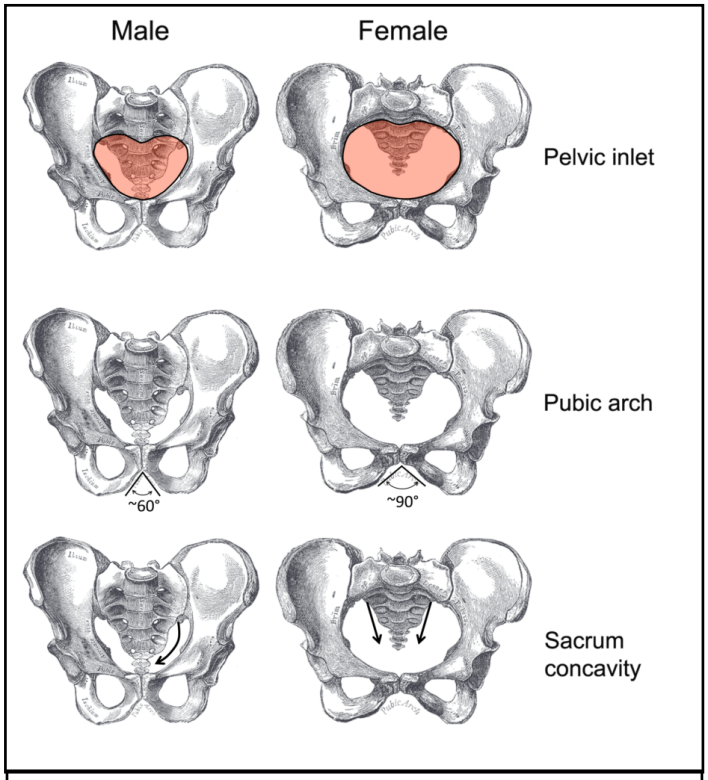

Figure 2. Illustration of some sexually dimorphic traits in the pelvis, from Henry VanDyke Carter (1918, plates 241 and 242), adapted by LumenLearning.

The second morphological method was applied to the skull. The traits scored are depicted below in Figure 3.[31] This method described in Buikstra and Ubelaker (1994) implies the observation of five characteristics when examining the skull, and these are also ranked from one to five, with one being more feminine morphology, and five being more masculine morphology. The first characteristic is the nuchal crest, which is a small

[31] Buikstra and Ubelaker, 1994.

protuberance on the occipital. It is able to be viewed from a lateral profile, and one should be able to feel the crest and determine the rugosity of the bone, as this is where the nuchal musculature attaches to the occipital bone. The second characteristic is the mastoid process, which is ranked by size, with a smaller mastoid process being associated with female morphology, and a larger one being a more masculine trait. The third characteristic is the sharpness of the supraorbital margin, which is a thin stretch of bone at the lateral aspect of the orbit. The more thin and sharp margins are scored as a female trait, and the more dull and thick margins are scored as a male trait. The fourth characteristic is the prominence of the supraorbital ridge which is a ridge on the frontal bone. By viewing the skull laterally, one can see how pronounced this ridge is. If the frontal bone is smooth, with little to no prominence, the trait is more feminine, and if the ridge is extremely pronounced and round, then the trait is more masculine. The fifth characteristic is the mental eminence of the mandible. By holding the mandible and feeling towards the midline until the eminence is reached, one can observe sexually dimorphic differences. If there is no protrusion, this trait is scored as female, and if there is a large, U-shaped protrusion on the anterior portion of the mandible, then the trait is scored as male. After assessing all sexually dimorphic structures, the individuals were allocated into the categories: female, probable female, undetermined sex, probable male, and male. It is important to note that non-adults cannot and should not be sexed, as these traits more prominent only after puberty.[32]

[32] White and Folkens, 385.

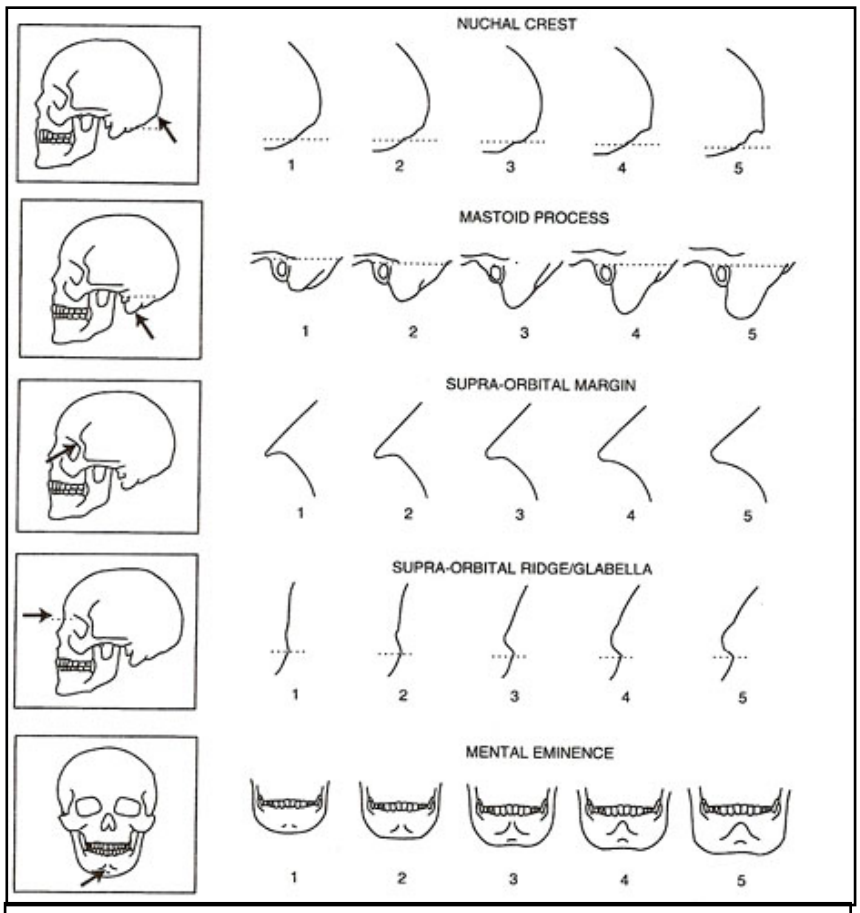

Figure 3. Illustration of the sexually dimorphic traits evaluated for the sex estimation from Buikstra and Ubelaker (1994).

2.2.3.2 Age-at-Death Estimation

There were multiple methods used to determine age-at-death in the course of my research. The Suchey-Brooks method (1990),[33] shown below in Figure 4 and Table 1,[34] helped to distinguish age-at-death of adults based on the male or female individual's pubic

[33] Nermin Sarajlić and Anisa Gradaščević, *Morphological Characteristics of Pubic Symphysis for Age Estimation of Exhumed Persons* (Bosnian Journal of Basic Medical Sciences, 2012).
[34] JM Suchey and S Brooks, *The Suchey-Brooks Method* (1990).

symphysis metamorphosis, due to the degenerative changes of bone morphology that occur with age.

Figure 4 (left). Illustration depicting the six age-at-death phases of the pubic symphysis for males and females, from the Suchey-Brooks method (1990).

Table 1 (below). Table depicting the data accompanying these six phases, for males and females, including the 95% age-at-death range, the mean age-at-death, and the standard deviation, from Suchey-Brooks (1990).

	Female (*n* = 273)			Male (*n* = 739)		
Phase	Mean	Standard Dev.	95% Range	Mean	Standard Dev.	95% Range
1	19.4	2.6	15-24	18.5	2.1	15-23
2	25.0	4.9	19-40	23.4	3.6	19-34
3	30.7	8.1	21-53	28.7	6.5	21-46
4	38.2	10.9	26-70	35.2	9.4	23-57
5	48.1	14.6	25-83	46.6	10.4	27-66
6	60.0	12.4	42-87	61.2	12.2	34-86

The Buckberry and Chamberlain (2002) method uses totaling scores from five different characteristics of the auricular surface of the os coxae. The characteristics are transverse organization (1-5), surface texture (1-5), microporosity (1-3), macroporosity (1-3), and apical changes (1-3), as seen below in Table 2.[35] After finding the composite score, one can determine which of the seven age stages the adult individual was in when they died, as depicted below in Table 3.[36] This method is also based on degenerative changes of bone morphology tied to increasing age.

Table 18.3 **Auricular age estimates.** Scoring of iliac auricular characteristics according to the revisions of Buckberry and Chamberlain (2002)

Characteristic	Score	Description
Transverse organization	1	90% or more of surface is transversely organized
	2	50–89% of surface is transversely organized
	3	25–49% of surface is transversely organized
	4	Transverse organization is present on less than 25% of surface
	5	No transverse organization is present
Surface texture	1	90% or more of surface is *finely granular*
	2	50–89% of surface is *finely granular;* replacement of finely granular bone by coarsely granular bone in some areas; no dense bone is present
	3	50% or more of surface is *coarsely granular,* but no dense bone is present
	4	*Dense bone* is present, but occupies less than 50% of surface; this may be just one small nodule of dense bone in very early stages
	5	50% or more of surface is occupied by *dense bone*
Microporosity	1	No microporosity is present
	2	Microporosity is present on one demiface only
	3	Microporosity is present on both demifaces
Macroporosity	1	No macroporosity is present
	2	Macroporosity is present on one demiface only
	3	Macroporosity is present on both demifaces
Apical changes	1	Apex is sharp and distinct; auricular surface may be slightly raised relative to adjacent bone surface
	2	Some lipping is present at apex, but shape of articular margin is still distinct and smooth (shape of outline of surface at apex is a continuous arc)
	3	Irregularity occurs in contours of articular surface; shape of apex is no longer a smooth arc

Table 2. Table from Buckberry and Chamberlain (2002), with the score system and the description of the morphological changes observed.

[35] J Buckberry and A Chamberlain, *Age Estimation from the Auricular Surface of the Ilium: A Revised Method* (American Journal of Physical Anthropology, 2002).
[36] Buckberry and Chamberlain, 2002.

