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"That Class of Person Who Cannot Afford a Pew": Analysis of the Human Remains from the Spring Street Presbyterian Church Burial Vaults

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The analysis of the skeletal remains of 85 people interred between ca. 1820 and 1846 in the vaults of the abolitionist Spring Street Presbyterian Church provides unique insights regarding the biological history of antebellum New York City unavailable from other sources. Even though the sample size is small, the remains reflect the prevalence of infectious diseases, metabolic disorders, nutritional deficiencies, premature deaths, and high infant mortality that characterized the rapidly industrializing city. Among the most remarkable discoveries were a rare case of abdominal cancer; a mother and her full-term fetus in utero buried together; two autopsied children; and a dental bridge made of gold that may have been buried with Nicholas Ware, United States Senator from Georgia, whose coffin plate from 1824 was unexpectedly found in one of the vaults. Although none of the individuals could be conclusively identified as being of African descent, skeletal evidence of possible admixture underscores the particularly active role of the church in the abolitionist movement of the 1830s.

L'analyse des squelettes de 85 individus enterrés dans des caveaux de la Spring Street Presbyterian Church entre c. 1820 et 1846 fournit un aperçu unique et inédit de l'histoire biologique humaine de New York avant la guerre de Sécession. Malgré ce petit échantillon, les restes analysés reflètent la prédominance de maladies infectieuses, de carences nutritionnelles, de décès prématurés et de taux de mortalité infantile élevé, ce qui caractérise la ville en cette période d'industrialisation rapide. Les découvertes les plus remarquables comprennent un cas rare de cancer de l'abdomen, une mère et son fœtus à terme in utero, deux enfants autopsiés, et une prothèse dentaire en or qui aurait pu être enterrée avec Nicolas Ware, un sénateur américain de Géorgie dont la plaque de cercueil datée de 1824 a été découverte de manière fortuite dans l'une des voûtes. Bien qu'aucun des individus ne soit d'origine africaine confirmée, les analyses des squelettes proposent un possible mélange, ce qui souligne le rôle particulièrement actif de l'église dans le mouvement abolitionniste des années 1830.

Introduction and Historical Context

In a letter that he wrote to his sister in 1828, Reverend Henry G. Ludlow described the 330 members of New York City's Spring Street Presbyterian Church as "…most of whom belong to that class of person who cannot afford to purchase or hire a pew in our city churches" (quoted in Meade 2008: II–3). Reverend Ludlow would know from personal experience; this abolitionist minister served as their pastor from 1828 to 1837, a momentous time for the small church as well as for the city rapidly emerging around it.

Excavations associated with construction of a 46-story condominium hotel in late 2006 and early 2007 revealed four partially disturbed brick vaults used by the Spring Street Church congregants to inter the remains of their families and friends. Contiguous with each other and oriented along a north-south axis, these vaults (numbered 1 to 4 from south to north) were located at the southeast corner of Spring and Varick Streets in Lower Manhattan. The first church building was built at the site in 1811. Incomplete church records indicate that interments in the vaults were made by 1820; the earliest legible coffin plates recovered from the vaults date to 1823 in Vault 3 and 1820 in Vault 4. Use of the vaults continued through at least 1835 despite the Manhattan Common Council's prohibition on burials in the city south of 14th Street after 1832 due to unsanitary conditions from cemetery overcrowding (Meade 2008: III–1). Proof of these later interments comes from other coffin plates: Vault 3 included two plates with dates of death from 1841, two from 1842, and one each from 1845 and 1846. Of the 22 legible plates found in Vault 4, 17 were dated between 1820 and 1829; four between 1830 and 1835; and one from 1843. Consequently, the broadest date range for the interments in the four vaults is 1811–1846, with most of the individuals buried between ca. 1820 and 1835.

This was a period of intense socio-economic transition in both New York City and the nation. The rise of the urban-based industrial manufacturing economy brought waves of young people and immigrants to the large East Coast cities; immigration alone accounted for an increase of between 20,000 and 30,000 people annually during the 1820s and this figure increased to over 200,000 per year by the late 1840s (Margo 1996: 606). New York City was particularly attractive to young men and women from the rural counties of the mid-Atlantic region due to its expanding economy and the social opportunities offered by the vast anonymity of its urban landscape. Dramatic shifts in demography followed: in 1800, New York City's population was about 60,000 and, by 1850, it had reached 600,000 people, of which more than half was foreign born (Gorn 1987: 393). Cheap labor became plentiful, leading to wide swings in unemployment and inflation throughout the 1840s and 1850s.

New York's antebellum working-class culture included withdrawal from conservative, organized religion, freedom from its social limitations, and greater social differentiation based on widening class disparities and racial segregation. By 1820, most of the African Americans in New York City were free but found themselves in increased competition with recent immigrants for jobs, stirring racial tension that grew stronger through the 1830s. Virtually all aspects of society were affected by the new economy and its ripple effects, including a rapid increase in tenement housing and an upsurge in infectious disease and infant mortality rates.

Amidst the racially divisive atmosphere of antebellum New York City, the Spring Street Church was one of several religious institutions that formed the core of the abolitionist movement in the 1820s and 1830s. The church's second pastor, the Reverend Dr. Samuel Hanson Cox, preached in support of abolition during his pastorship (1821–1825). Also during the 1820s, the congregation admitted African Americans as full members and established an inter-racial Sunday school.

It was in the 1830s, however, that the history of the Spring Street Church intersected most forcefully with the abolitionist movement. In the wake of the annual meeting of the American Anti-Slavery Society, held in the city in May 1834, heated debates fueled by racist newspaper editors over the increasing political and economic roles of African Americans sparked a series of physical confrontations throughout Manhattan. These culminated in July in the city's largest race riot (Harris 2003: 197). Between July 9th and 12th, rioters destroyed the home of abolitionist Arthur Tappan, homes and businesses owned by African Americans in the Five Points district (the notorious slum located in central Lower Manhattan), and the homes and churches of several abolitionist ministers. Among the targets were the Spring Street Presbyterian Church and its pastor Henry G. Ludlow, who was rumored to have officiated mixed-race marriages.

On July 11, 1834, a gang of rioters destroyed the interior of the church and nearly demolished the building itself (Meade 2008: II–4). A contemporaneous account printed by *Niles' Weekly Register* (1834: 357–360) described how the 27th Regiment of the National Guard was dispatched to the scene to quell the assault, which they did after overcoming two lines of barricades erected by the rioters using debris from the church. The crowd then moved on to Reverend Ludlow's house on Thompson Street, where they "broke in the windows and doors, and did all the injury they thought proper." The government eventually regained control of the city, imprisoning at least 150 rioters.

The congregants of the Spring Street Church subsequently raised sufficient funds to replace the damaged wood-frame church with a brick building that opened in 1836. The church prospered through the 1840s, counting more than 800 members among its vestry, but struggled in the 1850s and 1860s with the burden of the debts incurred during the previous decades. After moving through intermittent periods of expansion and retrenchment, the congregation was dissolved in 1963 due to a lack of members. The 1836 building was demolished and replaced by a surface parking lot in 1966.

It is within this historical context that the skeletal remains from the Spring Street Presbyterian Church's burial vaults were analyzed and interpreted. Combining a scientific approach with a humanistic perspective, the Spring Street project combines data from the archaeological excavations of the vaults with the results of historical research and the skeletal analysis to create a unique portrayal of the people who comprised the congregation during New York City's pivotal antebellum years.

Significance of the Human Remains from the Spring Street Church

Notwithstanding the city's long and varied history, relatively few bioarchaeological projects have been conducted in the five boroughs of New York, particularly in Manhattan. In their broad review of New York City archaeology, Cantwell and Wall (2001) noted that the excavation of over 400 individuals from the African Burial Ground (ca. 1640–1795) in 1991 was the only major bioarchaeology project conducted in the city. These graves were discovered during excavations for a new federal office building located along Broadway between Duane and Reade Streets and they generated intense public interest and considerable scientific controversy (African Burial Ground 2012; Blakey and Rankin-Hill 2004a; LaRoche and Blakey 1997). Apart from the analysis of the remains of 36 people who died during the 1840s and 1850s at the former Marine Hospital in St. George, Staten Island (Dwyer 2009), a recent review of the bibliography of archaeological reports maintained by the New York City Landmarks Preservation Commission (2012) confirms that no other large-scale bioarchaeological projects have been conducted in New York City since then. Consequently, the Spring Street Church burial vaults project represents the city's largest bioarchaeological study in the last 20 years.

Other historic-period burials have been located in Manhattan; most of these have been recorded in the vicinity of City Hall Park (located 20 city blocks southeast of the Spring Street Church site). The discoveries there include partially intact and disturbed remains found during utilities repairs under Chambers Street in 1993 (Hunter Research, Inc. 1994); in 1995 and 1996 (Stone 1997); in 1998 (Crist et al. 2000); and again in 2002 (Hartgen Archaeological Associates, Inc. 2004). These remains are likely associated with the city almshouse that was located at the northern part of City Hall Park between 1735 and 1816 but also may have come from the African Burial Ground or Revolutionary War-period prisoner interments. Excavations in City Hall Park itself between 1999 and 2001 revealed additional human remains including intact burials most likely from the almshouse burial ground (Anderson 2000; Hartgen Archaeological Associates, Inc. 2003; London 2004).

Historical skeletal remains have been found in other Manhattan locations, both in former burial grounds and under less typical circumstances. For example, the remains of two full-term neonates and a fetus were discovered in privy shaft deposits from the 1840s associated with a tenement at 12 Orange Street (now Baxter Street) in New York City's former Five Points district (Crist 2005). During construction activities in 2008, the remains of at least four intact burials and other previously disturbed remains were uncovered in Washington Square Park in Greenwich Village, the site of a former potter's field dating between 1797 and 1825 (Chan 2008). In 2010, 21 intact burials, 14 previously disturbed graves, and numerous headstones were recorded during archaeological monitoring of excavations associated with repairs to the brick wall at Old St. Patrick's Cathedral Cemetery, located on Prince Street 11 blocks east of the Spring Street Church site (Audin 2010). And most recently, a local community organization mobilized to protect human remains possibly still interred in a colonial burial ground for Africans and African Americans located at the current site of the 126th Street Bus Depot in Harlem (Harlem African Burial Ground Task Force 2012). Established in 1660 by the Reformed Low Dutch Church at First Avenue between 126th and 127th Streets, the burial ground included a section for free and enslaved Africans and was in use until 1845. This cemetery was rediscovered in 2008 during the expansion of the Willis Avenue Bridge, and a plan proposed in 2009 by the Metropolitan Transportation Authority (MTA) to replace the 1940s-era depot prompted the group to seek landmark status for the burial ground (Willis 2010). In 2011, the MTA agreed to conduct archaeological testing to determine whether human remains were still present at the site.

