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Cover Page Footnote
We would like to thank Canon Gosse, Dorothy Keeley, and Shirley Spragge for permission to transcribe the St. Thomas' parish registers. We are grateful to Carol DeVito, Rob Hoppa, and Tina Moffat for their enthusiastic and skilled assistance with the data analysis. The research was supported by McMaster University's Arts Research Board, the Ontario Heritage Foundation, and Social Science and Humanities Research Council of Canada Grant #410-92-1493.

BONES AND BURIAL REGISTERS: INFANT MORTALITY IN A 19TH-CENTURY CEMETERY FROM UPPER CANADA

D. Ann Herring, Shelley Saunders, and Gerry Boyce

The fortunate conjunction of a large skeletal sample (n=576) and reliable burial records (n=1,564) for St. Thomas' Anglican Church cemetery (1821–1874) makes it possible to make inferences about patterns of infant death in 19th-century Belleville, Ontario. Analysis of both sets of data indicates that males and females were equally likely to die during infancy and that environmental factors played an important role in Belleville's mortality profile. The parish records reveal elevated risks of infant death in the summer, probably from the weanling diarrhea complex, owing to unsanitary conditions and the presence of acute infectious diseases in the town. The importance of acute causes is supported by patterns of skeletal growth and development that show that St. Thomas' infants were developmentally similar to modern North American children. The study also suggests an excavation bias in the skeletal sample, with an over-representation of burials from 1840 onward.

L'heureuse combinaison d'un nombre important de squelettes (576) et de nombreux dossiers d'inhumation (1,564) reliés au cimetière de l'église anglicane St. Thomas (1821–1874) a rendu possible l'établissement de profils de mortalité infantile à Belleville au XIX^{e} siècle. L'analyse des deux ensembles de données permet d'établir que les personnes des deux sexes étaient tout aussi susceptibles de mourir en bas âge et que les facteurs environnementaux jouaient un rôle important dans la mortalité infantile à Belleville. Les documents paroissiaux révèlent un risque de mortalité infantile plus grand en été, probablement en raison de la diarrhée reliée au sevrage, occasionnée par de mauvaises conditions sanitaires et la présence dans la ville de maladies infectieuses aiguës. L'importance des causes aiguës est appuyée par le développement similaire des squelettes des enfants en bas âge de St. Thomas et de ceux des enfants nord-américains d'aujourd'hui. L'étude suggère de plus que l'échantillonnage des sépultures fouillées est biaisé en faveur d'inhumations postérieures à 1840.

Introduction

Until quite recently, physical anthropologists tended to work in isolation from historians, separated by different study periods, research questions, data, and theoretical frameworks. The increase in historical cemetery excavations since the 1970s in North America, however, has generated an expansion in the number of studies of the associated skeletal remains (cf. Lanphear 1989; Parrington and Roberts 1990; Owsley 1990; Williamson and Pfeiffer 1991; Saunders and Lazenby 1991). This has created a new convergence of historical and osteological interests as well as the opportunity to synthesize information from archaeological, documentary, and skeletal sources.

The diversity of aims and questions addressed by such studies is quite wide. Lanphear (1989), for example, has compared and evaluated demographic profiles derived from skeletal analyses to those from the burial records for a 19th-century poorhouse cemetery. In another study, comparison of coffin plates, coffin hardware, skeletal identifications, and family genealogies made it possible to establish the personal identities of several individuals interred in a 19th-century pioneer burying ground (Saunders and Lazenby 1991). Documentary evidence aided researchers in locating the burials of members of the ill-fated Franklin Expedition while autopsy analysis of their remains established the probable cause of death, lead poisoning because of a faulty canning process, as well as the probable reason for the failure of

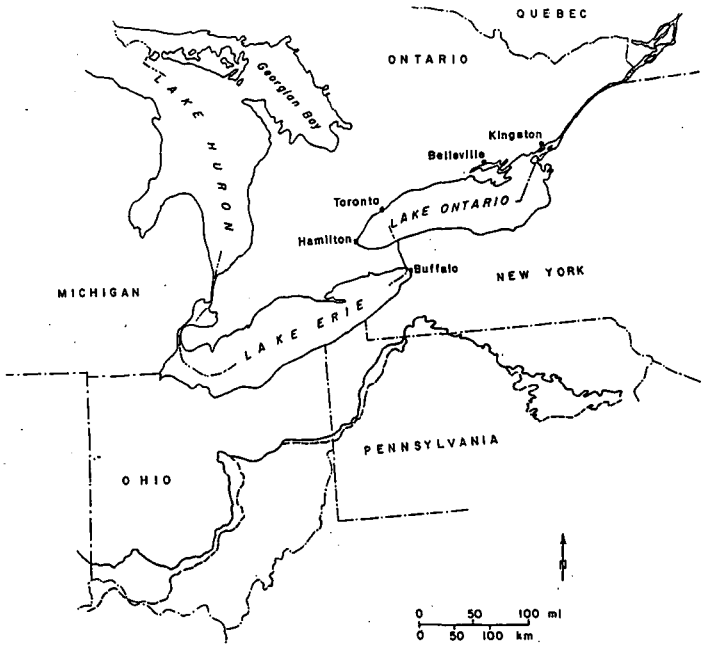

Figure 1. Map of southern Ontario illustrating the location of Belleville and the parish of St. Thomas' Church.

the endeavor (Beatty and Geiger 1987).

This paper is not intended to be a review of the increasingly rich body of literature on skeletal material from historic cemeteries (interested readers should see Owsley 1990); rather, we discuss a specific 19th-century cemetery where a fortunate conjunction of archaeologically excavated skeletal remains and historical documents is beginning to reveal aspects of life during the founding and development of the town of Belleville, Ontario (FIG. 1). The project focuses on individuals buried in St. Thomas' Anglican Church cemetery during the 53-year period it was used, from August 28, 1821, to April 16, 1874.

