Charles L. Fisher
Karl J. Reinhard
Matthew Kirk
Justin DiVirgilio

Privies and Parasites: The Archaeology of Health Conditions in Albany, New York

ABSTRACT

Large numbers of parasites were identified in archaeological samples collected from privies and other features in excavations in Albany, New York. This information provides the largest database available for the study of parasite infections in historical period American cities. The greatest numbers of parasites were in contexts related to the expansion of the city in the late-18th century. Parasites remained, but their quantities decreased in the 19th century during another period of rapid population growth. The city was able to control parasite infection during this period through several means, including new techniques of privy construction, new water supply systems, and medical treatments. Use of medical treatments against parasites varied among residents of the city and was evident in the archaeological record.

Introduction

Cities were the focal points of commerce and culture in early America, where information and ideas were rapidly exchanged along with the goods that were bought and sold. The vast quantities of artifacts and the complexities of urban settlement, development, and expansion have become popular subjects for archaeological study. The rapidly expanding cities of the historical period Northeast created health problems for many citizens, although the relationship was not understood in modern terms of a germ theory of disease. Despite the lack of a scientific understanding of their problems, archaeological studies summarized here demonstrated that residents of Albany took actions that provided some relief from illnesses.

The relationship between people and their environments is not fixed or constant. All human groups alter their environments, both consciously and unconsciously. The instability of this relationship causes change. The range of choices provided by the natural setting is limited by the selections made by people that reshape their environments and create new choices. Recent archaeological work in the city of Albany, New York, has employed interdisciplinary research methods suggested by Karl Reinhard, Adauto Araújo, and colleagues (1986), John Duffy (1993), Stephen Mrozowski (1993), and others to explore this adaptive process relative to the general health of the historical period residents.

Archaeologists have reported the analysis of only three colonial human burials from Albany, which has limited the potential of skeletal studies in understanding the health conditions in this city during the colonial and early federal periods (Philips 2003). Analysis of individuals from the Albany County Almshouse that operated from 1825 to 1925 has been reported, although the relationship between the occupants of this institution that was established as a farm in a rural setting and the residents of the city must be considered in the application of this information to problems of urban health conditions (LoRusso and Van Wagenen 1990). Recently, a larger cemetery was excavated on the grounds of this site, and analysis is currently underway (Lain and Solano 2003).

Assessment of the local environment of Albany is in very preliminary stages, although it appears to be a productive direction for research (Kelso 1999; Sidell 1999; Hartgen Archeological Associates, Inc. [HAA] 2002a; Davis 2003). Analyses of medical equipment and medicines have been successful in other locations (Howson 1992–1993; Veit 1996) and may be expected to provide important information for the study of Albany (Arnason et al. 2003). Water supply and waste disposal systems are frequently encountered in archaeological excavations and relate directly to ideas of sanitation and health (Bell 1987; Rosenswig 1999; HAA 2002a, 2002b, 2002c; Huey 2003; Fisher 2004). Future integration of information from these sources

Historical Archaeology, 2007, 41(4):172–197.
Permission to reprint required.
Accepted for publication 22 March 2006.

will be essential to a picture of health status in this city.

Archaeological study of human parasites in Albany has provided new information that has contributed to the description of health status in the past and the social dimensions of health conditions. Results of the investigation of parasites from sites in Albany provide the largest archaeological collection from a North American city in terms of variety of features sampled and range of socioeconomic classes represented. In addition, parasite infection rates are documented for more than a 200-year period within this city. Results of these studies are presented here as a contribution to the growing body of data on the history of health and sanitation in Albany and other cities.

The archaeological literature relevant to the study of parasites in Albany is briefly discussed. One of the authors of this paper has documented the study of parasites in North American archaeology and the use of parasitology in North American archaeology at historic period sites (Reinhard 1990, 2000d). A summary of the history of Albany is presented that emphasizes the supply of water and the disposal of waste there. Historians and archaeologists recognize the relationship between these systems and ideas about health and sanitation (Duffy 1968; Roberts and Barrett 1984). In addition, this background establishes the historical context of the archaeological sites and sediment samples.

Archaeological sites and features that were investigated are described in relation to the sediment samples collected and found to contain parasite eggs (Reinhard 2000a, 2000b, 2000c, 2001, 2002a, 2002b). The methods used in the parasite examination are outlined prior to the description of those identified in Albany.

The results of the parasite investigation include a summary of the changing relationship of parasites to their human hosts over a 200-year period. Variation in the parasite eggs counts is considered in terms of medical treatments and differences in the socioeconomic groups that may have been the sources of the differences observed.

Parasite Investigations in Northeastern North America

An important paper in the archaeological use of parasites was Reinhard's (1990) review of the archaeological literature for North America. He noted that the sources for archaeoparasitology were coprolites, mummies, skeletons, and latrine soils. The reported successes in North America resulted primarily from analysis of prehistoric human coprolites that were preserved in dry caves. The potential for the preservation of parasite eggs in latrine soils was untapped by American archaeologists at that time, although it was exploited by European archaeologists, such as A. W. Pike (1975) and P. D. Moore (1981). American scientists had demonstrated that the prehistoric inhabitants of North America suffered from a variety of parasitic diseases.

Only two archaeological collections from latrine soils at urban sites in the Northeast were included in that review. One was the 1986 study, directed by Mrozowski, of Queen Anne Square in Providence, Rhode Island. This is the first example of a parasite analysis included in the research design of an historical archaeologist in North America, and Reinhard conducted the analysis (Reinhard, Mrozowski et al. 1986). The second urban archaeological site referred to by Reinhard (1990) that dated to the historical period, 1830–1850, was the analysis he carried out in 1989 on sediment samples collected by Joan Geismar (1993) in Greenwich Village, New York City.