The human remains from the Spring Street Church vaults are significant not only for the number of excavated individuals but also for

the fact that these interments are the only sample found to date that represents the growing "middle class" of antebellum New York City. In contrast to Reverend Ludlow's description in 1828 of his congregants as unable to afford pews at other churches, census data, contemporary newspaper accounts and the archaeological evidence all indicate that successful businessmen and their families were interred in the vaults along with a few people buried with silver coffin plates (see White and Mooney, this volume). Among these merchants was Rudolphus Bogert (1766–1842), a member of one of the city's oldest Dutch families, whose remains were discovered in Vault 3 with his legible coffin plate. Additionally, a coffin plate from a disturbed context in Vault 4 indicates that Nicholas Ware, a United States senator and former mayor of Augusta, Georgia, was buried in one of the vaults. According to the coffin plate and historical documents, Senator Ware died in New York City on September 7, 1824, aged 48 years and seven months.

Given the small number of bioarchaeological projects in New York City, the analysis of the human remains from the Spring Street Church burial vaults provides unique information about the health, diseases, and activities of a sample of New Yorkers who lived and died as the city evolved from a colonial port into the economic capital of the new nation. The significance of the remains lies in the number of individuals available for study, their social status, and the array of pathological conditions that characterize this group of people.

Methods

Like all archaeological resources discovered in New York City, historical human remains fall under the jurisdiction of the Landmarks Preservation Commission (LPC). According to its *Guidelines for Archaeological Work in New York City*, the analysis of skeletal remains from historical cemeteries must include the minimum number of individuals represented by the remains; each individual's demographic profile (sex, age range at death, and ancestry or social identity); and descriptions of any paleopathological lesions that may be present (New York City Landmarks Preservation Commission 2002). By following these requirements, physical anthropologists generate data that may be compared with other historical and modern skeletal collections. This analysis is most effectively accomplished by following standard physical anthropological procedures for collecting and recording morphological and metrical information. For the present study, data were collected following the recommendations in *Skeletal Database Committee Recommendations* (Paleopathology Association 1991); *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker 1994); and *Data Collection Procedures for Forensic Skeletal Material* (Moore-Jansen et al. 1994).

The skeletal and dental inventories, information on demographic assessments, and measurements of the skeletal remains were recorded using standardized forms from both Buikstra and Ubelaker (1994) and Moore-Jansen et al. (1994). Determinations of the demographic profiles, stature estimations, handedness, and other personal characteristics for each individual were made following standard forensic anthropological methods as presented and discussed in Byers (2005), White and Folkens (2005), and other relevant journal articles. Analysis of the subadult remains was based on these sources and as well as Baker et al. (2005) and Scheuer and Black (2000, 2004).

When possible, a differential diagnosis was made to account for the observed pathological lesions presented by each skeleton or skeletal element. These diagnoses were based on the nature and distribution of the observed lesions and were determined through comparisons with lesions previously described in standard references on paleopathology (Aufderheide and Rodríquez-Martin 1998; Mann and Hunt 2005; Ortner and Aufderheide 1991; Ortner 2003; Steinbock 1976; Zimmerman and Kelley 1982). Among the lesions analyzed for this study were those related to dental health; metabolic disorders and nutritional deficiencies; nonspecific infections including periostitis and osteomyelitis; identifiable diseases such as tuberculosis and syphilis; enthesopathy (evidence of biomechanical stress where muscle tendons attach to bones); various arthritic conditions; and degenerative joint disease.

Upon completion of the field excavations, all of the human remains from the Spring Street Church burial vaults were transported to the Physical Anthropology Laboratory at Utica College in Utica, NY for examination and analysis. The remains from the Spring Street vaults comprised four groupings of skeletal material, based largely on their degree of completeness and level of preservation: (1) intact individuals including most or all skeletal elements; (2) incomplete but distinguishable individuals with some articulated skeletal elements; (3) unassociated but intact diagnostic bones (those that allow determinations of sex, age, or ancestry) and large bone fragments (including individual crania and mandibles); and (4) unassociated and poorly preserved non-diagnostic bones and bone fragments.

The skeletal remains in the first three categories, many of which had been identified as individuals during excavation, were sorted; cleaned of adherent soil with dry brushes and sparingly with water; allowed to air dry on steel drying racks; and subsequently examined, documented, and analyzed. Since they held little to no analytical information, poorly preserved and badly fragmented remains in the fourth category were examined and then placed in bags and boxes for storage and eventual reburial.

To most efficiently examine and analyze the thousands of commingled remains recovered from the four burial vaults, the physical anthropology team split the collection into two parts according to the vault numbers. The remains from Vaults 1 and 3 were cleaned, examined, and analyzed at the Utica College Anthropology Laboratory. The individuals from Vaults 2 and 4 were washed at Utica College and then transported to the Syracuse University Anthropology Laboratory in Syracuse, NY for examination and analysis under the direction of Shannon A. Novak, Ph.D., Associate Professor of Anthropology. In addition, the soil from Vaults 2 and 4 contained a large number of commingled, fragmentary skeletal remains. This soil was screened and the recovered remains were sorted at the Syracuse University Anthropology Laboratory. Individuals identified in this manner were assigned letter designations. The final report regarding the skeletal analysis of the remains from the Spring Street Church burial vaults (Crist et al. 2008) was submitted to the LPC as an appendix to URS's overall project report (Mooney et al. 2008).

Objectives of the Skeletal Analysis

To fulfill the LPC's requirements for the analysis of the human remains from the Spring Street Church burial vaults and to generate comparable data useful to other bioarchaeologists, several major objectives for the physical anthropological component of the project were defined. These objectives included:

- determining the minimum number of individuals represented by the bones and bone fragments;
- establishing a demographic profile (sex, age at death, and ancestry or social identity) for each individual, when possible;
- providing a description of the personal characteristics (including stature, handedness, evidence of pregnancy, occupation, and repeated activities) and paleopathological lesions of the individuals represented by the remains; and
- identifying skeletal lesions that may have contributed to the individual's cause of death.

Results

Inventory and Burial Designations

In December 2006, large-scale construction activities revealed the four contiguous brick burial vaults from the Spring Street Church at 244–246 Spring Street. Vault 1 was badly damaged by the excavation machinery; the other three vaults had been previously disturbed when the site was cleared for a parking lot in the 1960s. Forensic anthropologists from the Office of the Chief Medical Examiner (OCME) recovered fragmentary human remains from Vault 1 and determined that they were of historical origin (Crowder et al. 2008). Archaeologists from URS Corporation later numbered the Vaults 1 to 4 from south to north and excavated the three northernmost vaults over the next several weeks.

During excavations, each individual whose remains were clearly distinguishable was assigned a unique identifying number, generally in the order in which the burials were discovered within each vault. No distinctions were made in numbering the burials based on the presumed age of the individuals (i.e., the remains of infants and children were numbered in the same manner as the remains of adults). In terms of the minimum number of individuals documented in the field, the

OCME anthropologists determined that 16 individuals were represented by the badly fragmented remains from Vault 1. The URS archaeologists subsequently documented the remains of 12 individuals in Vault 2, 18 individuals in Vault 3, and 16 individuals in Vault 4 (Mooney et al. 2008: 4.16).

In addition to these 62 individuals, hundreds of intact and fragmentary bones and teeth that had been previously disturbed (collectively grouped as "unassociated remains") also were recovered from each of the vaults. Many of these remains, particularly the crania and mandibles, represented distinct individuals and were subsequently assigned unique identifying numbers during the laboratory analysis.

Demography

After sorting in the laboratory, the remains of at least 101 discrete individuals were identified. Screening and sorting of the fragmentary remains in Vault 4 is ongoing and will generate additional individuals from this context. The remains of the 101 people were distributed as follows: Vault 1: 16 individuals, Vault 2: 31 individuals, Vault 3: 27 individuals (including one set of fetal remains found in utero), and Vault 4: 27 individuals.

The remains from Vault 1 were significantly fragmented, commingled, and eroded. Consequently, individuals from this vault were neither labeled in the field nor assigned specific numbers during the laboratory analysis. The forensic anthropologists from the OCME identified skeletal elements from a number of adults and subadults (children under 16 years old). Among these remains were 32 bones or bone fragments from infants and children including one mandible, several cranial vault fragments, numerous long bones, and six innominates. Based on this distribution of bones, the OCME anthropologists determined that at least three subadults were present (Crowder et al. 2008: 2). Vault 1 contained 308 adult skeletal elements including 50 cranial fragments, four teeth, and numerous fragmentary long bones and vertebrae. Crowder et al. (2008: 2) determined that the bones from Vault 1 represented a minimum of 13 adults. Subsequent laboratory analysis confirmed these results. Given the incomplete nature of the remains, the age, sex, and ancestry determinations for the 16 individuals from Vault 1 were listed as indeterminate.

A total of 85 individuals was identified and analyzed from Vaults 2, 3, and 4 (TAB. 1). This total includes the skeletal remains of a full-term fetus discovered within the abdominal area of a woman in Vault 3 (Burial 17A). Table 2 presents the distribution of individuals in each vault (TAB. 2).

Regarding the subadults (children 16 years of age and younger), the remains of 30 infants and children were identified during the laboratory analysis. These included 14 subadults in Vault 2 and 16 in Vault 4. (The remains of at least 50 additional subadults have been subsequently identified after screening soil from Vault 4; see Ellis, this volume). Commingled mandibular fragments from three children were present in the soil beneath Burial 13 in Vault 3; together with the full-term fetus (Burial 17B from Vault 3), 34 subadults were available for this analysis.

Table 3 presents the demographic data for the subadults in Vaults 2, 3, and 4 (TAB. 3). The 34 subadults accounted for 40.0% of the 85 individuals from the three vaults. Their average age at death was just over four years. The distribution of their deaths varied by age: 15 of the 34 subadults (44.1%) had died before reaching the age of 18 months. Children between the ages of three and ten years old accounted for 11 (32.4%) of the individuals. Just under 15% of the subadults (n=5) were between ten and 15 years old at death.

Eleven legible coffin plates associated with infants and children 16 years of age and younger were found during the excavation of Vaults 3 and 4 (see White and Mooney, this volume). The information engraved on these plates provides comparative demographic data to that generated through the analysis of the skeletal remains. Dating between 1820 and 1835, the plates identified six boys, four girls, and one infant of unknown sex. The children's ages ranged from four months to 16 years of age, including three teenagers (aged 12, 14, and 16). Five of the 11 individuals (45.5%) were infants 18 months old and younger. The average age at death for these 11 subadults was five years old; the average for the six boys was three years old and the average for the four girls was nine years old.

Table 1. Demographic data for individuals from the Spring Street Church burial vaults.