A comprehensive analysis of the full skeletal collection is in progress (Rogers 1991; Jiminez 1991; Saunders, Herring, and Boyce 1991; Saunders et al. n.d.; Saunders et al. 1992, 1993; Saunders and Hoopa 1993) but the focus of this paper is infant death. Infant mortality is particularly interesting because it is regarded by demographers and medical statisticians as one of the most powerful indices of the overall quality of life and state of health of a community (Lee 1991; Swedlund 1990; Miller 1985; Stockwell and Wicks 1984). For places like Belleville, which were founded largely by United Empire Loyalists from the American colonies to the south and by emigrants from Britain, Ireland, and continental Europe, patterns of infant mortality offer insight into the conditions of life facing new settlers in northeastern North America. Equally, if not more important, the study illustrates how documentary and skeletal information can be used to complement each other and to verify the internal consistency of data derived from the two sources.

Combining Skeletal and Documentary Data on Infant Mortality

Despite its obvious potential, skeletal researchers have begun only recently to pay attention to the analysis of infant remains. This is because the small size of infant bones and the concomitant difficulty of recognizing infants in archaeological contexts makes it simpler to focus on adult skeletons. It has been assumed, moreover, that infant skeletons are underrepresented from most cemeteries because of lower quality bone preservation (Johnston and

Zimmer 1989). Ironically, skeletal age-at-death estimates are far more accurate for subadults because of the well-defined timing of the sequences of tooth eruption and epiphysal fusion during growth and development (Ubelaker 1989; El-Nofely and Iscan 1989).

In addition to the relative shortage of osteological analyses of infants, skeletal biologists have tended to define the period of "infancy" less stringently than demographers. Skeletons estimated to be anywhere from 1 to 5 years have been classified as "infants" and some studies have included stillbirths and miscarriages in infant samples (Saunders and Spence 1986; Saunders 1992). Demographers, on the other hand, define infant deaths as all *live-born* children who die before reaching their first birthday.

The age structure of infant mortality is also judged to be an important means of assessing the sanitary-social conditions that surrounded an infant in life (for an alternative point of view, see Lancaster 1990). Demographers conventionally divide infant deaths into two broad periods: (1) neonatal deaths that occur between birth and 27 days; and (2) postneonatal deaths that occur between 28 days and the first birthday. Neonatal mortality is considered to reflect the endogenous state of the infant (genetic and congenital abnormalities; maternal health and nutrition; circumstances surrounding the birth), while postneonatal mortality is judged a better indicator of aspects of the infant's environment, such as nutrition, infectious disease, and living conditions (Bourgeois-Pichat 1951a, 1951b). Obviously, one of the problems facing cemetery researchers lies in reaching agreement on common definitions that will allow for rigorous comparisons between skeletal and documentary data, as well as among sites (see Petersen 1974; Howell 1986).

Sex differences in the risk of infant death can be important indicators of preferential treatment, vulnerability to disease, and attitudes towards infants and children (Damme 1978; Hansen 1979; Siegel 1984). Burial records often indicate the sex of an infant or make it possible to infer the infant's sex from nominative information. The task of determining whether an infant skeleton is male or female, however, is far more difficult because the criteria used to assess sex, by and large, have yet to be manifested in bone this young (Workshop of European Anthropologists 1980; Saunders 1992; but see Schutkowski 1993). Consequently, when burial records are available for a sample of infant skeletons, it becomes possible to estimate sex-specific infant mortality rates that may provide a glimpse of cultural attitudes and practices surrounding children.

Both skeletal remains and burial records provide information on health and disease in infants, although they each present a different facet of the problem. Recorded causes of death in burial records tend to more closely approximate the social conditions around the time of the infant's death. As such, they are particularly useful for reconstructing changes in morbidity and mortality profiles over time, detecting excess mortality during epidemics, locating seasonal variation in the risks of death, uncovering socio-economic factors underlying infant mortality, inferring breastfeeding patterns, and determining the presence of acute community infections or non-infectious conditions that leave no impression on bone (Knodel and Kinter 1977; Meindl 1977; Meindl and Swedlund 1977; Dyhouse 1978; Hansen 1979; Knodel 1983; Trapp, Mielke, Jorde, and Eriksson 1983; Cheney 1984; Thompson 1984; Sawchuk, Herring, and Waks 1985; Swedlund 1990; Lee 1991; Sawchuk 1993). Family life cycles can be reconstructed by concatenating baptism, marriage, and burial records into genealogies, providing information on the relationship between infant mortality and family characteristics such as family size, birth order, socio-economic status, and so on (Boatler 1983; Brennan 1983; Sorg and Craig 1983; Herring and Sawchuk 1986; Moffat 1992).

Skeletal evidence, on the other hand, recapitulates a lifetime of nutritional and disease experiences. Consequently, the skeletons of children provide evidence of chronic indicators of physiological stress such as defects in tooth enamel (Goodman and Rose 1990), anemia (Stuart-Macadam 1992), altered bone metabolism, and dietary composition and intragroup dietary differences (Tuross, Fogel, and Owsley 1990). Growth and development patterns, key components for evaluating the quality of a child's environment, have been assessed by comparing the relative sizes of subadult long bones to modern standards and to other skeletal populations (Jantz and Owsley 1984; Cook 1984; Mensforth 1985; Lovejoy, Russell, and Harrison 1990; Hoppa 1991; Saunders 1992).