Table 18.4 Age estimates derived from the composite scores of auricular characteristics.
(after Buckberry and Chamberlain, 2002)

Composite score	Stage	Mean age and standard deviation	Median age	Age range
5 or 6	1	17.33 ± 1.53 years	17 years	16–19 years
7 or 8	2	29.33 ± 6.71 years	27 years	21–38 years
9 or 10	3	37.86 ± 13.08 years	37 years	16–65 years
11 or 12	4	51.41 ± 14.47 years	52 years	29–81 years
13 or 14	5	59.94 ± 12.95 years	62 years	29–88 years
15 or 16	6	66.71 ± 11.88 years	66 years	39–91 years
17, 18, or 19	7	72.25 ± 12.73 years	73 years	53–92 years

Table 3. Table depicting the values associated with the composite score (mean and median age, standard deviation, and age range), from Buckberry and Chamberlain (2002).

In order to find the age-at-death estimation of the non-adults, we analyzed the length of the long bones, patterns of dental eruption, and epiphyseal fusion patterns. The spectrum of the epiphyseal closure timing is depicted below in Figure 5, by Buikstra and Ubelaker (1994).[37] It is an accurate method of determining age-at-death, as the epiphyses of long and flat bones fuse at known ages. Most individuals have these bones fuse between the ages of 15 and 23, and the levels of closure are determined to be nonunion, united, and complete union. The age ranges documented in the remains were determined from the following bones: clavicle, sacrum, femur, humerus, radius, and the spheno-occipital synchondrosis of the skull.

[37] Buikstra and Ubelaker, 1994.

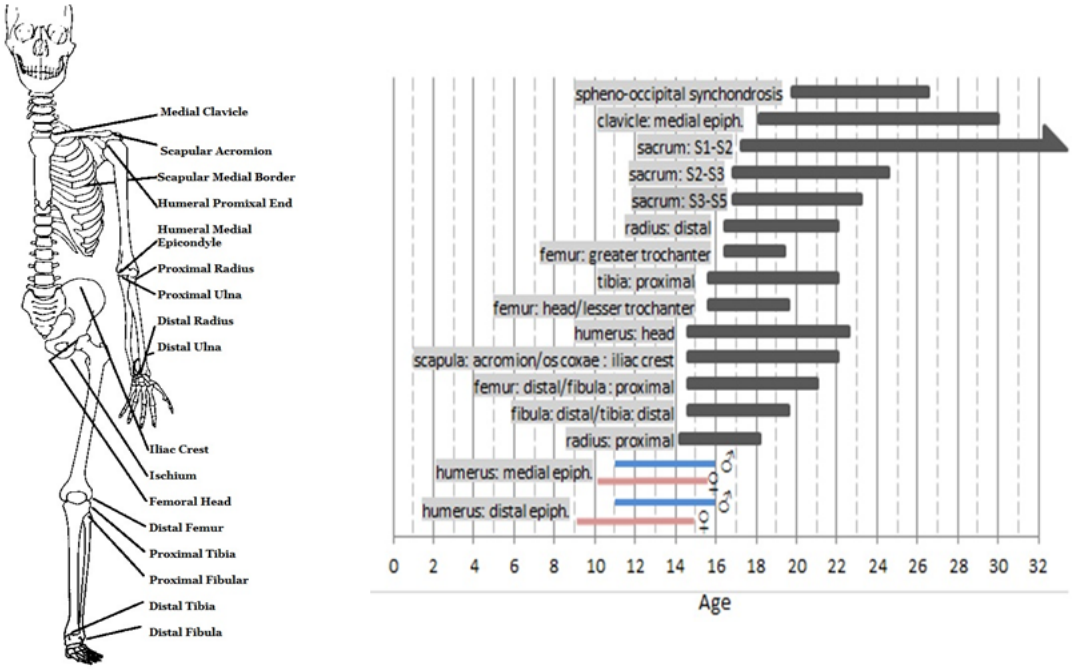

Figure 5. Illustration of the age intervals for the fusion of the epiphysis from Buikstra and Ubelaker (1994: 43).

The Schaefer et al. (2009) [38] reference tables for the length of the long bones were used to estimate age-at-death for the fetal/neonatal remains and for the child skeleton (RU-019-A and RU-037, respectively), as seen below in Figure 6.

[38] Maureen Schaefer et al., *Juvenile Osteology* (London: Academic Press, 2009).

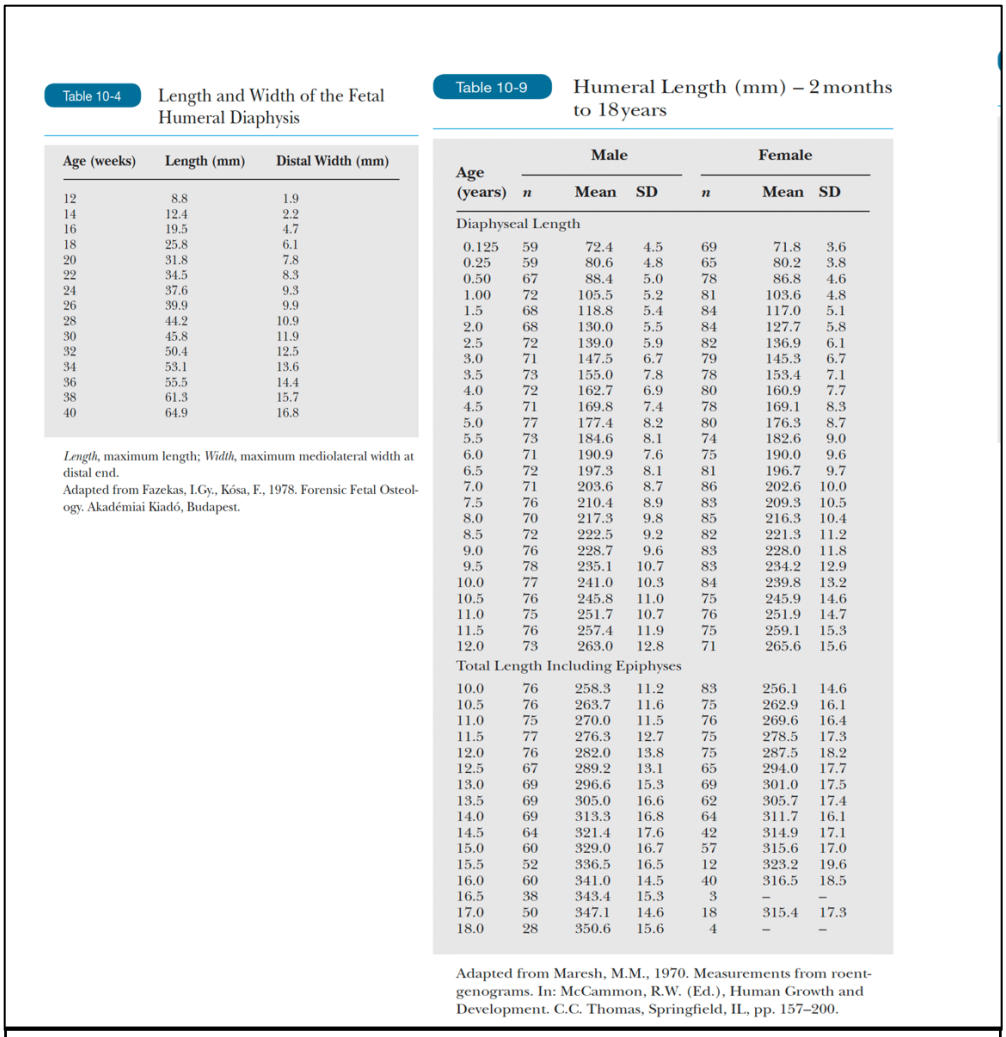

Table 10-4 Length and Width of the Fetal Humeral Diaphysis

Age (weeks)	Length (mm)	Distal Width (mm)
12	8.8	1.9
14	12.4	2.2
16	19.5	4.7
18	25.8	6.1
20	31.8	7.8
22	34.5	8.3
24	37.6	9.3
26	39.9	9.9
28	44.2	10.9
30	45.8	11.9
32	50.4	12.5
34	53.1	13.6
36	55.5	14.4
38	61.3	15.7
40	64.9	16.8

Length, maximum length; *Width*, maximum mediolateral width at distal end.
Adapted from Fazekas, I.Gy., Kósa, F., 1978. Forensic Fetal Osteology. Akadémiai Kiadó, Budapest.

Table 10-9 Humeral Length (mm) – 2 months to 18 years

Age (years)	Male n	Male Mean	Male SD	Female n	Female Mean	Female SD
Diaphyseal Length						
0.125	59	72.4	4.5	69	71.8	3.6
0.25	59	80.6	4.8	65	80.2	3.8
0.50	67	88.4	5.0	78	86.8	4.6
1.00	72	105.5	5.2	81	103.6	4.8
1.5	68	118.8	5.4	84	117.0	5.1
2.0	68	130.0	5.5	84	127.7	5.8
2.5	72	139.0	5.9	82	136.9	6.1
3.0	71	147.5	6.7	79	145.3	6.7
3.5	73	155.0	7.8	78	153.4	7.1
4.0	72	162.7	6.9	80	160.9	7.7
4.5	71	169.8	7.4	78	169.1	8.3
5.0	77	177.4	8.2	80	176.3	8.7
5.5	73	184.6	8.1	74	182.6	9.0
6.0	71	190.9	7.6	75	190.0	9.6
6.5	72	197.3	8.1	81	196.7	9.7
7.0	71	203.6	8.7	86	202.6	10.0
7.5	76	210.4	8.9	83	209.3	10.5
8.0	70	217.3	9.8	85	216.3	10.4
8.5	72	222.5	9.2	82	221.3	11.2
9.0	76	228.7	9.6	83	228.0	11.8
9.5	78	235.1	10.7	83	234.2	12.9
10.0	77	241.0	10.3	84	239.8	13.2
10.5	76	245.8	11.0	75	245.9	14.6
11.0	75	251.7	10.7	76	251.9	14.7
11.5	76	257.4	11.9	75	259.1	15.3
12.0	73	263.0	12.8	71	265.6	15.6
Total Length Including Epiphyses						
10.0	76	258.3	11.2	83	256.1	14.6
10.5	76	263.7	11.6	75	262.9	16.1
11.0	75	270.0	11.5	76	269.6	16.4
11.5	77	276.3	12.7	75	278.5	17.3
12.0	76	282.0	13.8	75	287.5	18.2
12.5	67	289.2	13.1	65	294.0	17.7
13.0	69	296.6	15.3	69	301.0	17.5
13.5	69	305.0	16.6	62	305.7	17.4
14.0	69	313.3	16.8	64	311.7	16.1
14.5	64	321.4	17.6	42	314.9	17.1
15.0	60	329.0	16.7	57	315.6	17.0
15.5	52	336.5	16.5	12	323.2	19.6
16.0	60	341.0	14.5	40	316.5	18.5
16.5	38	343.4	15.3	3	–	–
17.0	50	347.1	14.6	18	315.4	17.3
18.0	28	350.6	15.6	4	–	–

Adapted from Maresh, M.M., 1970. Measurements from roentgenograms. In: McCammon, R.W. (Ed.), Human Growth and Development. C.C. Thomas, Springfield, IL, pp. 157–200.