Burial #	Sex*	Age Range	Burial #	Sex*	Age Range
Vault 2			**Vault 3 (cont'd.)**		
1	F	<35	12	M	70+
2	C	2.5–3.5	13	F	30-34
3	C	4.5–5.5	14	M	35-39
4	F	40–49	15	M	45-49
5	M	<35	16	M	30-34
6	F	<35	17A and B	F	25-29/full-term fetus
7	C	4.5–5.5	18	F	25-29
8	F	25–29	18A	I	50+
9	M	40–49	A	M	40-45
10	M	20–29	B	I	35+
11	C(F)	14.5–15.5	C	I	35+
12	M	20–24	D	I	35+
A	C	Newborn	E	C	8-16 mos.
B	C	<6 mos.	F	C	5-6
C	C	6 mos.-1.5 yrs.	G	C	6-7
D	C	3.5-4.5	**Vault 4**		
E	C	7.5-8.5	1-4A	C	5 mos. fetus
F	C	7.5-8.5	1-4B	C	<6 mos.
G	C	10.5-11.5	1-4C	C	<6 mos.
H	C(F)	9-11	1-4D	C	2-3 mos.
I	C(M)	13-13.5	1-4E	C	6 mos.
J	C(M)	13.5-14.5	1-4F	C	6 mos.-1.5 yrs.
K	F	35-39	1-4G	C	6 mos.-1.5 yrs.
L	M	30-34	1-4H	C	6 mos.-1.5 yrs.
M	M	60+	1-4I	C	4.5-5.5
N	M	50+	1-4J	C	5.5-6.5
O	F	35-39	1-4K	C	2.5-3.5
P	M	18-22	1-4L	C	6 mos.-1.5 yrs.
Q	M	40-44	1-4M	C	5.5-6.5
R	M	18-22	1-4N	C	6 mos.-1.5 yrs.
S	M	50+	1-4O	C	1-3
Vault 3			5	M	20-24
1	F	25-29	6	M	35-39
2	F	20-24	7	F	30-34
3	F	20-24	8	M	60+
4	M	25+	9	M	50-59
5	M	,35	10	M	40-44
6	M	25-29	11	F	30-34
7	F	20-24	12	M	50-59
8	F	25-29	13	F	20-24
9	M	35+	14	M	30-34
10	M	30-34	15	M	40-44
11	M	25-34	16	C(F)	14.5-15.5

* Male is M; female is F, indeterminate is I, and child or infant is C. Total N=85. (Vault 2, n=31; Vault 3, n=27; Vault 4, n=27).

Table 2. Spring Street Church demography by vault.

Sex	Vault 1	Vault 2	Vault 3	Vault 4	Total
Male		11	11	8	30
Female		6	8	3	17
Child/Infant		14	4†	16	34
Indeterminate	16*		4		20
Totals	16	31	27	27‡	101

* MNI based on fragmentary, commingled remains.
† Includes Burial 17B, a full-term fetus found *in utero*.
‡ Analysis of the commingled remains from Vault 4 is ongoing.

Table 3. Spring Street Church subadult demography by age.

Age range	Number of individuals	Percentage*	Percentage of group†
Fetus/Newborn	3	8.8	3.5
1-6 months	5	14.7	5.9
6 months-1.4 years	7	20.6	8.2
1.5-2.9	3	8.8	3.5
3.0-4.9	5	14.7	5.9
5.0-9.9	6	17.6	7.1
10-14.9	5	14.7	5.9
Total	34		

* Percentage of total number of subadult burials identified (N=34); includes the full-term fetus from Vault 3.
† Percentage of total number of individuals, including adults (N=85).

Table 4. Spring Street Church adult demography by age and sex.

Age range	Adults*	Percentage†	Males	Percentage†	Females	Percentage†
15-19	2	4.6	2	4.6	0	0.0
20-24	7	16.3	3	7.0	4	9.3
25-29	8	18.6	3	7.0	5	11.6
30-34	7	16.3	4	9.3	3	7.0
35-39	5	11.6	3	7.0	2	4.6
40-44	6	14.0	5	11.6	1	2.3
45-49	1	2.3	1	2.3	0	0.0
50-54	4	9.3	4	9.3	0	0.0
55-59	0	0.0	0	0.0	0	0.0
60-64	2	4.6	1	2.3	1	2.3
65-69	0	0.0	0	0.0	0	0.0
70+	1	2.3	1	2.3	0	0.0
Totals	43		27		16	

* Excluding all indeterminate adults and two males and two females aged <35 years due to incompleteness of remains.
† Percentage of total number of adults (N=43).

The demography of the adults is presented in Table 4 (TAB. 4). A total of 51 adults (60% of the 85 individuals from Vaults 2, 3, and 4) was analyzed; two males and two females were excluded from the demographic analysis because their incomplete remains precluded generating an age estimate (listed only as <35). Four additional adults of indeterminate age and sex from Vault 3 also were excluded from this analysis. Analysis of the remaining 43 adults indicates that the men (n=27; 62.8%) outnumbered the women (n =16; 37.2%) in the assemblage. The average age at death for all 43 adults was 35 years, calculated by tallying the number of individuals in each five-year age range and dividing by total number of people in the sample. While only estimates (due to the standard error inherent to all age estimation techniques), the average age at death for the 26 men was 39 years and for the 16 women was 31 years, a difference of eight years. Chi-squared analysis of these data indicates that this difference in the average ages at death is not statistically significant (p=0.1317).

Among this group of 43 adults, 34.9% (n= 15) of the group died between the ages of 20 and 29 years while 27.9% (n= 12) died between the ages of 30 and 39 years. Of the 43 adults, only eight (18.6% of the group) died after reaching the age of 45. When analyzed by sex, more men had reached their 40s than women—12 men to only two women. Just over half of the women (56.3% of the 16 women) died before reaching 30 years of age, with only seven (43.7%) older than that at death. Conversely, 18 of the 27 men (66.7%) died after the age of 30. Death still came early for men—only six (22.2%) were older than 50 years when they died. When further analyzed by sex (TAB. 5), these trends are even more pronounced.

As with the infants and children, the recovery of coffin nameplates provides comparative demographic data for the adults. A total of 20 legible coffin plates associated with adults was recovered: three from machine-disturbed contexts, seven from Vault 3, and ten from Vault 4. These coffin plates ranged in date from 1822 to 1843 and included the names of 12 men, six women, and two adults whose sex could not be determined. These 20 individuals included two teenagers (18 and 19 years old, respectively) and 12 people (60.0%) who were older than 45 years when they died. Five of these older people (25%) were over 70 years old (three men aged 71, 74, and 76 and two women aged 70 and 76). The average age at death for all 20 adults was 46 years; the average age at death was also 46 years for the 12 men and the six women when analyzed separately.

Table 5. Spring Street Church adult demography within sex subgroups.

Age range	Males	Percentage*	Females	Percentage†
15-19	2	7.4	0	0.0
20-24	3	11.1	4	25.0
25-29	3	11.1	5	31.3
30-34	4	14.8	3	18.8
35-39	3	11.1	2	12.5
40-44	5	18.5	1	6.3
45-49	1	3.7	0	0.0
50-54	4	14.8	0	0.0
55-59	0	0.0	0	0.0
60-64	1	3.7	1	6.3
65-69	0	0.0	0	0.0
70+	1	3.7	0	0.0
Totals	27		16	

* Percentage of total number of males discovered (N=27); excludes two males aged <35 years,
† Percentage of total number of females discovered (N=16); excludes two females aged <35 years.

The ages at death estimated from the individuals' skeletal remains may be inaccurate for the reasons that affect most archaeological population samples: the incomplete nature of the skeletal remains; variation in human aging patterns; and the imprecision of the aging techniques used by physical anthropologists, especially when applied to the elderly. Even with these limitations, however, the data indicate that infants and young children were at the highest risk for death before reaching their second birthday. Adults also died young with a high percentage of women dying before they reached the age of 30 (25.0% died between the ages of 20 and 24 years and 31.3% between 25 and 29 years). These data are broadly supported by the demographic information from 31 of the 37 legible coffin plates recovered, although the artifacts indicate that a greater number of people older than 45 years, and particularly over 70, were interred in the vaults than was determined from analysis of the skeletal remains.

Ancestry and Possible Evidence of African Americans

Despite New York's 1817 manumission law, African Americans remained an oppressed demographic minority throughout the use of the Spring Street Church's burial vaults and long afterwards. While historical documents indicate that African Americans were members of the Spring Street Church congregation, thus far, no records have been found to indicate whether these individuals or their families were interred in the vaults. Based on the skeletal analysis, all of the excavated individuals whose cranial remains and dentition could be assessed for ancestry presented features consistent with European descent and were most likely recognized as white. Ten of the individuals in Vaults 2 and 4, however, presented cranial or postcranial features more frequently observed among people of African descent, suggesting the possibility of admixture. None of these individuals exhibited skeletal evidence indicating that they might have been socially identified as African Americans.

The determination of ancestry from skeletal remains is controversial and difficult to establish definitively (see Brace 1995; Ousley et al. 2009; Sauer 1992; and Relethford 2009 for various perspectives regarding this issue). Forensic anthropologists assess ancestry using a variety of morphological and multivariate statistical methods that primarily involve elements of the cranium, mandible, and teeth (Byers 2005; Gill and Rhine 1990). These features include the sizes and shapes of the cranial vault, nasal aperture, orbits, and the maxillae as well as the forms of the maxillary incisors and molar cusp patterns. Secondary and more variable information comes from the degree of femoral curvature, widths of the intercondylar notch, and dimensions of the femora and tibiae. Clusters of these traits determined by an individual's unique genetic composition are then associated with an ethnic identity within the context of the person's society. In the United States, ancestry or race is typically reported by forensic anthropologists as European (white), African (black), or Asian/Native American. No single skeletal feature can be used to identify an individual's ancestry or social identity but certain features, when present, may indicate parents of two different ancestries.

Among the ten individuals (11.8% of the 85 people in Vaults 2, 3, and 4) who presented at least one skeletal feature associated with African descent, two were young children with nasal sulci (grooves at the base of the nasal aperture) and arched transverse palatine sutures observable in the hard palate where the palatine bones articulate with the posterior margins of the maxillae (TAB. 6). One of these children also presented crenulated cusps on their first molars; people of European descent typically exhibit a +4 or Y-5 cusp pattern on these teeth. While the presence of these features hints at the possibility of mixed ancestry, subadults are particularly difficult to evaluate because of their immature features and the lack of comparative metrical standards. Of the seven adults with possible African skeletal traits, three presented only straight femoral shafts with no cranial or dental features available to assess (TAB. 6). A fourth adult was a young man who presented bossing (rounded prominences) of his frontal bone, while another older man presented both frontal bossing and a post-bregmatic depression (a small dip in the anterior part of the parietals immediately posterior to the frontal bone that is more common among people of African descent).

Figure 1. Crania from Burials 5 (at left) and 9 in Vault 4; note differences in the nasal roots and the shapes of the apertures. (Photograph by Dana Kollman.)

The remaining two individuals, both from Vault 4, featured several distinct traits suggesting mixed ancestry. The first was a man about 50–59 years old (Burial 9) whose cranium was nearly complete. His facial morphology was more typical of European descent but also included a wide nasal aperture, square orbits, and a low and round nasal root contour (FIG. 1), the latter three features are more common among people of African descent. Unfortunately, most of his upper teeth were lost before death and, therefore, the maxillae could not be assessed for prognathism (the degree of anterior protrusion). This man's cranial vault was characterized by a distinct post-bregmatic sulcus and oblique mastoids, and the shafts of both of his femora were straight.