Recognizing the potential wealth of com-

plementary inferences that ultimately can be drawn about 19th-century Belleville from the analysis of infant deaths in St. Thomas' Cemetery, we undertook a preliminary analysis of the skeletal and burial data in order to: (1) evaluate the quality of the two data sources; (2) compare the two series of data with respect to broad categories (infants vs. all deaths and neonatal vs. postneonatal deaths); (3) derive an infant sex ratio from the burial registers; and (4) examine the seasonal distribution of infant deaths to generate hypotheses about the stresses of pioneer life. This article outlines the results of these analyses and offers hypotheses to be tested as we continue to investigate this rich archaeological sample.

The St. Thomas' Anglican Church Project

The St. Thomas' Anglican Church project grew out of the church's decision to build a new parish hall on the site of a long abandoned 19th-century burial ground. The area targeted for construction was thought to overlay perhaps 80 graves, but it was difficult to estimate the numbers because all but 15 gravestones had been destroyed or removed in the wake of fires in 1876 and 1975, which also destroyed the only surviving plan of the cemetery. Recognizing the site's potential for scholarly inquiry, the Church made the decision to have the cemetery excavated by professional archaeologists. Northeastern Archaeological Associates were contracted to carry out the work on the legally severed portion of the cemetery in the summer of 1989.

Once the surviving tombstones were mapped and moved, the excavation progressed rapidly owing to the favorable geographical location and soil conditions at the site. Perched on a raised sandy knoll approximately one kilometer from the shoreline of the Bay of Quinte, St. Thomas' occupies one of the highest points of land in Belleville. This made the initial removal with a backhoe of two to three feet of topsoil a relatively simple matter. After the designated site was mapped and gridded, teams of archaeology students and volunteers systematically shovel shined the site to identify the rectangular soil stains indicative of grave shafts. Each grave was excavated individually, as were the areas below and between grave shafts, to ensure that no burials were overlooked. In most instances it was only necessary to lightly brush away the soil from the skeletal remains, enhancing preservation of the original bone surfaces. As one row of graves was excavated, the next was shovel-shined and test pitted. Burials were recorded on standard data forms, photographed, and measured from the site grid (McKillop et al. 1989).

The final excavated area constituted about one-half acre, approximately one-third of the estimated area of the original cemetery (FIG. 2) and yielded a surprising 579 graves. This makes St. Thomas' one of the largest historical-period cemeteries in North America. Fortunately, most of the graves were intact, and the complete or partial skeletal remains of 576 individuals were recovered. Approximately 5 percent (n=27) of the graves were empty, probably because the body had been disinterred and moved elsewhere. In most cases, a single individual was contained in each grave, but there were a few instances of stacked graves, usually involving one or more infants buried with an adult female. All of the bodies had been placed in coffins and lay extended on their backs with their heads oriented to the west.

A large number of artifacts was also recovered. These include coffin handles, nails, hinges, buttons and shroud pins, coffin viewing glasses, some clothing, shoes and other personal effects such as dentures. Coffin name plates or domes used to form names or initials proved to be especially important clues to personal identity of some 80 of the individuals. These individuals are currently the subject matter of a number of studies that are testing forensic methods (Saunders et al. n.d.; Saunders et al. 1992; Rogers 1991).

Scrutiny of St. Thomas' burial registers indicates that 1,564 burials were conducted at the cemetery between August 30, 1821, and April 14, 1874. The skeletal remains available for analysis therefore constitute a sample of 37% of the total burials. One of the issues addressed here is whether this quite substantial sample is, in fact, representative of all the people buried in the cemetery.

Following excavation, the skeletal remains were removed to the Physical Anthropology Laboratory at McMaster University, Hamilton, Ontario, where researchers from 15 universities collected morphological, histological, genetic, and chemical data for subsequent analysis. All

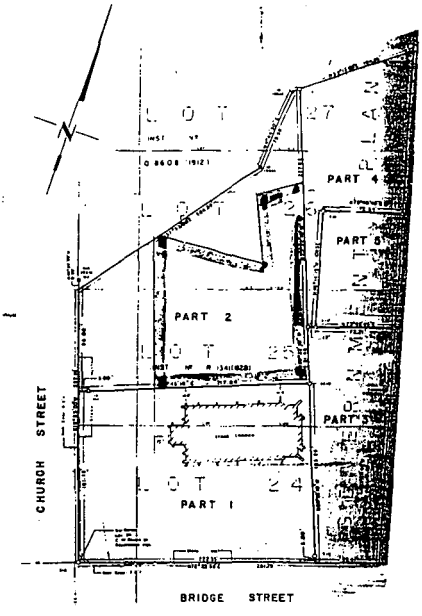

Figure 2. Excavated portion of St. Thomas' land.