Figure 6. Tables with long bone lengths and age intervals from Schaefer and Black (2009).

Ubelaker (1987) published a method of determining the age-at-death of non- and young adults by examining the pattern of tooth formation and eruption, as depicted below in Figure 7.[39] Even if we did not use X-rays to evaluate the full pattern of tooth formation

[39] Douglas Ubelaker, *Estimating Age at Death from Immature Human Skeletons: An Overview* (Journal of Forensic Sciences, 1987).

and eruption, the work of Ubelaker (1987) was used as a complementary method for the non-adult skeletons.

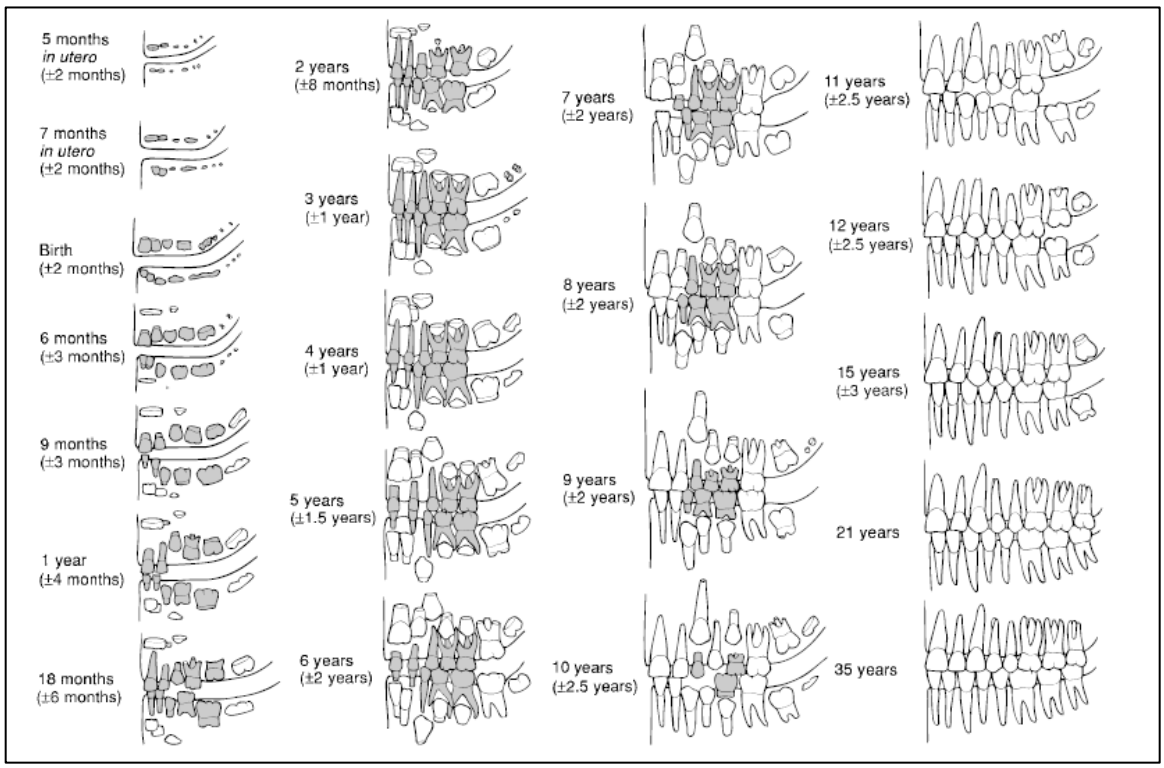

Figure 7. Illustration from Ubelaker (1987).

2.2.3.3 Methods for Stature Estimation

The formulae used to determine stature came from Trotter (1970).[40] It takes measurements from the long bones (e.g., femur, humerus, radius, ulna, and fibula). The formulae were used in the adult sample and took into consideration the sex estimation of

[40] M Trotter, *Estimation of Stature from Intact Long Bones* (Personal Identification in Mass Disasters, 1970), 71-83.

the remains. Every height was found by measuring the bone lengths in centimeters and inserting that number into the selected equation. The femur was the bone most regularly used to calculate height, as it is the one with the best correlation with the living height. While ancestry was not determined during the course of this research, the equations for both white and black males and females were used, as the cemetery these individuals were buried in belonged to a church that was attended by both white and free black individuals. The equations for stature are below in Tables 4 and 5.

White Males	*White Females*
3.08 x Humerus Length + 70.45 (± 4.05)	3.36 x Humerus Length + 57.97 (± 4.45)
3.78 x Radius Length + 79.01 (± 4.32)	4.74 x Radius Length + 54.93 (± 4.24)
3.70 x Ulna Length + 74.05 (± 4.32)	4.27 x Ulna Length + 57.76 (± 4.30)
2.38 x Femur Length + 61.41 (± 3.27)	2.47 x Femur Length + 54.10 (± 3.72)
2.68 x Fibula Length + 71.78 (± 3.29)	2.93 x Fibula Length + 59.61 (± 3.57)

Table 4. Stature equations for white population by sex, table by Trotter (1970). ± symbol refers to the SE (standard error). Values in cm.

Black Males	*Black Females*
3.26 x Humerus Length + 62.10 (± 4.43)	3.08 x Humerus Length + 64.67 (± 4.25)
3.42 x Radius Length + 81.56 (± 4.30)	2.75 x Radius Length + 94.51 (± 5.05)
3.26 x Ulna Length + 79.29 (± 4.42)	3.31 x Ulna Length + 75.38 (± 4.83)
2.11 x Femur Length + 70.35 (± 3.94)	2.28 x Femur Length + 59.76 (± 3.41)
2.19 x Fibula Length + 85.65 (± 4.08)	2.49 x Fibula Length + 70.90 (± 3.80)

Table 5. Stature equations for black population by sex, table by Trotter (1970). ± symbol refers to the SE (standard error). Values in cm.

2.2.3.4 Paleopathology, Discrete Traits, and Trauma

The other aspects of these individuals' lives that were determined were their pathological conditions and anatomical variations (that is, discrete traits or non-metric traits). Because numerous diseases show many of the same kinds of markers on skeletal remains, Waldron (2009)[41] and Ortner (2003)[42] were both consulted, in order to accurately determine which pathological condition that individual was suffering from, and how it could have affected their health. There are many diseases the individual could have had, but as there is often no more soft tissue to examine, a best estimate was made after exploring all possibilities. Pathological conditions were recorded considering their location, size, typology, and distribution in the skeleton. Trauma affecting the bones and unique skeletal characteristics were also documented. The process to record trauma followed the guidelines in Ortner (2003).

[41] Waldron, 2009.
[42] Ortner, 2003.

3. Results

3.1 Skeletal Completeness and Taphonomy

Skeletal completeness and their corresponding percentages were determined for only three individuals in the adult group, RU-009, RU-022, and RU-029, since the commingled bones of the other adult skeletons prevented a full assessment. The average skeletal completeness of these three individual adult skeletons is 55.7%, which is calculated by dividing the number of bones observed by the number of bones expected and multiplying by 100. The range is 45.0% to 73.0% of completeness, and the standard deviation is 12.4%.

The remains showed indications of taphonomic (postmortem) changes. Soil abrasion, insect activity, and the various pieces of construction equipment that dug into the different strata of the dirt were the main causes for postmortem changes to the bones. There were abrasions of the surfaces of the bones, as well as postmortem breakage, such as snapped long bones and crushed flat bones, due to both excavation by human and machine interference. The RU-019 young adult female had discoloration on the frontal bone, likely due to the oxidation of a coin or other metallic object buried with the remains, as seen below in Figure 8.

Figure 8. Oxidized portion on the frontal bone of the young adult female skeleton RU-019-C.

3.2 Biological Profile

It is inadvisable to macroscopically determine the biological sex of the young non-adults, as they have not finished maturing and growing. In the young adult sample (n=3) and adult sample (n=4), the majority were female, with 42.9% (3/7) being female, 28.6% (2/7) being probable female, and 28.6% (2/7) being probable male (see Table 6). Out of the entire sample of nine individuals, this means that 55.6% (5/9) are probable female or female and 22.2% (2/9) are probable male. The remaining 22.2% (2/9) of the sample were non-adults and thus sex was indeterminate.

As seen in Table 6, this sample was composed of mostly adult skeletons (77.8% (7/9), and only 22.2% (2/9) of the sample were the non-adult skeletons, RU-037 and RU-

019-A. The age-at-death of RU-002-A was unable to be determined with any degree of accuracy, as there were simply not enough remains to analyze, but based on the skull, it was determined that the individual was older than a non-adult, as all of their third molars had erupted, but still relatively young, as their cranial sutures were not fully obliterated. RU-002-A, along with RU-019-C and RU-009, made up the young adult population, 33.3% (3/9) of the total sample. RU-002-B, RU-022, and RU-029 made up the middle-aged adult population, 33.3% (3/9) of the total sample. RU-019-B was the sole older adult, at 11.1% (1/9) of the total sample. The average age-at-death for the adults (n=7) is 31.8 years (range: 18.5 years – 54.0 years, and the standard deviation is 13.4 years).