The second person was a teenage woman (Burial 16) who presented European cranial traits mixed with prognathism, an arched palatine suture, oblique mastoids, and crenulated first molars. Presumptively identified as Louisa Hunter who died in 1825 (see Werner and Novak, this volume), her femoral shafts were curved rather than straight but the intercondylar notches were wide. Of note, Louisa Hunter's father John was the Assistant Superintendant of the City Almshouse in Chambers Street at the time of her death; her funeral was held there in the family's apartment rather than at the Spring Street Church (see White and Mooney, this volume). A second teenager, a boy from Vault 2 (Burial I), also presented crenulated first molars. While not necessarily identifying themselves as African Americans, both Burial 9 and Burial 16 from Vault 4 may have been counted among the mixed-race congregants admitted to the Spring Street Church.

Paleopathology: Infectious Disease and Trauma

As a major port at the advent of industrialization with increasing numbers of immigrants arriving every year, antebellum New York was rife with unsanitary conditions, chronic and epidemic diseases, poverty, and violence (Rosner 1995). Public health pioneer Dr. John Hoskins Griscom (1845: 2–3) summarized the situation this way: "there is an immense amount of sickness, physical disability, and premature mortality, among the poorer classes [but] these are, to a large extent, unnecessary, being in a great degree the results of causes which are removable."

Beyond the poor individuals and families living in the tenements, all New Yorkers were at risk for disease and premature death. In his 1842 mortality report for the city, Griscom noted:

> it is a well-established fact, that diseases are not confined to the localities where they originate, but widely diffuse their poisonous miasma. Hence, though the poor may fall in greater numbers because of their nearer proximity to the causes of disease, yet the rich, who inhabit the splendid squares and spacious streets of this metropolis, often become the victims of the same disorders which afflict their poorer brethren (quoted in Bremner 1992: 7).

Stark evidence of these problems is manifest among the skeletal remains from the Spring Street vaults. While the effects of acute, soft tissue disorders are not typically observable in dry skeletal remains, physical anthropologists employ a variety of gross and microscopic techniques to document and diagnose lesions associated with chronic infections, metabolic disorders, nutritional disorders, and trauma.

Of the 85 individuals recovered from Vaults 2, 3, and 4, 37 (43.5%) presented evidence of infection or inflammation on at least one bone. This total does not take into account the degree of preservation of the skeletal remains available for analysis; many of the individuals' remains were incomplete or too badly eroded to observe. The evidence does indicate the presence of a wide range of disorders that reflect the conditions described by Griscom during the antebellum period. Sixteen of the 37 individuals were infants or children (including 17B, the full-term fetus from Vault 2), most of whom exhibited evidence of nutritional disorders including vitamin C deficiency (scurvy), anemia, and vitamin D deficiency (rickets). These 16 individuals represent 47.1% of the 34 infants and children from Vaults 2, 3, and 4.

Among the 16 infants and children with skeletal lesions, two of them (Burial 7 from Vault 2 and Burial 1–4H from Vault 4) presented active periosteal reactive bone (ossification of the periosteum that covered the bony surfaces during life) across the visceral surfaces of their ribs. They also exhibited lytic (resorptive) lesions of the vertebral bodies. Together, these lesions are indicative of pleural inflammation or infection. Three adults (Burials 8 and C from Vault 2 and Burial 5 from Vault 4) also presented active periosteal reactions on the visceral surfaces of their ribs (FIG. 2). Although these lesions may have resulted from several possible pulmonary conditions, tuberculosis is the most likely cause given its high prevalence during the 19th century, especially in densely populated communities like New York City (Ortner 2003: 227–263; Roberts and Buikstra 2008). Nutritional deficiencies including anemia and rickets also raise the risk for contracting tuberculosis. Two of the children with the rib and vertebral lesions presented bilateral cribra orbitalia (porosity located across the roofs of the orbits) that is typically associated with iron-deficiency anemia.

Table 6. Individuals presenting possible African skeletal traits.

Burial	Sex and age	Cranial	Dental	Postcranial
Vault 2				
2	C, 2.5–3.5 yrs.	Nasal sulcus; arched palatine suture	Crenulated first molars	—
9	M, 40-49	—	—	Straight femoral shafts; wide intercondylar notch
12	M, 20–24	Frontal bossing	—	—
I	C(M), 13–13.5	—	Crenulated first molars	—
Vault 4				
1–4I	C, 4.5–5.5 yrs.	Nasal sulcus; wide nasal aperture; arched palatine suture; square orbits; prognathism	—	—
7	F, 30–35	—	—	Straight femoral shafts
9	M, 50–59	Post-bregmatic sulcus; wide nasal aperture; square orbits; oblique mastoid	—	Straight femoral shafts
11	F, 30–35	—	—	Straight femoral shafts
15	M, 40–45	Frontal bossing; post-bregmatic sulcus	—	Wide intercondylar notch
16	C(F), 14.5–15.5	Prognathism; arched palatine suture; oblique mastoid	Crenulated first molars	Wide intercondylar notch

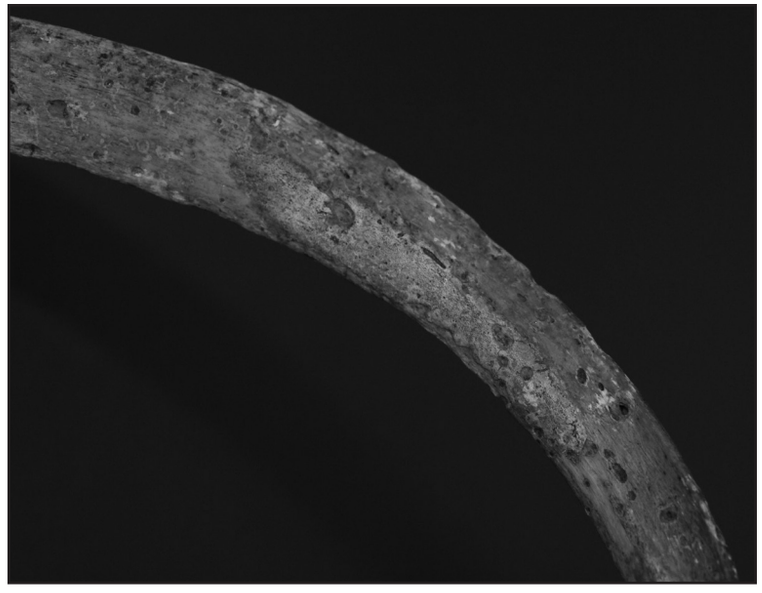

Figure 2. Periosteal reactive bone indicative of thoracic infection, probably tuberculosis, located on the visceral surface of rib shaft; Vault 4, Burial 5. (Photograph by Dana Kollman.)

While most of the periosteal lesions observed among the Spring Street skeletal remains resulted from non-specific infections, three of the individuals presented lesions indicative of syphilis. Syphilis is a disease caused by a spirochete bacterium that is primarily transmitted by sexual contact. It also may be transmitted from an infected mother to her fetus during pregnancy contributing to the formation of dental lesions including discolored enamel; small, widely-spaced incisors with distinct notches characterizing their occlusal surfaces (Hutchinson incisors); or the development of rudimentary cusps on the permanent first molars, known as "mulberry" molars (Ortner 2003: 595).

Two of the individuals with lesions suggestive of syphilis were men (Burial 12 from Vault 2 and Burial 10 from Vault 4) and the third, Burial 16 from Vault 4, was the teenager presumptively identified as Louisa Hunter. Burial 12 was 20 to 24 years old when he died. He presented ectocranial porosity of the cranial bones, mulberry molars (FIG. 3), Hutchinson incisors, active and healed periosteal reactive bone on the surfaces of his right tibia and left femur, and expanded cancellous bone in his scapulae. Burial 10 from Vault 4 was represented only by appendicular bones, including the femora and tibiae. He presented both active and healed periosteal reactive bone of moderate severity across the shafts of his tibiae, possibly the result of syphilis. The third set of remains was from Burial 16 in Vault 4, a young woman who was 14 to 15 years old when she died. Like Burial 10, she presented active periosteal reactive bone on her left tibia which may represent localized inflammation or a non-specific infection (see Werner and Novak, this volume). In addition, she exhibited resorptive lesions of the internal surface of her cranial vault bones and gray discoloration of all of her teeth. This combination of lesions suggests that she suffered from congenital syphilis (see Ortner 2003: 297–319 for a discussion of the paleopathology of syphilis).

Trauma was not well represented among these remains. Six people from Vaults 2, 3, and 4

(7.1% of the 85 people from these vaults) presented fractures, all of which were healed. None of the fractures was associated with a cause of death or could be conclusively attributed to interpersonal violence. There was no evidence of sharp-force trauma, gunshot wounds, or surgical intervention. Two of the individuals were infants who presented partially healed rib fractures (TAB. 7). The others were a woman who presented a small, depressed cranial fracture; a woman with a left clavicular fracture; an older man with fractures of his sixth cervical vertebra and one right rib; and another older man with a mildly displaced, healed fracture of the right distal tibia. In addition, one individual from Vault 2 presented dislocation of the distal left radius and another unassociated left radius from Vault 1 presented a healed Colles fracture of the distal shaft, located just proximal to the wrist (FIG. 4). The Colles fracture most likely occurred from a fall on the outstretched left arm and subsequently healed with mild posterior displacement and angulation of the distal articular end. The dislocated left wrist also most likely resulted from a fall.

One man from Vault 3 (Burial 14) presented several skeletal lesions that may reflect one or more injuries. Among these was bilateral ankylosis (fusion) of his sacroiliac joints, where the innominate bones articulate with the sacrum at the base of the spine (FIG. 5). This man was 35–39 years old at death and presented remodeling of the facets of the apophyseal joints between his ninth and tenth thoracic vertebrae; mild degenerative changes to both knees; eburnation of the anterior surface of the distal left femur (the result of patellar misalignment and loss of cartilage); and healed osteomyelitis (cortical or marrow infection) of the left tibia. Fusion of the sacroiliac joints also is a marker of several autoimmune disorders, including ankylosing spondylitis and rheumatoid arthritis, but, taken together, this man's lesions probably reflect at least one traumatic event that ultimately led to the fusion of his joints some years afterwards. In addition, Rudolphus Bogert (Burial 12 from Vault 3), a 76-year-old man identified by a legible coffin plate, presented numerous degenerative spinal lesions including fusion of the fifth and sixth cervical vertebrae, the latter probably the result of a disc herniation. His osteobiography is included below.