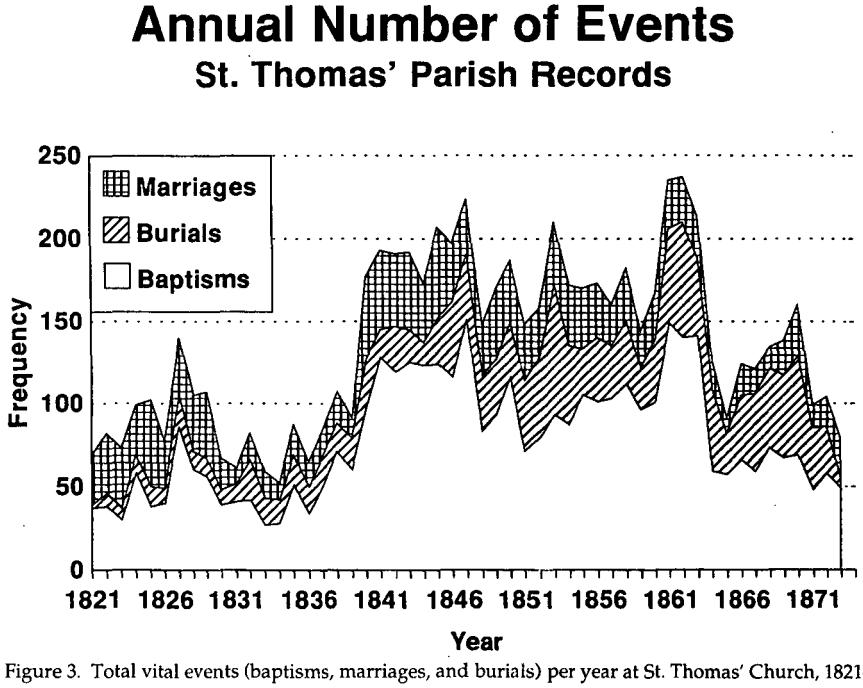

Figure 3. Total vital events (baptisms, marriages, and burials) per year at St. Thomas' Church, 1821–1874.

of the excavated individuals were reburied in a special ceremony at St. Thomas' in September, 1990, and the church plans to erect a memorial garden atop the grave near the new church hall.

Quality of the St. Thomas' Cemetery Data

Parish Records

During the spring of 1991, we received permission to transcribe St. Thomas' parish registers for 1821 to 1874, microfilm copies of which are held at the archives of the Anglican Church of Canada in Toronto, Ontario. Separate databases for the burial, baptism, and marriage records were created, the accuracy of the transcriptions was verified, and all transcription errors were corrected.

The parish records proved to be quite complete when a protocol for gauging the quality of church registers was applied (Rogers 1991: 12–30). The procedure (Drake 1974) involves detailed scrutiny of the full set of records to determine whether sample sizes are adequate for statistical analysis;[1] vital events were reliably registered without risk of significant underenumeration;[2] there was continuity between record keepers; people buried in other cemeteries were not included in the parish burial register;[3] and, information on age is reasonably accurate and unlikely to be gross estimates.

The annual totals of events for St. Thomas' were sufficient for most of the study period, but fell short of the minimal requirement of 100 per year for the first twenty years (FIG. 3). This is a reflection of the small size of Belleville's population at the time, rather than indicative of significant underrecording of vital events. No major gaps were detected in the baptism, marriage, and burial registers, and we conclude that the probability of unrecorded burials is low. St. Thomas' burial register contained 23 cases of parishioners buried elsewhere, but these entries were clearly marked and excluded from the analysis.

The personal information contained in each burial record was quite comprehensive for the 53-year period, with the exception of causes of death, which were disappointingly few (186 out of 1,564 or 12%). The age at death notations, which are especially important for this study, were reasonably complete. All but 32 burials (2%) contained enough information to allow them to be classified broadly either as adults (15 years or older) or children (under 15). Exact ages at death were recorded for 1,434 burials (92%). It was possible to assign sex to all but 6 individuals listed in the burial register (.3%).

Of the 1,434 individuals whose ages were known, 292 died before reaching the age of one (20%). Another 20 entries were ambiguous and potentially denoted infant deaths (2%): 9 were listed as "infants" and another 11 contained remarks suggesting they were either infants or children. The excavation revealed that approximately 14 infants were buried in the same grave as their mother, but we are unable to determine whether they were listed in the burial records. Because of this uncertainty, we use only the 292 infants whose exact age at death is known.

Skeletal Remains

The reliability of reconstructions of past life from skeletal evidence is inseparable from the quality and quantity of bone preservation. St. Thomas' sample of 576 individuals proved to be extremely well preserved, and only 55 (10%) were too fragmentary for age estimations. This left a large sample of 521 individuals for analysis in this study.

While it is a relatively simple matter to determine the sex and age at death of individuals listed in burial records when the quality of the registers is good, it is quite another matter to estimate an individual's age at death and to evaluate sex based on skeletal remains alone. This requires sophisticated techniques and careful checking and cross-checking of the results derived from a variety of methods.

Since it is well known that there are population differences in the rate and patterns of dental eruption and calcification (Demirjian 1977; Smith 1991), it is important to use population-specific standards when estimating skele-

[1]Combined marriage, baptism, and burial entries should number at least 100 per year.

[2]This is indicated by large gaps in entries between months or years, associated with changes in or temporary absences of the recording clergyman.

[3]This may occur for a variety of reasons; for instance, parishoners may die and be buried away from their church, but the minister may decide to record such events nonetheless.

tal ages. Earlier comparisons of mean dental age estimates using several combinations of different source samples showed that the contribution of permanent and deciduous standards based in the sample of children published by Moorrees, Fanning, and Hunt (1963a, 1963b) was the best possible method to use in estimating mean dental age from juvenile skeletons. The use or addition of modern Canadian standards published by Anderson and colleagues (1976) was rejected because of the truncation of Anderson and co-workers' reference sample at three years of age (Saunders et al. 1992).

The 14 developmental stages of deciduous and permanent teeth proposed by Moorrees, Fanning, and Hunt (1963a, 1963b) were determined for all observable teeth, and interpolation charts for the mean dental age of three deciduous teeth (mandibular canine, first and second molars) and 22 permanent teeth were prepared from their published norm charts. A database management program was used to calculate the values by cross comparisons to the calcification stages recorded for the sample.

Overall individual age estimates were then calculated from the sums of individual mean tooth ages based on the published values for each of the three standards. In all calculations the mean dental ages were weighted by the total number of teeth used for each individual. Simple standard deviations for the overall mean dental age estimates for each individual were also calculated as a gauge of the relative between-tooth agreement.

A total of 286 children (under 15) were identified in the sample on the basis of active tooth eruption and skeletal epiphyseal development and fusion. It was possible to record dental calcification for 240 cases using X-rays and macroscopic observation. Seventeen of the children had been personally identified on a separate occasion by reference to coffin plates.