The stature average, calculated by the midpoint, assuming the sample population was white is 160.63 cm (range: 152.16 cm – 170.89 cm, and the standard deviation is 7.31 cm). The stature average, again calculated by the midpoint, for assuming the sample population was black is 158.07 cm (range: 150.28 cm – 167.41 cm, and the standard deviation is 6.71 cm).

Individual #	Biological Sex	Age-at-Death Intervals	Stature (White population)*	Stature (Black population)*
RU-019-A	Indeterminate	36-38 weeks in utero	Indeterminate	Indeterminate
RU-037	Indeterminate	3-4 years	Indeterminate	Indeterminate
RU-019-C	Female	PS=19.4±2.6 years AS=17.3±1.53 years	157.10 cm ± 3.72	154.84 cm ± 3.41
RU-002-A	Probable Male/Ind.	Young adult	Indeterminate	Indeterminate
RU-009	Probable Female	PS=19.4±2.6 years AS=17.3±1.53 years	168.21 cm ± 3.72	165.10 cm ± 3.41
RU-002-B	Female	PS=30.7±8.1 years AS=29.3±6.71 years	163.03 cm ± 3.72	160.31 cm ± 3.41
RU-022	Probable Female	PS=38.2±10.9 years AS=37.9±13.08 years	152.41 cm ± 3.72	150.50 cm ± 3.41
RU-029	Female	PS=48.1±14.6 years AS=59.9±12.95 years	152.16 cm ± 3.72	150.28 cm ± 3.41
RU-019-B	Probable Male	Mature to older adult	170.89 cm ± 3.27	167.41 cm ± 3.94

*Stature calculations using the standard error of the mean.

Table 6. Summary of the data of the biological profile for the total sample (excluding ancestry).
Legend:
PS: Pubic Symphysis
AS: Auricular Surface

All of the methods mentioned above were instrumental in determining both the age-at-death of all nine individuals, and the biological sex of the adult remains. To follow, there will be an in-depth look into which specific methods were used in these determinations for each individual.

RU-019-A: Age-at-death calculated by using the length of the humerus (59 mm) (Schaefer et al., 2009).

RU-037: Age-at-death was calculated based on the length of the humerus (155 mm) and the length of the femur (205 mm) (Schaefer et al., 2009). Erupted dentition was used as a complementary method (Buikstra, 1987).

RU-019-C: Epiphyseal closure pattern was used to estimate age-at-death (Buikstra and Ubelaker, 1994). The Suchey-Brooks (1990) method and the Buckberry and Chamberlain (2002) method were used to determine age-at-death based on the pubic symphysis and auricular surfaces, respectively. Pelvic traits were used to determine biological sex (Buikstra and Ubelaker, 1994). Stature was based on the length of the femur.

RU-002-A: The skull was considered to be a young adult based on the erupted third molars in conjuction with the non-obliterated cranial sutures. The skull traits method was used to determine biological sex (Buikstra and Ubelaker, 1994).

RU-009: The Suchey-Brooks (1990) method and the Buckberry and Chamberlain (2002) method were used to determine age-at-death based on the pubic symphysis and auricular surface, respectively. Both pelvic and skull traits were used to determine biological sex (Buikstra and Ubelaker, 1994). Stature was based on the length of the femur.

RU-002-B: The Suchey-Brooks (1990) method and the Buckberry and Chamberlain (2002) method were used to determine age-at-death by checking the pelvis; The Buikstra and Ubelaker (1994) pelvic traits method was used to determine biological sex. Stature was based on the length of the femur.

RU-022: The Suchey-Brooks (1990) method and the Buckberry and Chamberlain (2002) method were used to determine age-at-death by checking the pelvis; The Buikstra and Ubelaker (1994) pelvic traits and skull traits methods were used to determine biological sex. Stature was based on the length of the femur.

RU-029: The Suchey-Brooks (1990) method and the Buckberry and Chamberlain (2002) method were used to determine age-at-death by checking the pelvis; The Buikstra and Ubelaker (1994) pelvic traits and skull traits methods were used to determine biological sex. Stature was based on the length of the femur.

RU-019-B: This individual had incredibly low bone density and the long bones show some aging features. It was considered as a mature to older adult. Metric analysis of the long bones indicates that the long bones may belong to a male. Stature was based on the length of the femur.

3.3 Descriptions by Individual: Discrete Traits, Pathological Conditions, and Antemortem Trauma

The humerus of the RU-019-A non-adult skeleton, aged 36-38 weeks in utero at death, presented with extensive new bone formation, with characteristics of woven bone, above the cortex and some widening of the bone contour. The humerus measured 59.2 mm in length, and the new bone growth measured 14 mm wide at the distal end. Even though woven bone may be associated with a wide range of causes, it is possible that this growth was the result of an infectious process, since it also has alteration of the shape (Figure 9). It must be noted that no cloacae were detected. For this reason, a general diagnosis of a probable infection of unknown origin is likely. Exposure to bacteria from the mother or an infection passed along in the bloodstream to the womb most likely caused the fetus' bone infection.[43]

Figure 9. New bone formation on the distal end of the humerus of the non-adult RU-019-A skeleton.

[43] Waldron, 84.

The RU-019-C adult female skeleton had a possible cyst of a lumbar vertebra (Figure 10). The vertebral cyst could not be totally confirmed, as we would have needed X-rays to fully determine the characteristics of this lesion. Macroscopically, we observed a small hole, measuring roughly 6 mm in diameter, extending into her L1 vertebrae. Vertebral cysts, a possible diagnosis, are classified as uncommon, fluid-filled sacs found on the spine. While there are no symptoms, it can cause spinal stenosis, which can in turn lead to pain and cramping after a period of time.[44]

Figure 10. Vertebral cyst in one of the young adult female RU-019-C lumbar vertebrae.

[44] Ortner, 504.

This skeleton also showed a non-metric trait, a septal aperture of the left humerus (RU-019-013), seen in Figure 11. A septal aperture is a relatively common anatomical variation, developing in early childhood, and is classified as "the absence of a septum in the coronoid-olecranon fossae of the distal humerus."[45] This simply means that there are one or more small holes in the thin wall of bone found in the largest hollow of the humeral fossae, where the proximal head of the ulna typically rests against the distal end of the humerus.

Figure 11. Septal aperture in the left humerus of the RU-019-C skeleton.

The right scapula of the RU-019-B adult male skeleton presented with a non-metric trait classified as os acromiale, which is "an accessory bone resulting from failure of the acromial apophysis to fuse to the scapula during adolescence," and is due possibly either to a genetic defect or mechanical stress during puberty.[46]

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[45]Buikstra and Ubelaker, 92.

[46] D.T. Case, S.E. Burnett, and T. Nielsen, *Os Acromiale: Population Differences and Their Etiological Significance* (HOMO–Journal of Comparative Human Biology, 2006), 1-2.

In the RU-002-A young adult male skeleton, there was evidence of metopism of the frontal bone (Figure 12). Metopism is classified as the appearance of the frontal metopic suture persisting into adulthood, which is also uncommon.[47] The purpose of the metopic suture in infancy is to allow the anterior cranial fossa to grow, ensuring more space for the infant's growing brain. There is no cause for the metopic suture not obliterating as a non-adult, which is when they normally fuse for a completely smooth frontal bone. Furthermore, the RU-002-A young adult male skeleton had antemortem tooth loss of the inferior, left first molar (Figure 13).

Figure 12. A metopic suture in the frontal bone of the young adult male RU-002-A skeleton.

Figure 13. Healed dental alveoli of the RU-002-A young adult male.

Wormian bones, or sutural bones, were discovered on the skull of the RU-002-A young adult male (Figure 14), and are classified as uncommon, isolated, and irregularly

[47] Buikstra and Ubelaker, 87.

shaped bones found within the sutures on the cranium, usually the lambdoid suture.[48] Rarely, Wormian bones may be associated with diseases such as osteogenesis imperfecta, or brittle bone disease,[49] but in the present study there is no evidence of such association.

Figure 14. Seven Wormian bones found along the lambdoid suture of the young adult male skeleton RU-002-A.

One of the RU-002 skeletons presented with woven new bone formation on the visceral surface of two lower left ribs (Figure 15), associated with thickening of the shafts near the vertebral ends. New bone formation was also visible on one right rib in the mid-thoracic region. Due to taphonomic factors, it was difficult to verify if any other ribs had the same lesions. Some authors have observed the association of new bone formation in the visceral ribs and suggested pulmonary tuberculosis. This is one possible diagnosis for

[48] Henry Gray and Warren Lewis, *Anatomy of the Human Body* (Philadelphia: Lea & Febiger, 1918).
[49] F.H. Glorieux, *Osteogenesis Imperfecta* (Best Practice & Research Clinical Rheumatology, 2008), 85-100.

this skeleton, however, the absence of vertebral lesions or other indicators of tuberculosis, makes this diagnosis merely possible. Pulmonary tuberculosis is a respiratory disease originated by the *Mycobacterium tuberculosis*.[50] This individual also had osteochondritis dissecans of the left talus (RU-002-020), shown in Figure 16. It was unable to be determined if these affected bones were from the RU-002-A young adult male or the RU-002-B adult female. Osteochondritis dissecans is a "joint condition that occurs when a piece of cartilage, and the thin layer of bone beneath it, separates from the end of the [main] bone."[51] It is usually diagnosed between the ages of 10 and 20, and causes the individual varying amounts of pain and weakness, as well as a limited range of motion.

Figure 15. Two enlarged right ribs with new bone formation of an RU-002 skeleton.

Figure 16. Osteochondritis dissecans of the left talus of an RU-002 skeleton.

[50] Waldron, 90-92.
[51] Waldron, 153.

The RU-022 adult female skeleton also presented with two Wormian bones on the lambdoidal suture. Furthermore, the RU-022 adult female skeleton had antemortem tooth loss of the inferior, left second molar, and the inferior, left first premolar (Figure 17). This individual's facial bones had been destroyed between her death and excavation, so the maxilla, and subsequently the superior dentition, was not available for study.

Figure 17. Healed dental alveoli and missing premolar of the RU-022 adult female.