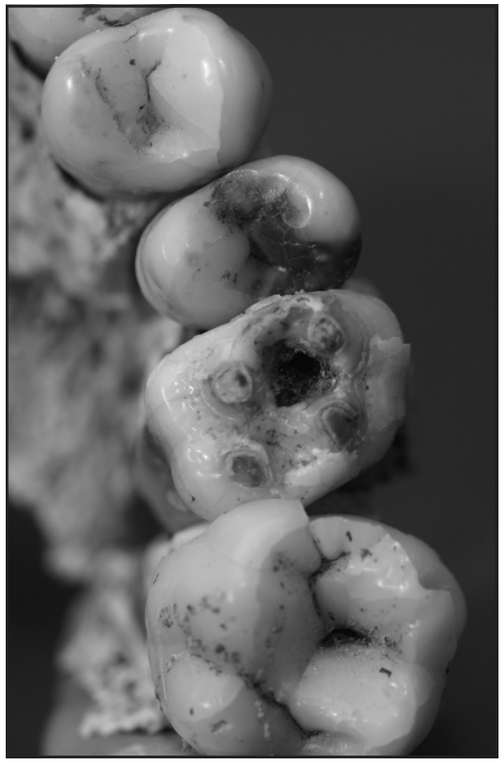

Figure 3. Maxillary first molar with "mulberry" cusps indicating congenital syphilis; Vault 2, Burial 12. (Photograph by Dana Kollman.)

Figure 4. Unassociated left radius from Vault 1 presenting a Colles fracture of the distal end, lateral view. (Photograph by the author.)

Table 7. Types and distribution of traumatic lesions by individual.

Burial	Sex and age	Type of trauma and location*
Vault 1		
No #	I (young adult)	Colles fracture of distal left radius
Vault 2		
N	M, 50+	Dislocation of distal left radius onto ulna
O	F, 35–39	Small, oval, depressed fracture in ectocranial surface of occipital
Vault 3		
13	F, 30–34	Fracture of midshaft of left clavicle
15	M, 45–49	Wedge fracture of sixth cervical vertebra Fracture of right rib shaft
A	M, 40–45	Fracture of distal right tibia with displacement
Vault 4		
1–4D	C, 2–3 mos.	Fractures of shafts of four right ribs
1–4F	C, 6 mos.–1.5 yrs.	Fractures of two right ribs at necks

* All lesions were healed.

Overall, these data portray the congregants of the Spring Street Church as people exposed to the various infectious diseases that characterized antebellum New York, especially tuberculosis and syphilis. The overall prevalence of trauma was low and no evidence of knife wounds, gunshots, or surgical treatment was observed. This general profile of people infected with urban diseases but suffering little or no trauma is consistent with the Spring Street Church congregants occupying the city's burgeoning middle class.

Metabolic Disorders and Nutritional Deficiencies

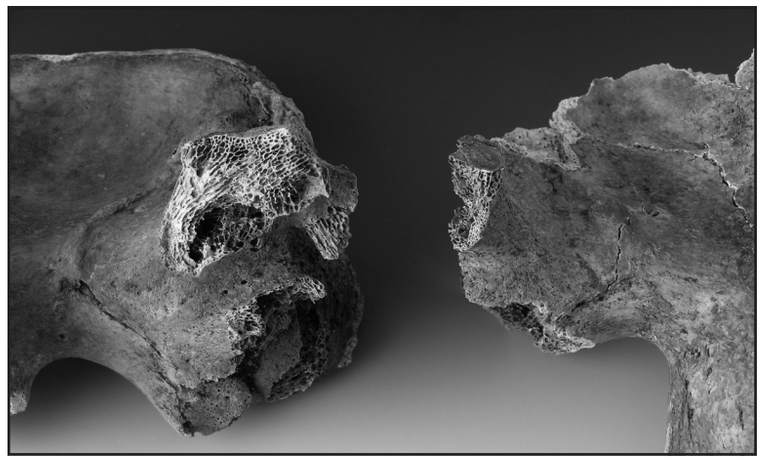

Figure 5. Bilateral ankylosis of the sacroiliac joints (the sacrum is fragmentary); Vault 3, Burial 14. (Photograph by the author.)

Holding positions in the city's business community and possessing disposable income to purchase nicely engraved coffin plates did not keep the members of the Spring Street Church, especially the children, from suffering metabolic disorders and nutritional deficiencies. Nutritional deficiencies result from limited access to required nutrients or from a disease that compromises the normal digestion and

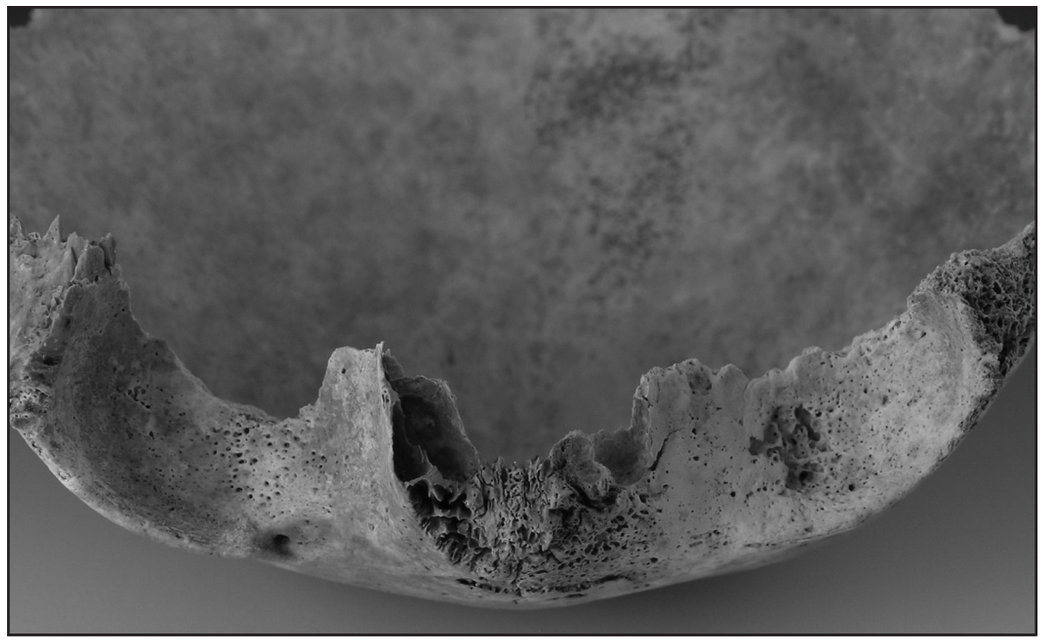

Figure 6. Bilateral porosity in the orbits (cribra orbitalia) associated with anemia; Vault 3, Burial 13, Child 1. (Photograph by the author.)

absorption of the required nutrients from food. These disorders are typically indicated in dry skeletal remains by resorptive porosity located across the external surfaces of the cranial vault and facial bones, the mandible, the scapulae, the long bones, and the vertebrae. The distribution and appearance of the porosity may allow for a diagnosis of the specific deficiency, but nutritional deficiencies often occur together and affect children who are ill from other diseases, particularly diarrheal disorders (Ortner 2003: 385). Skeletal lesions previously documented as resulting from three major nutritional deficiencies were observed among the skeletal remains from the Spring Street Church vaults. These were iron-deficiency anemia, vitamin C deficiency (scurvy), and vitamin D deficiency (rickets). Ellis (this volume) discusses the prevalence of vitamin D deficiency (rickets) among the subadults.

Porosity of the orbital roof (cribra orbitalia; FIG. 6) has been associated with both iron-deficiency anemia and vitamin C deficiency. Among the individuals from the Spring Street Church burial vaults, six children and two teenagers (accounting for 23.5% of the 34 subadults) presented cribra orbitalia in at least one orbit (TAB. 8). In addition, four adult males also presented active cribra orbitalia. Based on the presence of widespread porosity among their postcranial bones, one of these men, Burial 6 from Vault 4, was diagnosed with anemia. Two other infants (Burials 1–4D and 1–4F from Vault 4) who did not present cribra orbitalia were also diagnosed with anemia based on the distribution of widespread postcranial porosity. Combined, the 14 individuals with either cribra orbitalia or postcranial lesions associated with anemia represented 16.5% of the 85 people from Vaults 2, 3, and 4. The ten infants, children, and teenagers accounted for 29.4% of the 34 subadults.

Scurvy is indicated by porosity where the muscles of chewing (the medial and lateral pterygoid muscles) attach to the lingual surfaces of the mandibular ascending rami, the external and inferior surfaces of the sphenoid, the posterior surfaces of the maxillae, and the anterior portions of the temporals. The porosity results from inflammation of the attachment sites in response to the biomechanical stress of the muscle contractions as an individual chews. This is because a vitamin C deficiency causes the walls of the blood vessels to leak, resulting in localized inflammation. Among the skeletal elements from Vault 1, one 4–5-year-old child's fragmented mandible presented active porosity extending across the lingual surface of the left ascending ramus. In addition, two infants and children from Vault 2 and three from Vault 3 (14.7% of the 34 subadults) also exhibited cranial lesions indicative of scurvy (TAB. 8). These included porosity of the sphenoid, the ascending rami of the mandible (FIG. 7), and the posterior surfaces of the maxillae. Three of these children also displayed cribra orbitalia, which most likely reflects the coincident presence of anemia.

Dental Disease and Treatment

Together with analysis of the bones of the vault and face, the dentition reveals information regarding an individual's age at death, ancestry, health status, cultural practices, and various activities. While a full description of the dental analysis of the Spring Street Church individuals is beyond the scope of this paper, several aspects are of particular interest.

Evidence of tobacco use by both sexes was present. Five men and three women displayed dark stains on either the enamel or the calculus covering the occlusal surfaces of their teeth (TAB. 9). Combined, these eight individuals represented 9.4% of the 85 individuals recovered from Vaults 2, 3, and 4. In addition, one teenager (Burial J from Vault 2; a probable male 13–14 years old) presented dark staining of the eight maxillary teeth available for examination. Only two individuals, both men from Vault 4 who were in their 50s when they died, presented possible wear facets on at least one tooth consistent with pipe-stem wear. Burial 9 exhibited a facet on his mandibular left first premolar and Burial 12 displayed one on his maxillary right first molar.

Occupations or repeated activities were also suggested by the wear on the teeth. Two women, both from Vault 2, presented small notches in their anterior teeth that may have resulted from sewing. Known as "seamstress notches," these grooves result from repetitive wear of the enamel from holding pins and

Table 8. Distribution of porotic lesions associated with nutritional deficiencies by individual.*

Burial	Sex and age	Frontal (orbital roof)†	Sphenoid (external surface)	Mandible (ascending ramus)	Maxilla (posterior surface)
Vault 2					
2	C, 2.5–3.5	X	X	X	X
3	C, 4.5–5.5	X		X	X
7	C, 4.5–5.5	X			
J	C(M), 13.5–14.5	X			
P	M, 18–22	X			
Vault 3					
15	M, 45–49	X			
E	C, 8–16 mos.	X		X	
F	C, 5–6	X	X	X	
G	C, 6–7	X		X	
Vault 4					
1–4I	C, 4.5–5.5	X			
1–4M	C, 5.5–6.5	X			
5	M, 20–24	X			
6	M, 35-39	X			
8	M, 60+	X			

* Lesions present on at least one side of the body.
† Cribra orbitalia

Figure 7. Porosity indicative of scurvy on the lingual surface of the right ascending ramus; Vault 2, Burial 3. (Photograph by the author.)

thread in the mouth (Herschaft et al. 2007: 68). Burial 8, 25–29 years old, presented notches in the occlusal surfaces of her maxillary left lateral incisor and right canine. Burial O, 35–39 years old, exhibited a notch in her mandibular left lateral incisor.