Even though it is commonly believed that the skeletons of infants and children are substantially less well preserved than those of adults (Kapches 1976; Johnston and Zimmer 1989) because they are less mineralized and therefore potentially more susceptible to decay, only 6 of the children (2%) from St. Thomas' cemetery were insufficiently preserved to attempt any kind of age-at-death estimation. This compares very favorably to 13 percent of the 235 adults. While some infants may have been missed during excavation, the work was conducted very carefully, and the designated excavation area was cleared thoroughly.

A total of 148 infants, dentally estimated under 1 year of age, were identified among the 286 children. Because the age structure of the infant deaths provides insight into a community's socio-economic and environmental conditions, it is important to distinguish neonatal deaths (under 28 days) from post neonatal deaths (≥28 days and <1.0 year) in the skeletal sample. This was accomplished by using published descriptions of early deciduous tooth development (Kraus and Jordan 1965; Prahl-Andersen and Van der Linden 1972; Lunt and Law 1974; Nystrom 1977; Deuschetal 1985; Sunderland et al. 1987) and measurements of long bone diaphyses (Fazekas and Kosa 1978; Kosa 1989; Ubelaker 1989) to identify 39 neonates and 109 postneonates.

A Brief History of Belleville

Before proceeding to the results of the analysis, a brief history of Belleville is presented. The review is not intended to be comprehensive, but simply to provide a thumbnail sketch of the social backdrop to the study. For greater detail the reader is referred to Boyce (1967) and Mika and Mika (1986), the sources from which much of this discussion is drawn.

The original town of Belleville was surveyed and named in 1816. Prior to this and certainly by the 18th century, a small Mississaugus village was located on the town's eventual site, perched on a bluff of land overlooking the east bank of the Moira River. The strategic location provided easy access to important waterways: the Bay of Quinte; Lake Ontario; and the Trent and Moira River systems.

The rapid transformation of the area into part of the Upper Canadian "frontier" was stimulated in large measure by United Empire Loyalists (UEL) of varied ethnic backgrounds who fled across the St. Lawrence River in the 1780s from the former American colonies. Many of these families stayed in the Kingston area after 1784 before moving on to Belleville and Hastings County in 1787. The Kingston area remained a favored site for UEL settlement because of its superior location for lake transportation and because of its economic, govern-

mental, military, educational, and religious opportunities.

To accommodate the newcomers' need for land in the Belleville area, the British Government persuaded the Mississaugas to "surrender" most of their lands at that time. A second wave of settlement after the War of 1812 from the British Isles, especially England and Scotland, soon added a larger Old World component to the local population. Two waves of colonization can thus be identified: an initial influx of predominantly North Americans prior to the War of 1812, followed by a post-war flow of British and Irish settlers whose numbers stimulated rapid population growth in Upper Canada until the 1840s (Wood 1988: 56).

The Mississaugas ceded a substantial portion of their remaining land to the British Government in 1816 to accommodate the site of the town of Belleville. The original town occupied less than 200 acres and was laid out in a series of small lots. Plots were set aside for a district court house, market, school, and hospital, and a large section of land was reserved for the use and support of the Church of England. "Church Street" was laid out at this time, extending from the harbor to the Church of England land and to the eventual site of St. Thomas' Anglican Church.

Early population statistics for Belleville are scarce. When the town plot was established in 1816, a detailed census of the existing 45 buildings was completed, along with the names of the owners. Unfortunately, no information on the numbers of people in each family is provided. During the early years of settlement, in fact, only ministers kept vital statistics in the form of parish records of births, marriages, and deaths. The practice can be traced to the 1790s when municipal governments were first established in Upper Canada, and township government was intended to be directed by two elected wardens, acting in conjunction with two church wardens appointed in each parish. The Anglican Church therefore functioned as part of the civil government, and its secular role included the maintenance of vital statistics.

This arrangement was not particularly effictive, for many townships lacked an Anglican church! Furthermore, because the earliest local ministers were missionaries or "saddle-bag preachers," it was impossible to keep complete records of all the vital events in their extensive circuits. To make matters worse, many of the early records have disappeared. The earliest records available for Belleville are those kept by Methodist ministers who traveled the Smith's Creek and Bay of Quinte Circuits between 1805 and 1844.

It was not until the 1820s when the Anglicans (St. Thomas') and Roman Catholics (St. Michael's) established congregations at Belleville that vital records were maintained with any degree of reliability. Although early township governments compiled assessment rolls for taxation purposes, none of the town's survive prior to the 1850s. Civil registration, moreover, only began in Ontario on July 1, 1869, and despite *legal fiat*, church records are still considered a more reliable source of information for families with church connections during the early years of civil registration. St. Thomas' parish registers, therefore, are among the most detailed records of the early development of the town of Belleville.

The available demographic evidence suggests that the town's population consisted of about 100 people at the time of its founding and grew to about 700 by the end of the 1820s (FIG. 4). The population expanded rapidly thereafter to 4,569 by 1851 as Belleville became the hub for marketing farm and lumber products from the nearby townships and the nucleus for manufacturing and services in the area. Lumber and flour mills, farm machinery companies, and foundries proliferated, and, when the town became a divisional point on the Grand Trunk Railway linking Montreal and Toronto in 1856, the railway became an important source of employment to the region. Belleville's proximity to the mineral wealth of the Canadian Shield led to several mining booms, including development of the Marmora Iron Works (25 miles north) in the 1820s, Ontario's first gold rush in the Madoc-Eldorado area (30 miles north) after 1866, and copper, lead, talc, and marble mining. By 1874, the end of the study period, the town had mushroomed to some 7,500 people, in keeping with its rapid industrial development and continued attractiveness to immigrants.