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The RU-009 young adult female had spina bifida occulta present in the sacrum (RU-009-030), shown in Figure 18. The type that this individual had is known as spina bifida occulta as the rest of the vertebrae were unaffected. While spina bifida occulta is usually mild with no disturbance of the spinal function, some individuals have neurological or physical disabilities. [52] Furthermore, the RU-009 adult female skeleton had antemortem tooth loss of the superior, left third molar, and all three inferior right molars (Figure 19).

[52] Ortner, 469.

Figure 18. Spina bifida in the sacrum of the young adult female skeleton labeled RU-009.

Figure 19. Healed dental alveoli of the RU-009 adult female skeleton.

The RU-029 adult female skeleton had a condition called Diffuse Idiopathic Skeletal Hyperostosis (DISH), in which the ossifications of the bones bear a striking resemblance to melted candlewax (Figure 20). DISH is classified as "exuberant production of new bone into the anterior longitudinal ligament of the spine with calcification or ossification of extra-spinal entheses and ligaments, and other soft tissues."[53] It is not known exactly what causes DISH, but it causes extreme pain and lack of motion in the spine.

[53] Waldron, 73.

Figure 20. Severe Diffuse Idiopathic Skeletal Hyperostosis (DISH) and osteophytic lipping on the vertebral column of the adult female skeleton labeled RU-029.

The RU-029 adult female skeleton was also the only individual within the sample who had suffered antemortem trauma, shown in Figures 21 and 22. This was underscored however by incredible amounts of postmortem destruction. At some point during her life, the left tibia (RU-029-064) had been broken through the diaphysis, and a right rib (RU-029-014) had also been broken near the sternal end.

Figure 21. Healed fracture of the left tibia of the RU-029 adult female skeleton.

Figure 22. Healed fracture of a right rib of the RU-029 adult female skeleton.

3.4 Sample: Discrete Traits, Pathological Conditions, and Antemortem Trauma

As depicted in Table 7, Wormian bones were the most prevalent of the discrete traits in this sample, appearing in 22.2% (2/9) of the remains, but also 11.1% (1/9) of post-infancy metopic suture, 11.1% (1/9) of os acromiale of the right scapula, and 11.1% (1/9) of septal aperture appearing on a left humerus. There were a wide range of pathological conditions and diseases in this collection of individuals. It is possible that an infectious process may have occurred in 22.2% (2/9) of the remains. There was also 11.1% (1/9) of vertebral cyst, 11.1% (1/9) of spina bifida occulta, 11.1% (1/9) of Diffuse Idiopathic Skeletal Hyperostosis, and 11.1% (1/9) of osteochondritis dissecans.

This sample was relatively free of antemortem trauma, with only RU-029 (11.1% or 1/9) portraying signs of two healed fractures: a medial diaphysis fracture of the left tibia and a right rib fracture of the sternal end. Three of the skulls in the sample, RU-022, RU-

002-A, and RU-009, 60.0% (3/5) of the total skulls, presented with signs of healed dental alveoli.

Individual	Pathological Changes	Discrete Traits	Antemortem Trauma	Oral Alterations
RU-019-A	Infection	None	None	None
RU-037	None	None	None	None
RU-019-C	Vertebral cyst	Septal aperture in left humerus	None	None
RU-002-A	New bone growth	Full metopic suture and wormian bones	None	Healed dental alveoli
RU-009	Spina bifida occulta in the sacrum	None	None	Healed dental alveoli
RU-002-B	Infections with new bone growth; Osteochondritis dissecans	None	None	None
RU-022	None	Wormian bones	None	Healed dental alveoli
RU-029	DISH; Abnormal bone growth	None	Healed fractures on tibia and rib	None
RU-019-B	None	Os acromiale in right scapula	None	None

Table 7. A continuation of the information for the full sample, including pathological changes, discrete traits, antemortem trauma, and oral alterations.

4. Discussion

4.1 Discussion of the Sample Studied

In this section, the health and overall attributes of this sample group will be examined, as well as a look into the results of age-at-death and biological sex, how the antemortem trauma may have been received, and a final, deeper look into the skeletal discrete traits and skeletal pathological conditions.

In this group, there are two individuals under the age of 10 years old, which is 22.2% (2/9) of the sample. There are three individuals (33.3% or 3/9) who are young adults, three individuals (33.3% or 3/9) who are middle-aged adults, and one individual (11.1% or 1/9) who is an older adult. The United States Census of the year 1800[54] was checked, specifically because it was roughly halfway between when the church was built and when the cemetery was moved. The Arch Street Project sample seems to be comparatively accurate in relation to the Census data. The number of individuals who were aged 10 and younger in 1800 made up about one third (33.0%) of the entire United States population, and they account for 22.2% (2/9) of this small sample. The majority of the

[54] Daniel Lynch, *1800s Census Questions* (Census Research for Genealogists).

population was counted in the young adult to middle-age adult age range, and fewer in the older adult age ranges.

One thing to keep in mind is that, in such a small sample size, as old as it is, there is the matter of differential preservation. For the RU-002-A individual, it was difficult to accurately determine both age-at-death and biological sex, due to the degradation of the remains. It was also difficult to determine the biological sex of the skull of the RU-019 group, which may have belonged to the RU-019-C young adult female. The fact that the non-adults cannot have their biological sex determined also prevented further statistical analysis.

Discrete traits are distinctive variations of the skeleton. These skeletal abnormalities are extremely common and are typically asymmetrical. While it would have been a wonderful research experience to be able to take X-rays of the skeletal remains in this small population of individuals, it was still quite interesting to see the various discrete traits that these remains presented with externally. In this sample, the cranial discrete traits appeared in 60.0% (3/5) of all cases, and the other 40.0% (2/5) of the cases appeared in the post-cranial skeleton as os acromiale (11.1% or 1/9 of the sample) and septal aperture (11.1% or 1/9 of the sample). Of the cranial discrete traits, the Wormian bones were most common, with two individual Wormian bones appearing on the adult female RU-022 cranium, and seven individual Wormian bones appearing on the young adult male RU-002-A cranium. The RU-002-A cranium also presented with the full post-infancy metopic suture.

Pathological conditions were also observed in the present study. Often signs observed in the skeleton can offer the paleopathologists an informed hypothesis on which disease(s) the individual may have been suffering from in life, and sometimes even if that particular disease is what killed the individual. In this sample, there were seven distinct pathological conditions to study. These conditions show that some biological function in these individuals was either compromised or failed completely. In 28.6% (2/7) of this sample, the pathological condition was new bone formation, possibly associated with an infectious process. For the non-adult RU-019-A skeleton, we could not be specific in determining a disease that would cause this new bone formation, and thus labeled it a general infection of the bone. In the RU-002 individual, the lesions and new bone formations could eventually be related with tuberculosis, but it is not possible to establish due to the absence of other signs of this condition. In the young adult female RU-019-C skeleton, the pathological condition was a small hole in one of her lumbar vertebrae, which led to the conclusion that it had most likely been a vertebral cyst. In one of the RU-002 individuals, the other pathological condition was a detachment of bone on the left talus, leading us to believe that osteochondritis dissecans is what the individual was suffering from. The adult female RU-029 skeleton showed signs of advanced osteophytic lipping of the vertebrae, as well as abnormal bone growth on the enthesis of the sacrum, the ribs, the calcanei, the femurs, the patellae, and one radius. Diffuse Idiopathic Skeletal Hyperostosis is the most likely etiology. The RU-009 adult female skeleton had malformed splits running medially through the sacral vertebrae, S1-S5, leading us to the conclusion that she had been born with spina bifida occulta.

Based on the research data, there was not much antemortem trauma, which is curious, as these individuals lived through war and its related destruction, the beginning of the Industrial Revolution, and jobs which required manual labor, such as fieldwork, construction, and textile mills.[55] Even though this was a small sample size to work from, it was slightly surprising that only one individual, the RU-029 adult female, who lived through a time period with less technologically advanced healthcare, had broken bones, and even then only two healed fractures. It was less surprising to see the high number of antemortem tooth loss, due to the poorer standards of dentistry of the late 1770s and early 1800s. There were healed dental alveoli present in the RU-002-A young adult male skeleton and the RU-022 adult female skeleton, and especially so in the RU-009 adult female skeleton. Overall, this small group of individuals made it through their lives relatively unscathed physically.

The causes of death for these individuals were impossible to determine. It is possible that the individuals who showed signs of a possible infection could have died from them, but this is merely speculative. It is unlikely that the spina bifida of the RU-009 adult female and the Diffuse Idiopathic Skeletal Hyperostosis on the RU-029 adult female had any causal effect on the death of these individuals. There were still many questions left after documentation and analysis. Did the mother of the RU-019 subadult also have an infection, possibly of the bone? What caused the fractures in the RU-029 female — trauma, a medical condition, stress? These were just two of many questions left at the conclusion

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[55] Harvard Business School, *Women at Work: Manual Labor* (Harvard Business School, 2010).

of this research. For such a small population, there were immensely fascinating discoveries to be made among these individuals, and while there were many answers found during this research, there were also several questions we were left with that will remain unanswered.

4.2 Health During the Industrial Revolution and the Civil War

In the 19th century, healthcare in the United States was moving into its own realm, away from European influences. Psychological care in particular surged forward with new practice, starting in Philadelphia.[56] Though medical knowledge was ever increasing, "physicians and lay people alike worried little about day to day infection" prior to the Civil War and the constant movement of large numbers of troops and their accompanying germs.[57] The Industrial Revolution forced most people out of rural settings and into the dense, urbanized areas,[58] and the Civil War saw the migrations of troops and the subsequent transference of diseases among susceptible populations, not to mention the uptick of hasty burials. However, poor hygiene does not affect one individual or just a small group of people — it affects the whole city and all of its inhabitants. In the 1760s, Philadelphians started working collectively to make their city a healthier one. "Street paving, garbage collection, increased water supplies, nuisance abatement, smallpox inoculation, hospitals and training programs for midwives, all began in the years before the

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[56] Anthony Walsh, *The 'New Science of the Mind' and the Philadelphia Physicians in the Early 1800s* (Carlisle: Dickinson College, 1976).
[57] Shauna Devine, *Health Care and the American Medical Profession, 1830-1880* (The Journal of the Civil War Era, 2018).
[58] Simon Szreter, *The Population Health Approach in Historical Perspective* (American Journal of Public Health, 2003).

revolution."[59] When the yellow fever epidemic hit in 1793, that spurred the city of Philadelphia to introduce the nation's first public water supply. Hospitals also started distributing the smallpox vaccine which helped to stabilize mortality rates even as the city grew. "Philadelphians claimed that theirs was the healthiest city in the nation;"[60] a claim that was probably true between the years of 1810 and 1850. Unfortunately, only the white upper and middle classes of Philadelphia had access to good healthcare, leaving the immigrants and the poor, both white and black, to suffer from deteriorating conditions. One of these conditions included being forced to group large families in small apartments, where the risk of disease transmission was especially high, and individuals were dying daily of typhoid, typhus and tuberculosis.[61] Fortunately, the American Public Health Association began a new sanitary reform of the city in the mid 1800s after the Civil War. Though increased health measures are no longer a novel thing, the treatment of lower-class individuals, especially those of color, is still not the best, in this case regarding healthcare.