Dental restorations were not observed among the teeth from any of the 85 individuals in Vaults 2, 3, and 4. Two loose molars unassociated with any of the labeled individuals from Vault 4, however, each presented yellow metal restorations in the middle of their occlusal surfaces. These fillings were almost certainly formed from 24-kt-gold pellets or foil, common materials used by dentists beginning in the 1820s (Taylor 1922: 125–126). Mild wear of the occlusal cusps with no dentin exposure indicated that the teeth were from younger adults of indeterminate sex, possibly the same person based on their size and cusp patterns. That only one or possibly two people from the Spring Street Church vaults presented dental restorations reflects the infancy of the dental field and the expense of restorations during this period. Initially a branch of surgery, the formal practice of dentistry emerged in the United States during the same period the Spring Street Church vaults were in use. In 1840, the country's first dental college opened in Baltimore, and the American Society of Dental Surgeons was organized in New York City. It was not for another 25 years that the New York College of Dentistry opened in Manhattan, in 1865.

Given their expense, dental restorations generally were restricted to elite members of 19th-century America. United States Senator Nicholas Ware of Georgia, whose legible coffin plate was found loose in the disturbed soil of Vault 4, may be the source of the two molars with gold fillings. Although historical documents indicate otherwise, Ware, who died in New York City on September 7, 1824, may have been buried in Vault 4. While his skeletal remains have not yet been identified, a man of Ware's standing certainly is an excellent candidate for having had expensive dental work performed. Ware was just over 48 years old when he died and may have lost some teeth or presented at least some caries that required attention. Intriguingly, a removable dental appliance made of gold also was recovered from the disturbed soil in the western half of Vault 4. Likely from the same person as the molars with gold fillings, this dental appliance reflects cosmetic dental work that a senator might want and be able to afford.

Initially thought to be a fastener from a piece of jewelry (Mooney et al. 2008: 5.27), URS Laboratory Manager Rebecca White later identified the device as a dental bridge. The bridge measured 23.9 mm (0.94 in.) long and was formed from a single, thin strip of gold. The ends of the piece were shaped to fit over a tooth, probably a molar in the square opening and a canine or premolar in the round space (FIG. 8). Each end of the bridge terminated in flattened points. It is unclear if this was a maxillary or mandibular appliance. The middle part of the bridge was flat and would have been oriented toward the cheek (buccally) to mount a false tooth, which was not present. This part of the bridge included two small holes, one of which contained a tiny iron nail or pin (FIG. 9). The nails would have held the false tooth in place so that it filled a gap in the dental arcade and was visible when the wearer opened his or her mouth. The device was likely fashioned to replace a lost premolar, two of which are normally found between the canine and the first molar in adults. This evidence of early cosmetic dentistry reflects the high social status of at least one person, possibly Senator Nicholas Ware, interred in the Spring Street Church vaults. Apart from the two gold-filled molars, none of the other individuals in the vaults had dental restorations despite the prevalence of carious teeth among people of all backgrounds during the antebellum period.

Figure 8. One-unit dental bridge made of gold discovered in western half of Vault 4. (Photograph by the author.)

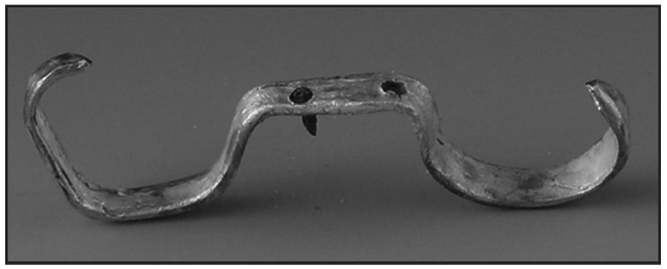

Figure 9. Detail of dental bridge from Vault 4 depicting holes and pin to secure false tooth. (Photograph by the author.)

Evidence of Autopsy

Although none of the individuals from Vaults 2, 3, and 4 presented evidence of surgical treatment or sharp-force trauma, two of the children had been subjected to autopsies or dissection of their crania. While not unknown in early 19th-century American medical education, autopsies, either to determine the cause of death or to dissect for anatomical study, were relatively uncommon for children as compared to those for adults; consequently, their remains are rare in the bioarchaeological record (Crist and Crist 2011). To date, the only other conclusively autopsied or dissected individual whose remains have

Table 9. Distribution and location of dental staining and occlusal wear associated with smoking.

Burial	Sex and age	Location of dental stains	Location of pipe stem wear
Vault 2			
1	F, <35	Multiple loose teeth	—
8	F, 25–29	Maxillary first molars and left second premolar	—
12	M, 20–24	Maxillary right first and second molars	—
J	C(M), 13.5–14.5	Maxillary teeth	—
O	F, 35–39	Mandibular left second premolar and first molar	—
R	M, 18–22	Mandibular right first molar	—
Vault 4			
5	M, 20–24	Mandibular molars	—
6	M, 35–39	All teeth, especially maxillary left first and second molars	—
9	M, 50–59	—	Mandibular left first premolar
12	M, 50–59	Maxillary right first and second molars	Maxillary right first molar

been found in Manhattan came from the African Burial Ground. Burial 323 was a man 19 to 30 years old whose dissected cranial vault was lying in his abdomen and beneath his right upper limb when he was excavated (Blakey and Rankin-Hill 2004b: Section IV: 111; Heilen et al. 2009: 84). Saw marks located along the margins of the separated cranial vault bones clearly indicated that he had been autopsied or dissected prior to interment, most likely between 1776 and 1795.

It is remarkable that both of autopsied individuals from the Spring Street church vaults were children. Burial J from Vault 2 was 13–14 years old at death and Burial A from Vault 4 was about one year old. A metal pin embedded in Burial J's frontal bone indicates that this teenager's cranium was used as an anatomical specimen. Novak and Willoughby (this volume) present more detailed analyses of these two individuals and the social context in which their postmortems were performed.

Osteobiographies

Several individuals from the Spring Street Church burial vaults presented remarkable burial circumstances and unusual pathological lesions. Osteobiographies provide in-depth histories for these individuals based on their skeletal data, offering a humanistic perspective regarding their lives and deaths.

Burial 9: The Man with Prostate Cancer

Cancer is one the most uncommon diseases observed among historic-period skeletal remains. In its most basic form, cancer is the uncontrollable growth of abnormal cells in any part of the body. The onset of cancer may be genetic; may be triggered by exposure to an environmental factor such as toxic chemicals or radiation; may be caused by viruses; or may arise from random mutations. The types of cancer and the frequency of their incidence vary by population and geographic location (Micozzi 1991).

One man from the Spring Street Church vaults (Burial 9, Vault 2) presented lesions of his pelvic bones and femora strongly suggesting that he suffered from some form of metastatic carcinoma, most likely prostate cancer. The prostate is a small gland located below the bladder in men. It wraps around the urethra and serves as part of the reproductive system. Prostate cancer causes enlargement of the prostate, progressively restricting the flow of urine through the urethra as the condition progresses. National health data indicate that it is the most frequently diagnosed type of non-skin cancer and is the second leading cause of cancer deaths among modern American men (National Cancer Institute 2012). Prostate cancer is rarely observed in men under the age of 40 and is more common among African Americans, who present the highest incidence of prostate cancer and associated mortality rates in the world (Anglade and Babayan 2003: 121; Sawczuk and Shabsigh 2003: 115–116). Unlike many other forms of cancer, prostate cancer commonly results in the formation of osteoblastic (bone-forming) metastases (Aufderheide and Rodríquez-Martin 1998: 388; Ortner 2003: 543–544).

During their examination of Burial 9 from Vault 2, Dr. Novak and her assistants at Syracuse University identified lesions reflecting neoplastic bony growth as well as lytic resorption located across this individual's innominates, sacrum, and femora. Based on the appearance of his innominates and the degree of dental attrition, Burial 9 was 40–49 years old at death. His skeleton was poorly preserved but included the partial remains of his pelvic girdle and lower limbs. His fragmentary left maxilla was identified during the screening of soil from Vault 2; the maxilla articulated with the frontal process that was associated with the partial remains in the grave for Burial 9. Determination of Burial 9's ancestry was inconclusive: the femora were straight and the intercondylar spaces were wide, both morphological traits typically associated with African ancestry, but the appearance of the partial left maxilla indicated that he had a narrow nasal aperture and a flat face, which are features consistent with European ancestry.

The neoplastic lesions were represented by new bone that had formed across the visceral surfaces of Burial 9's ilia, presenting a fuzzy, velvet-like appearance (FIG. 10). The growth was denser and more prominent on the left ilium. The innominates were pitted with numerous lytic lesions, which were especially prominent across the posterior surfaces of the ilia. Similar lytic lesions, appearing as large pores surrounded by dense bone, also characterized the three fragments of the sacrum that were present. None of the lumbar vertebrae were present for observation. The disorder also affected Burial 9's groin and thighs. Both femora presented widespread microporosity across the proximal thirds of the shafts. This reactive bone extended down the medial surface of the right femoral shaft, gradually becoming less pronounced inferiorly. The left femur and tibia also exhibited active, mild porosity that extended along the shafts of these bones. The right tibia was not present. Burial 9's right ulna and left maxilla also presented widespread porosity. Based on appearance and distribution of these lesions, the Syracuse University researchers determined that the most likely cause for the lesions was metastatic prostate cancer (Crist et al. 2008: D.16–D.18). While other types of intestinal cancer may have caused the lesions, a subsequent review of cases of prostate cancer reported in the paleopathological literature has provided further support for this differential diagnosis (Hosek and Novak 2011).

Skeletal lesions in human remains from archaeological contexts often reflect the extreme manifestations of a disease, since treatment options were few and generally ineffective. In Burial 9's case, the lesions of his pelvis suggest a painful condition of some duration. While recognized earlier in the 19th century, prostate cancer was first described in the medical literature in 1853 when British surgeon Dr. John Adams published an article in the medical journal *The Lancet* regarding his postmortem examination of a 59-year-old patient. Adams (1853: 393) reported that the subject of his paper had died three years after the onset of his symptoms, which included a "frequent desire to pass urine and required the constant use of the catheter…pains about the pelvis ensued; the saphena vein became thickened; [and] the thighs were drawn up upon the trunk." Writing about prostate cancer 15 years later, Thompson (1868: 270–271; first published in 1858) described the symptoms of prostate cancer as "severe pain, often very intense; occasional, often frequent, hemorrhages; and more or less constitutional cachexia [overall bodily wasting]…The pain is felt in the rectum, or in the region of the sacrum, and shooting down the thighs, either the anterior or posterior aspects." These clinical symptoms are reflected in Burial 9's bony lesions.