St. Thomas' Anglican Church was formed on December 26, 1818, at a meeting of "the respectable inhabitants of the town and vicinity for the purpose of devising means to erect a commodious Episcopal Church" (Bellstedt n.d.: 5). Construction began in 1819, and the first church service was held in June, 1821. The

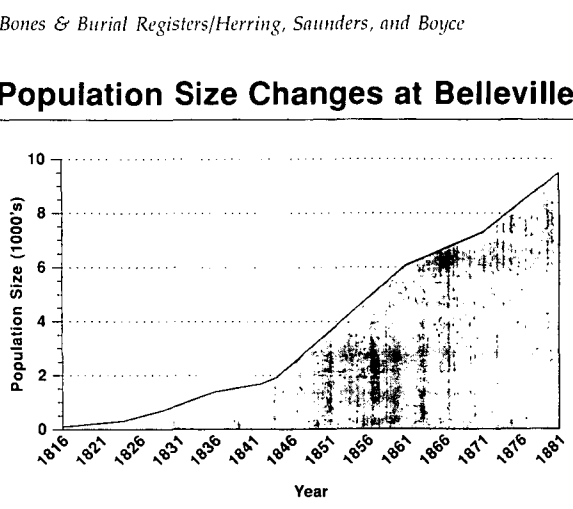

Figure 4. Population growth at Belleville, 1816–1871.

parish registers indicate that the first baptismal service was celebrated on July 24th, 1821, the first burial service on August 28th, and the first marriage on September 11th. Characteristically acerbic, Sussannah Moodie described the original church in 1853 as "a great eyesore, suitable for the time when Belleville was but a small settlement on the edge of the forest, scarcely deserving the name of a village . . . [but not] . . . now, when . . .the village . . . has grown into a populous, busy, thriving town" (Moodie 1853: 6, 7).

St. Thomas' cemetery was the first public burial ground established in Belleville.[4] Accordingly, some Methodists, Presbyterians, and members of other denominations from the surrounding area were buried there. The cemetery drew from a widely-dispersed local population, most of whom were of British descent, although there were many continental Europeans and a few blacks.

Several other cemeteries soon opened,[5] but the Methodist, Presbyterian, and Anglican cemeteries ceased to be used in 1874 after the present Belleville Cemetery was opened, just west of town. Largely for health reasons, the town council passed a bylaw prohibiting further burials within town limits after April 30, 1874. Unfortunately, most of the old graveyards soon ceased to be treated as cemeteries and the majority of the gravestones from the Roman Catholic and Methodist cemeteries were lost or discarded.[6] Only St. Thomas' cemetery continued to be treated as a burial site.

Infant Mortality and Medicine in 19th-Century Belleville

Although there appears to have been a general expectation in the 19th century that many children would not survive infancy, relatively little is known about the health of infants and children in Upper Canada beyond what can be gleaned from the letters and diaries of a few early settlers (Siegel 1984). In all probability, infant mortality rates were high, in light of figures ranging from 94/1000 to 250/1000 for 19th-century Europe and North America (Hibbs 1916; Swedlund 1990). But infant mortality levels oscillated considerably in industrial nations in the latter half of the 19th century (Lee 1991: 56), and particularistic so-

[4]The first was Taylor Burial Ground, a private cemetery just outside the original town border.

[5]St. Michael's Roman Catholic Church opened a cemetery in 1821; the site was used until at least 1856, after which most of the burials were conducted in a new cemetery east of the town. The Methodist Episcopal Church consecrated a one-acre parcel on March 23, 1828, overlooking the bay. St. Andrew's Presbyterian congregation probably began to bury in the land to the north and south of its Church Street building about 1831.

[6]The Roman Catholic site was used for a new building and a paved parking lot, the Methodist became a children's playground and swimming pool, and the Presbyterian became a park and paved tennis court (now used as a car park).

Table 1. Infant vs. other deaths at St. Thomas' cemetery.

	Skeletons		*Records*	
	N	%	N	%
Infants	148	28.4	292	20.4
Others	373	71.6	1142	79.6
Total	521		1434	

$LRX^2 = 13.71, p = .001, df = 1$

ecological circumstances contributed to extensive diachronic and synchronic variation between communities (Swedlund 1990).

There was often a shortage of doctors in the Belleville area, even though trained physicians and surgeons were attached to the British garrison at Kingston. In addition, Belleville lacked a hospital until 1886. A structure erected in 1832 to deal with the threat of cholera but never used for that purpose was subsequently an immigrant center and then a school, providing an interesting indication of the citizen's priorities at the time.

Many of the early doctors who came from the United States were said to have come "to turn a penny . . . too frequently they knew only how to deceive the people by arrant quackery" (Canniff 1894: 6–7). The Upper Canada Medical Board found in 1832 that many "ignorant pretenders . . . [practiced] . . . in open defiance of the law" (Canniff 1894: 66). Such "pretenders" included Dr. Samuel Thompson, the founder of a medical sect known as the Thompsonians, which had a wide following in the Belleville area in the 1850s. A homeopath, Thompson advocated healing by "medicinal vegetables," and "his apothecary shop was the woods and the fields." His assortment consisted of some 30 vegetable products, including cayenne, bayberry root bark, poplar bark, and ginger. Thompson claimed that a year's supply of these items could be readily obtained and "will enable them to cure any disease, which a family of common size may be afflicted with" (Canniff 1894: 74). Home remedies were popular, and patent medicines often based on narcotics and alcohol were widely and successfully advertised in the press by the 1850s. There is also evidence that the local settlers, as early as 1789, sought medical assistance from the Mohawk Indians at nearby Tyendinaga.