4.3 Health and Social Status

Studies have long shown that subjective social status is always an accurate predictor of health and can have more impact on an individual's mental and physical well-being than their education, job, wealth, age, or marital status. While there are variations between the

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[59] Charles Olton, *Philadelphia's First Environmental Crisis* (Pennsylvania Magazine of History and Biography, 1974).
[60] Susan Klepp, *Demography in Early Philadelphia, 1690-1860* (Proceedings of the American Philosophical Society, 1989), 85-111.
[61] Richard Shryock, *The Early American Public Health Movement* (Durham: American Journal of Public Health and the Nation's Health, 1937), 2.

health of men and women, "socioeconomic inequalities in health [have always been] a key public health problem" overall.[62] Those of higher socioeconomic and social statuses are likely to live longer, be healthier, and have fewer disabilities. This is most likely due to the fact that those of higher social status have less to worry about in general, and also have better access to resources. This is not something that has changed between the 19th century and the modern era. In 1800s Philadelphia, it was common for the upper class to leave the lower classes to fend for themselves, especially in terms of health. Thousands of these lower socioeconomic individuals died of easily preventable diseases, caused in part by the greed and indifference of those of a higher social status.[63] This is disheartening to see, as these kinds of parallels are still occurring today, as those who have better access to resources tend to live both better and longer. Health clearly was and always will be a luxury, but the practice of both bioarchaeology and paleopathology shows just how much the quality of healthcare (vaccines, social safety nets, etc.) in this country actually has increased since the 1700s and 1800s.

4.4 Comparisons Between Arch Street and Other Philadelphia Sites

As stated previously, many of the other Philadelphia excavation sites took place at the cemeteries of current or former churches. All of these burial sites were uncovered on accident, in the process of the city of Philadelphia doing construction for other buildings and projects. There are so many human remains buried in Philadelphia, in old cemeteries

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[62] Panayotes Demakakos, et al., *Socioeconomic status and health: The role of subjective social status* (Social Science & Medicine, 2008), 330-331.
[63] Shryock, 2.

and potter's fields, that these accidental exhumations are incredibly common. There are dozens of unmarked cemeteries, graveyards, and general burial sites being monitored by the Philadelphia Archaeological Forum (PAF), in an interactive map database. The city of Philadelphia needs to be incredibly cautious when starting new projects which involve ground excavation, as to not destroy properly buried remains. The PAF wishes to remind the public that burial sites can extend down 25 feet into the ground, and that all human burials, marked or not, are protected and must either remain or be granted permission to be exhumed and reinterred elsewhere.[64] These individuals, however long they may have been dead, were human beings and are due the utmost respect.

One of the goals of this thesis was to compare the data of the Arch Street Project with the data of other Philadelphian burial excavations, examples of which were provided by the Philadelphia Archaeological Forum. While four out of the five total excavation sites were comparable in terms of the locations of burials, the paleopathological and bioarchaeological aspects of the remains were more widely varied between the five sites. Below there are four examples to compare with the Arch Street remains, which are all intriguing cases.

In a report created for the United States Department of Transportation, there was a significant archaeological data recovery project undertaken in 1990 of a former cemetery, used between 1810 and 1822, belonging to the First African Baptist Church at Tenth Street. In making room for the new Vine Street Expressway (I-676), "the skeletal remains and

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[64] Philadelphia Archaeological Forum, *Historic Philadelphia Burial Places Map* (www.phillyarchaeology.net, 2018).

funerary artifacts of 89 African-American individuals" were found.[65] The congregation buried here belonged to one of the earliest free African American churches in Philadelphia. The remains buried here showed high levels of trauma on the bones, as well as evidence of disease. While the Arch Street remains were most likely a conglomerate of both white and black individuals, there was trauma in only 11.1% (1/9) of the remains, but pathological conditions in 44.4% (4/9) of the remains. However, the conditions apart from tuberculosis could not lend any insight into the socioeconomic status of the Arch Street remains. The information learned from the Vine Street excavation was incredibly insightful, as these remains were able to offer up details about an extremely marginalized group that had little historical documentation.

The burial grounds of one other First African Baptist Church at Eighth Street, dated 1823 to 1842, were discovered during construction, filled with remains of those who had died as free black and religious individuals.[66] Several of these remains were buried with household items, such as shoes, plates, and ceramic vessels, in order to help guide the spirits of the deceased into the next world. While this has been unverified, it was assumed to be a tradition held over from the creole aspect of enslaved culture, and not a direct African or Christian tradition, thus showing that individuals of many traditions and backgrounds were allowed to be buried in these cemeteries.[67] These rituals were

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[65] Philadelphia Archaeological Forum, *Research and Reporting On Archaeological Burials in Philadelphia….* (www.phillyarchaeology.net, 2018).
[66] Patrice Jeppson, *Digging Up the Past: First African Baptist Church Burial Grounds* (Philadelphia: the African Diaspora Archaeology Network, 2007).
[67] John McCarthy, *Plates in Graves: An Africanism?* (Philadelphia: the African Diaspora Archaeology Network, 1998).

something unique to these burial grounds, and not seen to quite the same degree in the Arch Street remains. This congregation in particular seemed to have an immense respect and regard for their ancestral traditions, and while they did consider themselves Christians, they also took precautions in order to keep the souls of their loved ones from remaining in this world and becoming ghosts.[68] In the Arch Street burials, the customs were not of direct African influence, with only a few small items being interred with the remains. In these 1823-1842 burial grounds, there were 140 remains found, which indicates that the congregation was likely much smaller than that of the First Baptist Church of Philadelphia. Of the 140 Eighth Street remains, there were 60 non-adults and 75 adults, with 5 remains unsuitable for study. There were also 7 cases of fracture trauma, and 72 cases of pathological conditions caused by various disease states.[69] While the population numbers between these two studies are not wholly comparable, there were more adults than non-adults in both, and very low cases of fracture trauma in both.

These cases of the First African Baptist Churches are similar to the Arch Street Project in two ways. These remains were also buried in the cemeteries of churches which hosted black congregants. The burials were found under similar circumstances, during construction projects aimed at vehicular ease of access. However, the difference here is that the African Baptist Church burial grounds were found on public property, and not private property like the Arch Street burial ground. There was immediately a partnership

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[68] Michael Parrington and Janet Wideman, *Acculturation in an Urban Setting: The Archaeology of a Black Philadelphia Cemetery* (Philadelphia: Expedition, 1986), 60.
[69] J. Lawrence Angel, et al., *Life Stresses of the Free Black Community as Represented by the First African Baptist Church, Philadelphia, 1823-1841* (American Journal of Physical Anthropology, 1987), 213-229.

formed between the city, anthropologists, and the descendant community, in order to efficiently excavate the remains so that the construction could continue. Unfortunately, with the Arch Street Project, it took time to convince the property owners to stop the construction, and finally they were granted one week for excavation, but only after dozens of graves and remains had been desecrated. Hopefully, what happened with the Arch Street remains will not happen again in the event of an accidental exhumation.

In 2001 an excavation was performed in south Philadelphia, after the city's water department was attempting to lay down new pipes and instead uncovered human remains. The city's plan had been to simply lay new piping over the coffins and forget about the remains, as had been the plan of the Arch Street property owner early on. Fortunately, in both cases, other plans were made, and the remains were excavated and saved from further abandonment and possible desecration. Several professors (experts in anthropology, archaeology, history, and dentition) and students from Temple University, cemetery workers, and members of the Philadelphia Archaeology Forum helped to raise the coffins out of the pipe trench. It was found that the individuals had most likely been originally interred in the old St. Joseph's Catholic burial ground, with most of the graves having been relocated in the early 20th century. Over the course of four years, the remains were thoroughly analyzed and cleaned, and were then reinterred in the Laurel Hill Cemetery on Memorial Day, during a celebration commemorating Civil War veterans.[70]

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[70] A. Washburn, et al., *Partnering in a South Philadelphia Dig: The Washington Avenue Bioarchaeology Project* (Philadelphia: Philadelphia Archaeological Forum, 2018).

Fifteen individuals were uncovered during a thorough excavation, with nine adult remains and six non-adult remains. They were then taken to the Laboratory of Anthropology at Temple to be examined. The remains were dated to just before the Civil War (1824 to 1850), and though these individuals were originally thought to have died of injuries they sustained while fighting during the war, the designs of the coffins, clothing samples, and the demographics of these remains disproved this idea. There were very few material goods found with the remains, only buttons, a wedding band, strips of fabric, and a clay pipe, which are small, customary personal items, and dissimilar to the artifacts found with the First African Baptist Church remains. All of the non-adult remains were determined to have died very young, from 2-30 months old. The ages-at-death of the adults were not able to be determined with any specificity, but it was found that there were four males and five females. One adult had rickets, and one adult had periostitis of the tibia which had healed before death.[71]

These remains are relatively similar to the Arch Street remains. There were more adult remains than non-adult remains, with the non-adults having died fairly young, and the females outnumbering the males. However, there was more evidence of both antemortem trauma and pathological conditions in the Arch Street remains. The main parallel between this case and the Arch Street Project is that university students were allowed to assist in the excavations and examinations of the remains. The most curious aspect of this case was that, out of all these excavation examples, the individuals buried

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[71] R. Michael Stewart, *Summary of the Archaeological Salvage of Burials, Washington Avenue, Philadelphia* (Philadelphia: 2005).

here were most likely Catholic, compared to the rest of the Protestant congregants of other churches. Unfortunately, in this example, there was more emphasis placed on the archaeological methods of this excavation, rather than the osteological findings of the remains.