In his practical guide to prostate disease published more closely to Burial 9's lifetime, Courtenay (1839: 75–76) described the current treatments available to the physicians of his day:

> regular use of the catheter…the local abstraction of blood [using leeches], and the warm hip-bath night and day; and after two or three local bleedings, we may employ with advantage an ointment composed of iodine, camphor, &c., which should be rubbed on the perineum night and morning…[and] administer at bedtime an anodyne [pain reliever] enema.

He further recommended that the patient "should as much as possible keep in the horizontal posture; his diet should consist principally of milk and light puddings, and of course he should avoid all spirits, wine, and beer." Apart from catheterization, an uncomfortable procedure where a metal tube is passed through the penis into the bladder to open the urethra, it is unlikely that any of these methods provided much relief.

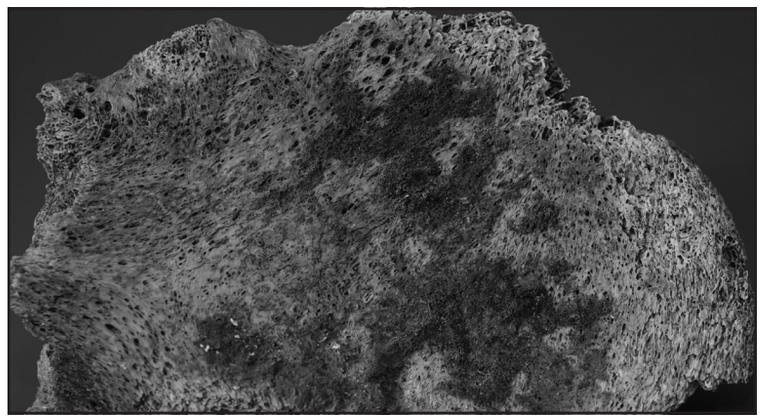

Figure 10. Proliferative and lytic lesions of the right ilium indicating probable case of prostate cancer; Vault 2, Burial 9. (Photograph by Dana Kollman.)

Given these descriptions and how the historical treatments

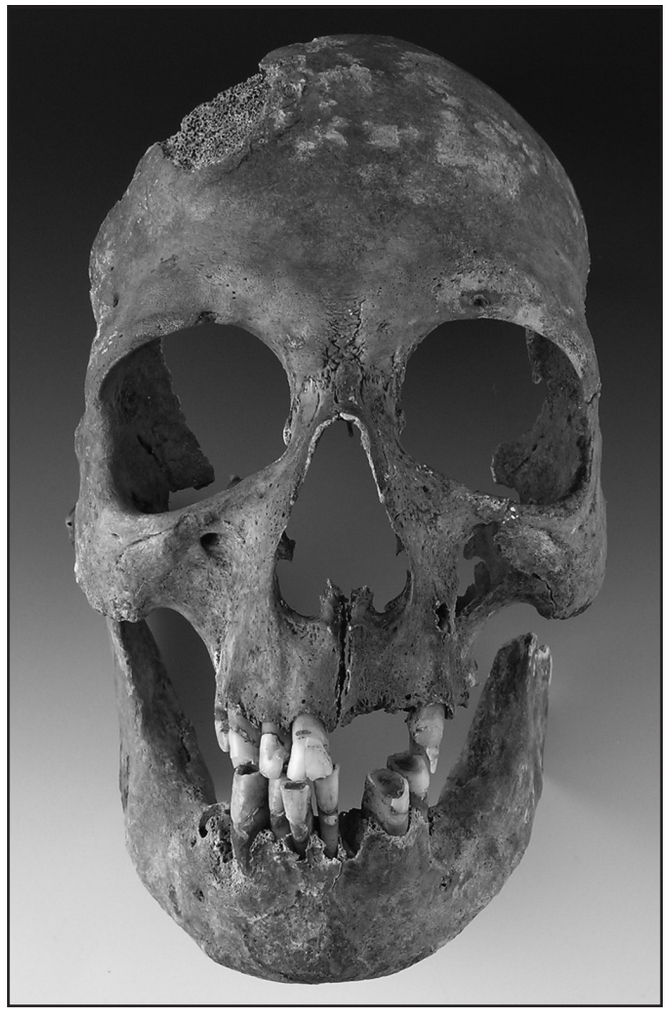

Figure 11. Facial skeleton of Burial 12 from Vault 3; identified as Rudolphus Bogert who died in 1842 at age 76. (Photograph by the author.)

contrast with the practice of modern medicine, one can only imagine the pain and indignities that this man, now known as Burial 9, suffered due to his condition. Burial 9 died at least a decade before Dr. Adams published his article in 1853 and, similar to the patient described in the article, likely suffered from his disease for some time, possibly for years. Burial 9's lesions reflect what must have been an agonizing affliction, underscoring the human dimensions both of medicine during the antebellum period and of paleopathology today.

Rudolphus Bogert, New York Merchant

Although more than 35 legible coffin plates were recovered during the archaeological excavations of the Spring Street Church burial vaults (see White and Mooney, this volume), only one was clearly associated with a set of skeletal remains. Burial 12 from Vault 3 was found with a coffin plate inscribed "Rudolphus Bogert/Died 15th Nov 1842/Aged 76 Yrs" in close proximity to his cranium. Subsequent laboratory analysis indicated that Burial 12 was indeed a man at least 70 years old at death.

Rudolphus Bogert was born on February 16, 1766 and was baptized four days later at the New York Reformed Dutch Church. A merchant from one of the New York's oldest Dutch families, he served as a captain in the New York State Militia and was a member of New York City Fire Company #36 (Mooney et al. 2008: 5.8). He married Ann Clark (1784–1850) on May 2, 1802 and together they had ten children between 1803 and 1826 (Riker 1904: 457). Working for his family's cotton business (Bogert and Kneeland, founded in 1803 and closed in 1870), he was successful enough to have a miniature portrait of his likeness made in 1806 by New York artist Parmenas Howell, an item now on display at the New York Metropolitan Museum of Art (see White and Mooney, this volume).

Bogert's skeleton was generally intact, although his cranium and ribs were fragmented and his scapulae, fifth lumbar vertebra, and sacrum were absent. His spinal column presented significant pathological lesions, including fusion of the fifth and sixth cervical vertebrae. The joints of his lower extremities, however, exhibited minimal evidence of degenerative changes, suggesting that he was a gentleman rather than a man who had labored physically.

Commensurate with his advanced age, Bogert lost many of his teeth well before death. Most of his maxillary teeth were lost antemortem with complete resorption of their sockets; both right incisors, both canines, the right second premolar, and the left third molar remained (FIG. 11). An active abscess was located at the root of the left canine. All of his mandibular molars also were lost antemortem with complete socket resorption, as were the left second and right first premolars. Both mandibular canines, three incisors, and the left first premolar all were present in their sockets. The left lateral incisor and right second premolar were lost postmortem. The cusps of all of Bogert's teeth were completely worn away, resulting in moderate dentin exposure.

An examination of Bogert's long bones revealed a leg-length discrepancy: his left femur was 14 mm (0.55 in.) longer than his right one. A small osteophyte (a bony spur) projected superiorly from the lateral eminence of his right tibia; this bony growth may reflect the ossified remains of a torn anterior cruciate ligament of his knee. A number of degenerative changes affected Bogert's spinal column. All of his cervical vertebrae presented osteophytes and porosity of their bodies, probably due to his advanced age but possibly resulting from a traumatic event that affected his fifth and sixth cervical vertebrae. These vertebrae were fused together at their bodies and at both apophyseal articular facets (FIG. 12). This ankylosis (fusion) most likely resulted from a localized neck injury, probably an intervertebral disc herniation that occurred when he was much younger. Modern medical data indicate that the overwhelming majority of disc herniations in the neck occur between the fifth and sixth vertebrae, the site of maximum cervical mobility (Schoen 2000: 235). The resulting clinical symptoms include intermittent paresthesia (the "pins-and-needles" sensation) of the thumb and lateral side of hand along with weakness and atrophy of the biceps. It is possible that Bogert experienced these symptoms in both arms due to progressive compression of the sixth cervical spinal nerves as the two vertebrae fused together.

While there were minimal arthritic changes to the apophyseal articular facets of Bogert's thoracic vertebrae, their bodies exhibited multiple syndesmophytes (beak-like osteophytes that cross the disc spaces) and marginal osteophytic ridges. The syndesmophytes located on the bodies of the eighth through eleventh vertebrae were large and had begun to fuse (FIG. 13). The twelfth thoracic vertebra presented minor anterior wedging, possibly from a compression fracture. Bogert's lumbar vertebrae also presented marginal osteophytic lipping and syndesmophytes. Eburnation from bone-on-bone contact of the third lumbar vertebra's right inferior facet and remodeling of the left superior facet from the fourth lumbar vertebra suggest that Bogert suffered a localized injury to his lower back. It is possible that this injury occurred in association with the disc herniation that resulted in the fusion of his fifth and sixth cervical vertebrae.

Figure 12. Posterior view of Rudolphus Bogert's lower cervical spine (C5–C7) depicting ankylosis of the apophyseal joints at the fifth and sixth vertebrae. (Photograph by the author.)

Rudolphus Bogert was part of a Dutch family whose members were among the earliest settlers of New Netherland in the late 1600s. Born into the Reformed Dutch Church, Bogert apparently chose to join the Spring Street Presbyterian Church and was buried in

one of its vaults in 1842, seven years after interments in Lower Manhattan were specifically prohibited by law. It is unclear whether Bogert's wife Ann (who died on April 13, 1850 in Brooklyn) or any of their ten children (three of whom predeceased him) were interred with him in the vaults. Although prosperous and civically active, Bogert's remains indicate that his last years were marked by discomfort from neck and back pain, limited mobility, and dental problems; his skeleton serves as a testament to a long life as a successful merchant who helped build New York City into the economic engine of the early United States.

Figure 13. Left antero-lateral view of Rudolphus Bogert's lower thoracic spine (T8–L1); note bridging syndesmophytes located along the right side of the vertebral bodies. (Photograph by the author.)

Burials 17A and 17B: Mother and Baby

Perhaps the most compelling story depicted by the skeletal remains from the Spring Street Church vaults is that of a young woman interred with the remains of a full-term fetus. Although DNA analysis was not performed to confirm their relationship, the position of the fetal remains makes it almost certain that the skeletons represent a mother and her baby.

Burial 17A was a woman of European descent who was 25 to 29 years old when she died. During excavations the URS archaeologists discovered the remains of a full-term fetus in the woman's lower abdominal region, with most of the immature bones laying primarily on her sacrum and right innominate (FIG. 14). There was no evidence of a separate coffin for the fetal remains, indicating that the woman most likely died either during childbirth or as the result of some other cause during her ninth month of pregnancy. It is also possible, though less likely, that the baby was born alive and that they both died and were buried together shortly thereafter.

The skeletal remains of both the woman and the baby were well preserved, with most skeletal elements and the woman's teeth present and intact. Her cranium and facial bones were present but fragmentary and eroded. Almost all of the bones of the fetus were present with the exceptions of the facial bones, the right innominate, and portions of the unfused vertebrae (FIG. 15). The bones of the cranial vault were fragmentary. No immature dental remains were found.