The relative absence of institutionalized medicine in Belleville probably had little, if any, effect on infant mortality. Given the growing body of evidence that medical treatment and the growth of hospitals in the late 19th and early 20th century accounted for only a small fraction of the decline in mortality from infectious disease during that period (McKeown 1976; Pennington 1979; Swedlund 1990), it is unlikely that circumstances in Belleville of Upper Canada deviated significantly from this general trend.

Evidence of Infant Mortality: Burials versus Documentary Records

Before infant mortality patterns in Belleville can be described and interpreted it is necessary to determine the degree of concordance between the burial record and skeletal counts of infant deaths. A previous analysis of the full set of skeletons and burial records indicated that the two sources were statistically indistinguishable, at least in terms of broad categories such as the sex ratio of adults, and the ratio of adults to subadults (Saunders, Herring, and Boyce 1991).

But when the proportion of recorded infant deaths, defined in the demographic sense of all liveborn children who failed to survive to their first birthday, was compared to the proportion of infant burials (TAB. 1), significant differences emerged (LRX^2=13.71, p<.001, df=1). The standardized residuals indicate that significantly fewer infants were listed in the burial records (-1.71) while significantly *more* were in the skeletal sample (+2.84).[7] This was somewhat surprising in view of the expectation from the archaeological and osteological literature that infant skeletons would be underpreserved.

In light of the instances of multiple burials referred to earlier, it is possible that some infants, especially the very young, were interred with their mothers without being recorded in the burial register. Alternatively, some infant

[7]Standardized residuals compare each observed cell frequency to its expected value (observed-expected/square root of expected). Values greater than 1.64 indicate a significant value at the .05 level (Reynolds 1977).

Table 2. Neonatal vs. postneonatal deaths at St. Thomas' cemetery.

	Skeletons		*Records*	
	N	%	N	%
Neonatal (<28 days)	39	26.4	79	27.1
Postneonatal (28 days–<1 year)	109	73.6	213	72.9
Total	148		292	

$LRX^2 = .95, p = .33, df = 1$

burials may not have been recorded simply because they were considered less important than the deaths of older individuals, possibly because infant death was a common, perhaps even an expected occurrence in Belleville. These two explanations are difficult to reconcile with the good quality of the burial register and the very complete data provided for the infants who were listed in it, however. Although it is conceivable that skeletons were under-aged and children past their first birthday were incorrectly categorized as infants, close reexamination of the infant skeletons suggested that this would have occurred only rarely.

To explore the possibility that very young infants were more likely to occur in the skeletal records than the parish records, the relative representation of neonate (8<2 days) and postneonates (≥28 days, <1 year) in the two data sources was compared (TAB. 2). The proportion of neonates and postneonates in the two samples proved to be virtually identical: 26 percent of the infant skeletons and 27 percent of the infant burials were aged within the first 28 days of life (LRX^2=.95, p=.33, df=1). It would seem, then, that: (1) the infant category as a whole was over-represented in the skeletal sample, not just neonates; and (2) postneonatal deaths predominated in the pattern of infant deaths in both samples, indicating a strong environmental component in the underlying causes of death.

We have begun to suspect that the over-representation of infants in the skeletal sample is the product of a temporal bias in the archaeological excavation of the site (TAB. 3). Examination of the proportion of infant burials to all other burials, by decade, shows proportionately fewer infants in the early decades of cemetery use, compared to the later period. Specifically, infant burials were significantly under-represented among the 1820–1839 burials (-1.74) compared to the burials for 1840–1859 and 1860–1874 periods, even though the overall Likelihood Ratio Chi Square was not significant (LRX^2=4.77, p=.092, df=2).

Taken together these analyses suggest that if the excavated area contained a disproportionately large part of the cemetery used from the 1840s onward, then the proportionately greater number of infants buried during this time would account for the excess infants among the skeletal remains.[8] Scrutiny of the legible coffin nameplates provides weak support for this idea, for 70 percent of them have dates that fall within the post-1860 period. Nameplates were more commonly used in the latter half of the 19th century (Woodley 1991), however, and the dates on the more recent ones are less likely to have been obliterated by wear.

Table 3. Infant vs. other burials, 1821–1874.

	Infants	*Others*	*Total*
1821–1839	29	167	196
1840–1859	142	514	656
1860–1874	121	461	582
Total	292	1142	1434

$LRX^2 = 4.77, p = .092, df = 2$

Historical evidence offers some ideas as to why infants might be underrepresented in St. Thomas' cemetery during the 1820s and 1830s. First of all, the parish of St. Thomas' encompassed a wide geographical area during the town's founding period, and much of this was rural (Bellestedt n.d.; Mika and Mika 1977). With the lack of physicians in Belleville and the surrounding region, most doctoring was done in the home. There was no reason for farm families to make the trip to town either to treat a sick child or to bury a dead one. Infants who died were most likely interred in family plots on the farm. Later, when the size and population of the town had grown, most members of the parish lived in town and, hence, would have been more likely to bury dead

[8]As noted above (p. 57), there is no surviving map of interments from the period of tenure of the cemetery.(Mika and Mika 1977; McKillop et al. 1989).

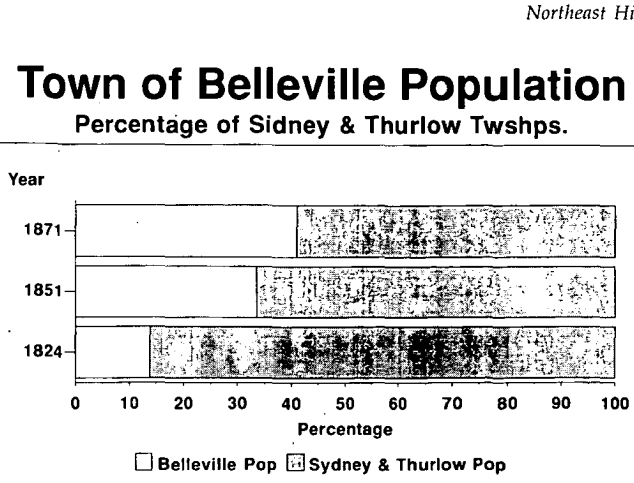

Figure 5. The population of Belleville as a percentage of Sidney and Thurlow townships, 1824–1871.

infants at the church (FIG. 5).