Another interesting excavation took place in Franklin Square, where the old First Reformed Church of Philadelphia (1741-1836) used to stand. The city was trying to transform the old park into a new fairground and instead uncovered 56 headstones and 30 burials. Because Franklin Square had been around since 1683, remains were not the only thing uncovered during this excavation. There were also pieces of decorative walkways, signs, and a gun-powder magazine.[72] This is intriguing, and an aspect unique to this particular site. During the excavations of the rest of the sites examined here, only funerary materials were found, and it is curious as to why the First Reformed Church chose a park as the burial ground for their deceased. The congregation of this church was mostly German immigrants and descendants, and church record shows that many of the individuals (more than 3,100 women, men, and children) died from yellow fever. These records, like in the First Baptist Church of Philadelphia, were carefully maintained by the minister of the church, and were able to be used for identification purposes, as the headstones had not been moved or destroyed, like they had for the Arch Street remains. The First Reformed Church remains that had been disturbed during construction were thoroughly documented and excavated by John Milner Associates, Inc.

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[72] Rebecca Yamin, et al., *"Leaving No Stone Unturned": Archeological Monitoring and the Transformation of Franklin Square* (Philadelphia: John Milner Associates, Inc., 2007).

There was an osteological analysis of the bones discovered in three of the excavated trenches, and it was found that several animals (one possible rabbit, one possible cow, and one possible ox) had been buried with the human remains. Of the human remains, the degree of erosion made it nearly impossible to identify biological sex or age-at-death of these individuals, and there was almost no trace of skeletal trauma or pathological conditions.[73] After the remains had been identified through records, they were cleaned and wrapped in cloth, and then laid back to rest in a small part of Franklin Square, and reinterred so that they would never be bothered again.[74] While the Arch Street remains were slightly eroded as well, it was still possible to determine the age-at-death for 66.7% of the remains and the biological sex of 77.8% of the remains, as well as the cases of skeletal trauma and pathological conditions. This level of erosion was surprising, as the First Reformed Church remains were only slightly older than the First Baptist Church remains. This was an incredibly intriguing case, because in all of the other excavation examples, the recovered remains were reinterred in a different location than where they were found, which is what will happen to the recovered Arch Street remains, as well. In this case, the Franklin Square remains were reinterred within the park, which was a lovely show of respect.

The buried individuals were religious and were often interred with artifacts. All of this information was discovered on the remains by professors, students, and non-academic anthropologists and archaeologists, and the excavations were done efficiently and respectfully, and most excavated individuals have been or will soon be reinterred at

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[73] Arthur Washburn, *Report of Osteological Analysis* (Philadelphia: 2006).
[74] Yamin, et al., 2007.

different resting sites. One very interesting thing to note is that all of these excavations appear to be of individuals from the same time period, the late 1700s to the mid 1800s, and one has to wonder why. It does seem upon closer examination that the city of Philadelphia has a very specific type of burial site — former religious settings with material goods, and in that roughly 75-year time period — that is often not found intentionally, and that the excavations and reinterments are handled and documented well.

4.5 Theories on the Abandonment of the First Baptist Church Remains

One of the most pressing questions we had at the start of this research project was: why were so many individuals who had been part of the congregation of the First Baptist Church of Philadelphia left behind, while the rest of the deceased had been properly reinterred at the Mt Moriah Cemetery? It is highly unlikely that hundreds of their fellow congregants were simply forgotten about. Because of this, there were two prominent theories extrapolated upon, based on prior research done during the course of the project.

The first theory is based on the fact that New York City was rapidly becoming the financial hub of not only the country, but the world, subsequently taking over Philadelphia's spot as the top economic hotspot. The idea here is that families were beginning to uproot from Philadelphia and move to New York City and the surrounding area. There may have been no workers to help exhume and then reinter the rest of the remains, and even if there were, there may not have been enough money or goods for the First Baptist Church to reimburse said workers.

The second theory is centered around the fact that the congregation of the First Baptist Church of Philadelphia decided to change its location to a different church building, and reinter its dead into the Mt Moriah Cemetery, circa 1860, which coincides with the beginning of the American Civil War. The idea here is that men were starting to be drafted for the Union forces and could not be spared for the strenuous and tedious labor of reinterment. Even if these men were still in the area, and even if they had not yet been asked to fight, the atmosphere in the northern United States was most definitely fraught with tension, as the southern United States became more aggressive. There is a natural human imperative to ensure that one's living loved ones are protected and safe, even if it comes at the expense of the respected, and subsequently forgotten, dead.

5. Conclusion

In sum, a minimum of nine individuals were found to have impressive skeletal pathological conditions, trauma, and discrete traits. The methods used and data that was collected has helped in my educational journey. It was interesting to study Philadelphia and some of its other burial sites, as they were similar in manner and individuals to the Arch Street Project. This research and study are relevant for three reasons: using bioarchaeological and paleopathological theory in practice, finding answers and rest for the forgotten individuals of the First Baptist Church of Philadelphia, and finding connections between the health of the past and the present.

In the end, my hypothesis was partially supported. Those individuals who were of lower socioeconomic status were more likely to have increased health problems. However, the First Baptist Church of Philadelphia welcomed practitioners of all races and backgrounds, and therefore there is no way to determine if the health issues of the individuals seen in this sample size were caused by lack of healthcare or just general human physiology. Philadelphia is a city that is full of vibrant history, and it was an extraordinary experience to be able to conduct research on the city and on this small group of individuals who will soon be returning home.

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Appendix

Appendix A: Full Inventory of the Remains

Remains Labeled RU-009:

-Cranium (RU-009-133)
-Mandible (RU-009-134)
-Left Scapula (RU-009-035)
*-Right Scapula (RU-009-033)**
-Left Clavicle (RU-009-022)
-Right Clavicle (RU-009-023)
-Left Os Coxae (RU-009-031)
*-Right Os Coxae (RU-009-033)**
-Sacrum (RU-009-030)
-Right Ulna (RU-009-026)
-Left Ulna (RU-009-027)
-Right Radius (RU-009-028)
-Left Radius (RU-009-029)
-Right Tibia (RU-009-132)
-Left Tibia (RU-009-127)
-Right Fibula (RU-009-024)
-Left Fibula (RU-009-025)
-Right Humerus (RU-009-128)
-Left Humerus (RU-009-131)
-Right Femur (RU-009-130)
-Left Femur (RU-009-129)
-Body of Sternum (RU-009-133)
-Right Patella (RU-009-011)
-Left Patella (RU-009-008)
-Right Calcaneus (RU-009-006)
-Left Calcaneus (RU-009-004)
-Right Talus (RU-009-005)
-Left Talus (RU-009-003)
-Right Navicular (RU-009-014)
-Left Navicular (RU-009-015)
-Right Cuboid (RU-009-013)
-Left Cuboid (RU-009-012)
-Left Medial Cuneiform (RU-009-010)
-Right Intermediate Cuneiform (RU-009-001)
-Left Lateral Cuneiform (RU-009-002)
-Right Lateral Cuneiform (RU-009-095)

-Left Intermediate Cuneiform (RU-009-099)
-Left Lunate (RU-009-102)
-Right Lunate (RU-009-106)
-Left Capitate (RU-009-097)
-Right Capitate (RU-009-098)
-Hamate (RU-009-100)
-Scaphoid (RU-009-101)
-Trapezium (RU-009-104)
-Triquetral (RU-009-096)
-Triquetral (RU-009-103)
-Metatarsals (RU-009-059, RU-009-060, RU-009-061, RU-009-063, RU-009-070, RU-009-077, RU-009-080, RU-009-081, RU-009-083, RU-009-088)
-Foot Phalanges (RU-009-009, RU-009-064, RU-009-066, RU-009-069, RU-009-074, RU-009-092)
-Metacarpals (RU-009-071, RU-009-072, RU-009-078, RU-009-082, RU-009-084, RU-009-086, RU-009-087, RU-009-090, RU-009-091)
-Hand Phalanges (RU-009-062, RU-009-065, RU-009-067, RU-009-068, RU-009-073, RU-009-075, RU-009-076, RU-009-079, RU-009-085, RU-009-089, RU-009-093, RU-009-094)
-Cervical Vertebrae (RU-009-057, RU-009-058, RU-009-043, RU-009-041, RU-009-056, RU-009-039, RU-009-053)
-Thoracic Vertebrae (RU-009-051, RU-009-055, RU-009-052, RU-009-045, RU-009-037, RU-009-050, RU-009-049, RU-009-048, RU-009-054, RU-009-046, RU-009-036, RU-009-044)
-Lumbar Vertebrae (RU-009-047, RU-009, 034, RU-009-042, RU-009-038, RU-009-040)
-Left Ribs (RU-009-018, RU-009-109, RU-009-118, RU-009-114, RU-009-112, RU-009-119, RU-009-120, RU-009-110, RU-009-124, RU-009-123, RU-009-021)
-Right Ribs (RU-009-017, RU-009-107, RU-009-116, RU-009-125, RU-009-113, RU-009-122, RU-009-126, RU-009-115/RU-009-016, RU-009-108/RU-009-020, RU-009-121, RU-009-117, RU-009-019)
-Unknown (RU-009-007)

**These two bones were labelled with the same identifying number.*

Remains Labeled RU-037:

-Cranium (RU-037-081)
-Mandible (RU-037-082)
-Right Scapula (RU-037-024)
-Left Scapula (RU-037-021)
-Right Femur (RU-037-001)
-Right Os Coxae (RU-037-025)
-Right Tibia (RU-037-003)
-Left Tibia (RU-037-023)
-Right Fibula (RU-037-019)
-Left Fibula (RU-037-007)
-Right Humerus (RU-037-002)
-Left Humerus (RU-037-004)
-Right Ulna (RU-037-012)
-Right Radius (RU-037-015)
-Right Ribs (RU-037-047, RU-037-006, RU-037-043/RU-037-042, RU-037-016, RU-037-009, RU-037-018, RU-037-017, RU-037-013, RU-037-011, RU-037-041, RU-037-029)
-Left Ribs (RU-037-040, RU-037-026, RU-037-043, RU-037-020, RU-037-010, RU-037-027, RU-037-014, RU-037-005, RU-037-008, RU-037-028, RU-037-046, RU-037-048)
-Right Clavicle (RU-037-045)
-Left Clavicle (RU-037-044)
-Left Calcaneus (RU-037-077)
-Left Patella (RU-037-073)
-Cervical Vertebrae (RU-037-052, RU-037-054, RU-037-050, RU-037-051, RU-037-049)
-Thoracic Vertebrae (RU-037-059, RU-037-062, RU-037-058, RU-037-055, RU-037-056, RU-037-064, RU-037-053, RU-037-057, RU-037-060, RU-037-061, RU-037-067, RU-037-071, RU-037-072)
-Lumbar Vertebrae (RU-037-065, RU-037-063, RU-037-022, RU-037-068, RU-037-070, RU-037-069)
-Unknown (RU-037-078, RU-037-074, RU-037-075, RU-037-066, RU-037-080, RU-037-079, RU-037-076)

Remains Labeled RU-019 (MNI 3):

-Subadult Humerus (no number)
-Cranial Fragment (RU-019-066)
-Right Femur 1 (RU-019-002)
-Left Femur 1 (RU-019-003)
-Right Femur 2 (RU-019-014)
-Left Femur 2 (RU-019-005/RU-019-004)
-Cranium (RU-019-001)
-Mandible (RU-019-011)
-Left Os Coxae (RU-019-019)
-Right Os Coxae (RU-019-020)
-Sacrum (RU-019-018)
-Right Humerus (RU-019-012)
-Left Humerus (RU-019-013)
-Right Ulna (RU-019-007)
-Left Ulna (RU-019-008)
-Right Radius (RU-019-017)
-Left Radius (RU-019-010)
-Right Tibia (RU-019-015)
-Left Tibia (RU-019-016)
-Fibula (RU-019-009)
-Fibula (RU-019-006)
-Right Patella (RU-019-069)
-Metatarsal (RU-019-065)
-Tarsal (RU-019-068)
-Tarsal (RU-019-067)
-Metacarpal (RU-019-070)
-Right Scapula 1 (RU-019-057)
-Left Scapula (RU-019-037)
-Right Scapula 2 (RU-019-038)
-Right Clavicle (RU-019-039)
-Cervical Vertebrae (RU-019-022, RU-019-027, RU-019-028, RU-019-032, RU-019-021, RU-019-031)
-Thoracic Vertebrae (RU-019-030, RU-019-029, RU-019-024, RU-019-035, RU-019-023, RU-019-025, RU-019-028, RU-019-026, RU-019-033, RU-019-036)
-Lumbar Vertebra (RU-019-034)
-Left Ribs (RU-019-049, RU-019-060, RU-019-043, RU-019-059, RU-019-063, RU-019-062, RU-019-010, RU-019-041, RU-019-058, RU-019-044, RU-019-054)
-Right Ribs (RU-019-040, RU-019-055, RU-019-045, RU-019-004, RU-019-051, RU-019-046, RU-019-053, RU-019-056, RU-019-055, RU-019-042, RU-019-052, RU-019-041)

Remains Labeled RU-029:

-Left Femur (RU-029-065)
-Right Femur (RU-029-063)
-Right Tibia (RU-029-062)
-Left Tibia (RU-029-064)
-Right Patella (RU-029-005)
-Left Patella (RU-029-004)
-Right Humerus (RU-029-003)
-Left Ulna (RU-029-050)
-Left Radius (RU-029-002)
-Right Fibula (RU-029-061)
-Left Fibula (RU-029-060)
-Sacrum (RU-029-057)
-Left Os Coxae (RU-029-013/RU-029-055)
-Right Os Coxae (RU-029-066)
-Left Calcaneus (RU-029-051)
-Right Calcaneus (RU-029-006)
-Left Ribs (RU-029-019, RU-029-023, RU-029-033, RU-029-018, RU-029-034, RU-029-032, RU-029-035, RU-029-031, RU-029-017, RU-029-026, RU-029-022)
-Right Ribs (RU-029-024, RU-029-031, RU-029-030, RU-029-028, RU-029-020, RU-029-024, RU-029-016)
-Thoracic Vertebrae (RU-029-070, RU-029-064, RU-029-072, RU-029-058, RU-029-015, RU-029-067, RU-029-014, RU-029-073)
-Lumbar Vertebrae (RU-029-068, RU-029-071, RU-029-059, RU-029-007, RU-029-056)
-10 Unnumbered Tarsals
-5 Unnumbered Phalanxes
-7 Unnumbered Phalanges
-2 Unnumbered Metacarpals
-3 Unnumbered Carpals
-Metacarpals (RU-029-049, RU-029-043, RU-029-037, RU-029-041, RU-029-036)
-Tarsals (RU-029-052, RU-029-053, RU-029-051/RU-029-006)
-Metatarsals (RU-029-042, RU-029-038, RU-029-048, RU-029-040, RU-029-046, RU-029-045, RU-029-054, RU-029-047, RU-029-044, RU-029-034)

Remains Labeled RU-002 (MNI 2):

-Cranium (RU-002-042)
-Full Mandible (RU-002-044)
-Partial Mandible (RU-002-043)
-Sacrum (RU-002-069)
-Right Os Coxae (RU-002-003/RU-002-019)
-Left Os Coxae (RU-002-012)
-Right Humerus (RU-002-063)
-Left Humerus (RU-002-067)
-Right Femur (RU-002-001)
-Left Femur (RU-002-064)
-Right Ulna (RU-002-062)
-Left Ulna (RU-002-065)
-Right Radius (RU-002-068)
-Left Radius (RU-002-066)
-Tarsal (RU-002-021)
-Phalange (RU-002-037)
-1 Unnumbered Carpal
-Metacarpals (RU-002-061, RU-002-007, RU-002-034, RU-002-036, RU-002-033, RU-002-035)
-Left Talus (RU-002-020)
-Left Clavicle (RU-002-018)
-Manubrium (RU-002-069)
-Right Scapula 1 (RU-002-081)
-Right Scapula 2 (RU-002-022)
-Left Scapula (RU-002-060)
-Thoracic Vertebrae from Individual One (RU-002-012, RU-002-009, RU-002-012*, RU-002-050)*
-Cervical Vertebrae from Individual Two (RU-002-031, RU-002-032, RU-002-026, RU-002-011, RU-002-018, RU-002-079, RU-002-025)
-Thoracic Vertebrae from Individual Two (RU-002-015, RU-002-016, RU-002-022, RU-002-073, RU-002-010, RU-002-014, RU-002-075, RU-002-074, RU-002-076, RU-002-071
-Lumbar Vertebrae from Individual Two (RU-002-023, RU-002-070, RU-002-072, RU-002-077, RU-002-017)
-Left Ribs (RU-002-006, RU-002-057, RU-002-047, RU-002-038, RU-002-055, RU-002-024, RU-002-041, RU-002-008
-Right Ribs (RU-002-058, RU-002-051, RU-002-050, RU-002-054, RU-002-041/RU-002-027, RU-002-056, RU-002-004, RU-002-005, RU-002-028, RU-002-053
-Rib Fragments (RU-002-048, RU-002-040, RU-002-046, RU-002-039, RU-002-013, RU-002-029)

Remains Labeled RU-022:

-Partial Cranium (RU-022-014)
-Mandible (RU-022-109)
-Left Zygomatic (RU-022-100)
-Left Os Coxae (RU-022-005)
-Right Os Coxae (RU-022-008)
-Left Femur (RU-022-006)
-Right Femur (RU-022-002)
-Right Tibia (RU-022-004)
-Left Tibia (RU-022-001)
-Right Humerus (RU-022-013)
-Right Ulna (RU-022-007)
-Left Ulna (RU-022-012)
-Right Radius (RU-022-009)
-Left Radius (RU-022-011)
-Right Fibula (RU-022-010)
-Left Fibula (RU-022-003)
-Left Scapula (RU-022-034)
-Right Scapula (RU-022-032)
-Right Clavicle (RU-022-078)
-Left Clavicle (RU-022-015)
-Left Ribs (RU-022-025, RU-022-026, RU-022-082, RU-022-028, RU-022-030, RU-022-019, RU-022-081)
-Right Ribs (RU-022-026, RU-022-027, RU-022-018, RU-022-024, RU-022-021, RU-022-022, RU-022-033, RU-022-017, RU-022-023, RU-022-106)
-Rib Fragments (RU-022-079, RU-022-080, RU-022-093, RU-022-020, RU-022-075, RU-022-077, RU-022-104, RU-022-105, RU-022-103, RU-022-098)
-Cervical Vertebrae (RU-022-053, RU-022-068)
-Thoracic Vertebrae (RU-022-062, RU-022-066, RU-022-036)
-Lumbar Vertebrae (RU-022-031, RU-022-067, RU-022-052, RU-022-061)
-Left Patella (RU-022-059)
-Carpal (RU-022-101)
-Metacarpals (RU-022-047, RU-022-038, RU-022-091, RU-022-042, RU-022-092, RU-022-016, RU-022-048, RU-022-049)
-Phalanges (RU-022-089, RU-022-086, RU-022-085, RU-022-087, RU-022-070, RU-022-080, RU-022-084, RU-022-041)
-Phalanxes (RU-022-083, RU-022-050, RU-022-046, RU-022-072, RU-022-074, RU-022-073, RU-002-099)
-Tarsals (RU-022-054, RU-022-051, RU-022-053, RU-022-058, RU-022-063, RU-022-060, RU-022-064, RU-022-055, RU-022-107, RU-022-056, RU-022-102, RU-022-108)
-Metatarsals (RU-022-040, RU-022-096, RU-022-095, RU-022-043, RU-022-039, RU-022-098, RU-022-097, RU-022-045, RU-022-044, RU-022-037)