The sex and ancestry of the fetal remains were indeterminate, but his or her age was clearly indicated by fusion of the tympanic ring and petrous portion of the right temporal, which occurs just before birth. The lesser wings of the sphenoid also were fused to its body, another normal development in a full-term fetus. The left greater wing was partially fused; this portion normally joins the body during the first year of life but also may do so in utero. Measurements of the long bones indicated that the fetus was small relative to others in this age range, but within normal parameters.

The woman's remains presented no evidence of trauma or cause of death. Complications of labor, including obstruction of the fetus, are likely possibilities, especially given the position of the fetal remains in her lower abdominal region. Another possibility, however, is suggested by the lesions present on the woman's cranial bones. Her frontal exhibited a thin layer of light-colored, remodeled bone that extended across the internal (endocranial) surface from the orbital plates superiorly to the coronal suture (FIG. 16). In contrast, the unaffected portions of the bone were characterized by a smooth, tan-colored surface. The atypical surface was bumpy with widespread porosity and elongated cavitations. Both parietals also presented similar endocranial porosity in the centers of the bones and along the channels

Figure 14. In situ view of the remains of a full-term fetus located in the abdominal cavity of probable mother; Vault 3, Burials 17A and 17B. (Photograph by the author.)

Figure 15. Remains of the full-term fetus from Vault 3, Burial 17. (Photograph by the author.)

for the blood vessels, especially around the grooves for the meningeal arteries. This porosity and remodeling probably reflect meningitis, which is an infection of the thin membranes that cover the brain and lie close to the endocranial surfaces of the cranial vault bones. Acute meningitis arises from a variety of causes, most commonly viruses and bacteria. Even with modern antibiotic treatment, bacterial meningitis may be quickly fatal.

Burial 17A's endocranial lesions actually may have resulted from a more chronic meningeal infection, such as tubercular meningitis or syphilitic aseptic meningitis. While no other osteological evidence of these diseases was present on her other bones, both tuberculosis and syphilis were common in antebellum New York and their respective causative organisms may have infected this woman's brain or its surrounding tissues. Historical research supports this possible explanation: "Tuberculosis in the nineteenth century disproportionately attacked young women between the ages of 15 to 45, and frequent pregnancies in these same women put them at a greater risk of early death" (Leavitt 1986: 25).

A study of the frequency and distribution of endocranial lesions among a large sample of

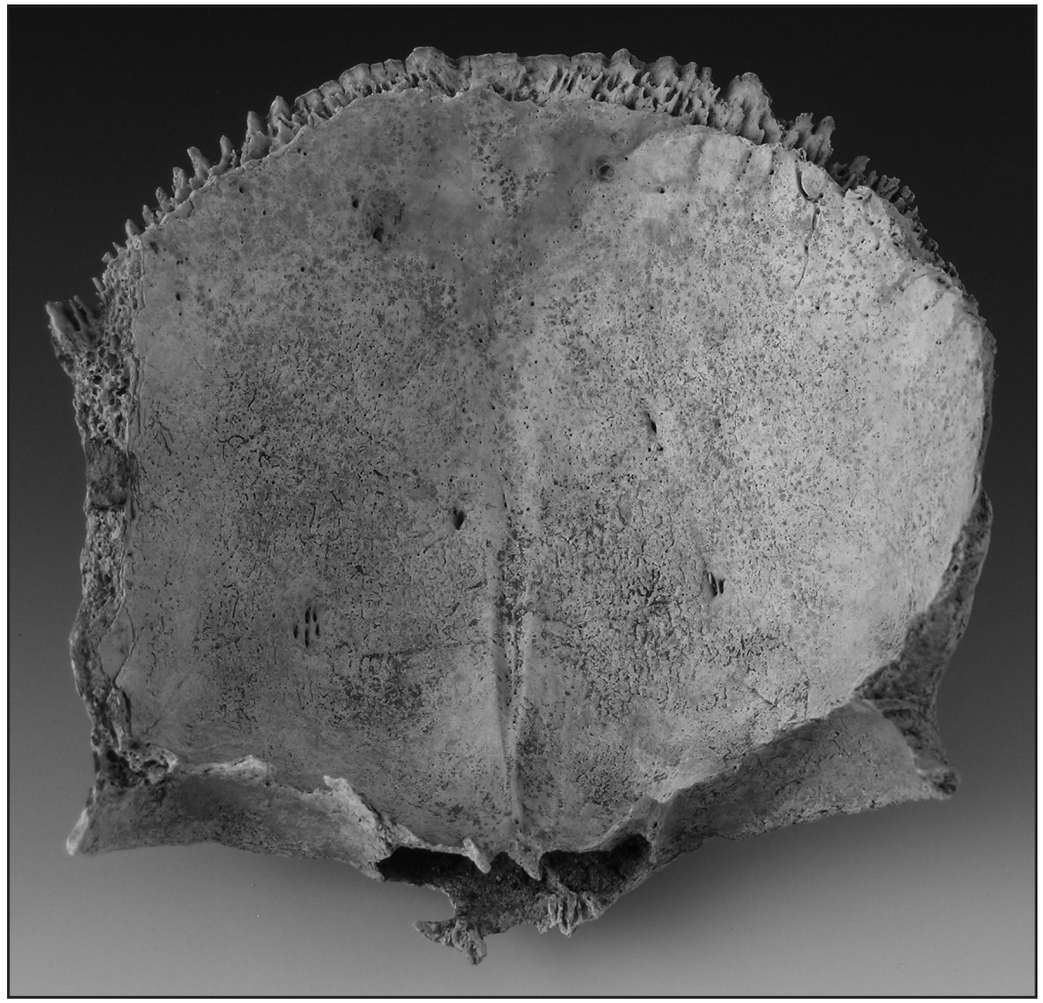

Figure 16. Endocranial surface of the frontal presenting reactive periosteal bone and remodeling; Vault 3, Burial 17A. (Photograph by the author.)

adult skulls in the Hamann-Todd Collection in Cleveland may support a link between Burial 17A's cranial lesions and infection with tuberculosis. Hershkovitz et al. (2002) identified superficial endocranial lesions and discolored bone that they collectively termed *serpens endocranial symmetrica* in 32 of the 1,884 skulls (1.7%) that they examined. These individuals had all died during the first four decades of the 20th century. Of significance, 29 of the 32 people (90.6%) were reported to have had thoracic infections; tuberculosis was listed as the cause of death for 25 of them (78.1%). The lesions were bilateral in 90.9% of the cases, as were those presented by Burial 17A.

Lesions presented by Burial 17A's baby also may have resulted from tuberculosis or syphilis. While some porosity is a normal characteristic of the developing bones, extensive fine to coarse porosity was present across the surfaces of the basilar and left lateral portions of the occipital, the right temporal, the petrous portion of the left temporal, and the surfaces of the mandible. The right greater wing of the sphenoid also presented a thin, white-colored, slightly raised layer of bone across the endocranial surface. Its entire external surface was covered by widespread, fine porosity. All of the ribs presented fine to coarse, honeycomb-like porosity across their external and internal surfaces. Fine, smooth porosity was also present on the scapulae, humeri, ulnae, the left ilium, and the lower limb bones. The appearance and widespread distribution of this porosity was most likely pathological and resulted from a systemic illness, probably transmitted from the woman during pregnancy.

In a report written in 1857, New York physician David Meredith Reese tabulated a total of 24,164 stillborn and premature births recorded in New York City between 1804 and 1853 (Reese 1857: 18). A further 78,762 infants under one year old reportedly died during these 50 years, which span the period when the Spring Street Church burial vaults were in use. Combined, these infants accounted for 28% of the 363,242 deaths reported in New York City during this period. Burial 17B serves as a poignant representative of these many premature deaths. Together, these individuals dramatically reflect the high risk of childbirth for mothers and their babies during the historical period. As noted by Leavitt (1986: 14): "During most of American history, an important part of women's experience of childbirth was their anticipation of dying or of being permanently injured during the event."

Discussion and Conclusion

In 1865, some 31 years after their church and house had been destroyed by anti-abolitionist mobs, Reverend Henry G. Ludlow's son, Fitz Hugh Ludlow, wrote about the night that his family returned to their home:

> When [my family] came cautiously back, their home was quiet as a fortress after it had been blown up. The front-parlor was full of paving-stones; the carpets were cut to pieces; the pictures, the furniture, and the chandelier lay in one common wreck; and the walls were covered with inscriptions of mingled insult and glory. Over the mantel-piece had been charcoaled "Rascal;" over the pier-table, "Abolitionist" (1865: 504–505).

Such was the state of affairs for the leader and the congregants of the Spring Street Presbyterian Church amidst the explosive tension that the abolitionist movement generated in New York City during the 1830s.

This was an unusual group of people: progressive and open to a mixed-race congregation, willing to follow a controversial abolitionist pastor, and many with money to spend on silver coffin plates and rebuilding their church quickly after its destruction in 1834. It is unfortunate that history does not record more of their personal stories. The discovery and excavation of the Spring Street Church burial vaults, however, brings these church members back to life, even though only a few of them can be personally identified. Their skeletons also provide a glimpse into the biological history of antebellum New York. As the only group of human remains from this period available for study to date, the demographic and paleopathological data that they generate allow for a more accurate reconstruction of the nature of life and death during this turbulent period in the city's history.

Even considering the small sample size relative to New York's population of a quarter million people in the 1830s, virtually every disease and disorder described in the city's historical accounts are represented among the Spring Street Church congregants' remains. These include cases of syphilis and tuberculosis;

nutritional disorders including anemia, rickets, and scurvy; a small number of accidental fractures; a possible case of abdominal cancer; and one poignant burial where a mother and her baby had apparently both died during childbirth. Almost half of the 85 individuals presented evidence of skeletal infection or inflammation and about 10% of the adults had a healed fracture, but none of the fractures resulted from injuries of a violent nature. About one-third of the 34 infants and children appeared to have suffered from anemia and at least five of them may have had scurvy.

When compared to the modern American population, the average age at death of the adults in the Spring Street Church vaults at just over 35 years old was strikingly low. This average age also was lower than that reported for adults in New York City when the vaults were in use; during the 1820s the average age at death for adults over 20 years old was 43 years and in the 1830s it was 39 years (Wynne 1857: 192). Although the historical data are almost certainly imprecise and the skeletal ages estimated, it appears that the individuals whose remains were recovered from the vaults, on average, died younger than their fellow New York residents. Consistent with the high rates of infant mortality reported during this period, almost half of the 34 infants and children died before reaching 18 months of age.

Despite Reverend Ludlow's comments to his sister about the low financial position of his congregants, overall this group of people appears to be a broadly representative sample of the residents of Manhattan during the 1820s and 1830s. Neither particularly wealthy nor poor, they chose to associate with a church active in the abolitionist movement and included people of African descent in their services and perhaps in their burial vaults. From Rudolphus Bogert and Louisa Hunter to the 83 other nameless adults and their infants and children, the skeletal remains of these people highlight the unique and under-appreciated roles that they and their church hold in the history of the American abolitionist movement and the development of New York City.

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