Further analyses of the coffin hardware and other excavated objects may confirm this hypothesis. But we suspect that the combined effects of under-recorded infant deaths in the parish records and an excavation bias are contributing to this result.

Sex Differences

Historical accounts reveal that overlaying, a euphemism for infanticide (Hansen 1979), was not unknown in 19th-century Upper Canada (Siegel 1984). While there is no way to directly assess whether infanticide or preferential treatment/neglect of one sex occurred among St. Thomas' parishioners, sex differences in infant death rates can indicate whether the risks of death were higher for one sex compared to the other.

Unfortunately, it is extremely difficult to determine the sex of an infant from skeletal evidence alone. This is because secondary sex characteristics in bone develop much later when the child undergoes sexual maturation during puberty. However, it is possible to estimate infant mortality rates from information contained in the burial and baptismal records. IMRs for St. Thomas' were estimated by dividing the number of infant deaths by the number of baptisms for each sex respectively over the study period (TAB. 4).

The period death rate (1821–1874) for infant males was roughly equivalent at 76.5 deaths per 1000 liveborn to that for females which was 71.69 deaths per 1000 (LRX^2=.36, p=.549, df=1). These approximations suggest that neither sex was receiving preferential burial treatment or, by inference, substantial advantages in life that would have enhanced survival to one year of age.

Table 4. Estimates of infant mortality by sex, 1821–1874.

	Males	*Females*	*Total*
Deaths	155	137	292
Baptisms	2025	1925	3950
IMR/1000 everborn	76.5	71.7	73.9

$LMR^2 = .36, p = .549, df = 1$

Seasonality

Other clues to the stresses of pioneer life are suggested in Figure 6, which compares the distribution of infant burials to all other burials, by season, from 1821 to 1874. It is clear that the summer was a period of particularly high risk for infants, with 39% of the infant burials clustering between June and August (+1.82). By the same token, significantly fewer infants died during the winter months of December to February compared to all other deaths (-1.81).

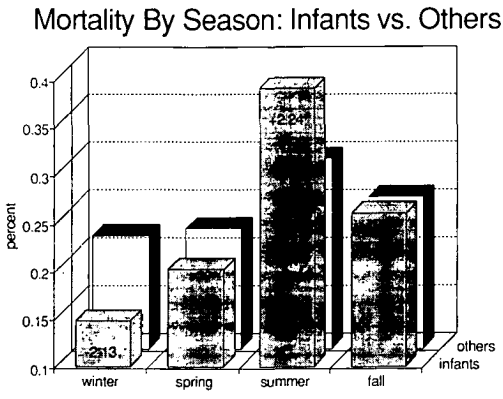

Figure 6. Mortality by season at St. Thomas' cemetery: infants vs. others.

These two deviations from the seasonal pattern for all other deaths proved to be highly significant (LRX^2=12.73, p=.005, df=3).

Swedlund (1990: 173) notes that seasonal patterning of infant deaths varied by region in the 19th-century United States, but it is a common observation in historical studies that diarrheal diseases were particularly deadly for infants during times of drought and in the heat of summer (Boatler 1983; Cheney 1984; Sawchuk et al. 1985; Sawchuk 1993). The poor quality of weaning foods, coupled with the tendency to dilute them with contaminated water, made infants particularly susceptible to gastrointestinal disease, and the weanling diarrhea complex typical of developing countries today (Sawchuk et al. 1985; Thompson 1984; Hardy 1984; Wohl 1983). Certainly, Belleville's water supply in the mid-19th century was a source of concern to citizens (Moodie 1853) and authorities alike (Bell 1876).

Conclusions

It would appear from this preliminary analysis that St. Thomas' skeletal sample is probably derived from the later period of the cemetery's use (possibly 1840 onward). Most infants died in the postneonatal period, and, hence, environmental factors played an important role in Belleville's mortality profile. Males and females were equally likely to die during infancy, and the summer season was an especially difficult period for infants, probably because sanitary conditions and poor water quality elevated the risks of the weanling diarrhea complex.

The implied importance of acute disease conditions in infant death at St. Thomas' is supported by analysis of the relative growth of long bones. This work indicates that the St. Thomas' infants were comparable developmentally to modern North American children (Saunders and Hoppa 1993). If prolonged nutritional or chronic disease problems were a conspicuous feature of their lives, the patterns of growth and development would be expected to more closely approximate those of infants from Third World countries. Microscopic analyses of evidence for iron deficiency anemia as well as isotopic and trace element compositional studies are currently underway to explore further the relative contributions of chronic and acute conditions to mortality in Belleville. We also are carrying out a more finely grained evaluation of the age-specific pattern of infant burials via the Bourgeois-Pichat (1951a, 1951b) method and probing the potential influence of birth seasonality on the seasonal distribution of infant deaths (see Knodel 1983). Clearly, the complementarity of information provided by skeletal and documentary data is providing a much more comprehensive picture of life and death at St. Thomas' than either could on its own.

As a final note, it would appear that the risks of infant death in Belleville were influenced by factors identified in other small towns and communities in 19th-century North America: unsanitary conditions and acute infectious disease. While the scarcity of doctors may have played a role in some illnesses that led to the death of a child, the lack of institutionalized medicine in Belleville was probably not a significant contribution to mortality.

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