More recently, Reinhard (2000d:391–392) reviewed the history of archaeoparasitology on historical period sites in eastern North America in the archaeological report on Five Points in New York City (Yamin 2000). He concluded that North American historical archaeologists have applied this technique with increasing frequency, yet it remains underutilized with few large-scale urban case studies. Since 1986, Reinhard and his colleagues have shown that parasites were present throughout the region during the colonial period at sites such as Williamsburg, Virginia, and Philadelphia, Pennsylvania, and during the 19th and early-20th centuries at sites in Minneapolis, Minnesota; Wilmington, Delaware; and Harpers Ferry, Virginia. At Harpers Ferry, parasites were found in archaeological contexts dating as recently as the 1930s (Reinhard 1994). The results have revealed a wide range in the quantities present among the sites investigated (Reinhard 2000d:392). In general, roundworm and whipworm eggs were identified at these sites, with the addition of a tapeworm related to the fish-based diet of the Norwegian residents of the Minneapolis site.

In addition to the discovery of parasite contamination on urban sites, the social dimensions of health conditions were described in several studies. Analysis from three privies excavated by Mrozowski at Queen Anne Square indicated both artisan and merchant households during the Revolutionary War were subject to parasite infections (Reinhard, Mrozowski et al. 1986). Research in Philadelphia demonstrated that different construction techniques for privies did not aid in the control of parasites (Reinhard 2000d).

Archaeologists have reported parasites in various features, usually in relationship to discussions of sanitary improvements. John McCarthy and Jeanne Ward (2000:126) interpreted the presence of parasites in cisterns in Minneapolis as evidence of general contamination of the water supply but were puzzled by the absence of parasite eggs in a workers' privy from the 19th century. They concluded that roundworm and tapeworm infections resulted from resistance to sanitary reform by some workers, following the earlier analysis of Harpers Ferry parasites (Reinhard 1994).

Samples that contained parasite eggs from other urban archaeological projects include Greenwich Village and Five Points in New York City and Mugavero in Brooklyn (Reinhard 2000d:392). Five Points is the most relevant to the archaeological study of Albany, New York, in terms of geographic and chronological similarity, as well as the number of samples and the attempt to understand the health conditions of a densely populated urban area.

Rebecca Yamin (2000) included parasite examination in the research design for the archaeology at Five Points and obtained numerous samples from several features within a densely settled urban area. The absence of tapeworm eggs associated with beef or pork indicates that residents cooked these meats and did not suffer from diseases such as trichinosis. Parasite eggs resulting from fecal contamination were identified, although the residents reduced roundworm infection through some type of treatment. In general, the tenement inhabitants at Five Points suffered from parasites but not to the extent expected from the literature on urban parasitism or the historical descriptions of the site (Reinhard 2000d:391–392).

Archaeological investigations to date have demonstrated that parasites were present and that they constituted a health threat to the urban residents, regardless of their socioeconomic position. The specific parasites present may reflect ethnic identity through diet or food-preparation techniques. In addition, parasites were not reduced by improved sanitation in many cases.

The 26 samples examined from Five Points represent the largest number reported from a city outside of Albany. The samples from Five Points differ from those from Albany because they represent multiple samples from different stratigraphic levels within just seven features. An important result of the Five Points analysis for the study reported here was that the parasite eggs were distributed fairly consistently throughout the night soil deposits, despite the observation of different strata. Parasite eggs appear to diffuse throughout a privy. They are not isolated on the top or bottom of a privy content but may concentrate on the bottom in some cases (Reinhard 2000a). As a result, a sample taken from the night soil deposit near the base of a privy appears to represent the parasite content of the feature. This is supported by the samples from the same privies reported here from the Quackenbush Parking Garage and 40 Howard Street, although additional research is needed on this topic.

Another result from the earlier studies was that sanitary improvements in privy construction did not eliminate the parasite eggs from the environment. The change from 17th-century, barrel-style privies to 19th-century, cistern-style privies in urban Philadelphia did not reduce the number of parasite eggs per gram of soil (Reinhard 2000d). This study found an increase in the number of parasite eggs in the later privies, despite the effort to improve the sanitary conditions. This is one of the topics that relates directly to the study of the Albany samples, where parasites in the privies and overall environment remained, but their numbers decreased with improved privy-construction techniques.

The difficulty of discovering archaeological deposits of night soil in privies and the associated parasite evidence was the subject of analysis by Geismar (1993). The combination of disinfecting, deodorizing, and cleaning privies reduced the formation of night soil in many urban privies. Even when privies were thought to have been totally cleaned, such as a privy at Greenwich Mews, New York City, Reinhard found evidence of whipworms in the sediment (Geismar 1993).

Background

Albany is one of the oldest, continuously occupied European cities in the United States. The Dutch West India Company established Fort Nassau in the southern portion of the present city in 1614 and built Fort Orange in 1624 on the site of the present city (Huey 2003). Albany's position as an inland port at the gateway to the natural western transportation corridor of the Mohawk Valley enabled the Dutch and their Iroquois allies to control much of the fur trade (Kammen 1975). During the 18th century, this strategic location turned Albany into military headquarters for numerous British expeditions against the French in Canada (Kammen 1975). The military buildup included construction of a new city wall and numerous buildings, including guardhouses, barracks, a hospital, stables, magazines, and storehouses. These buildings were placed on public land within the streets to minimize conflicts with the townspeople. Numerous problems developed as a result of the military presence, the increased population density in the city, and the tensions over community security during the war.

> As many as 1400 officers and soldiers were moved into the already doubly occupied Dutch homes. During the winter of 1756, Albany's tightly circumscribed world was composed of seventy-five acres filled with 335 households and a teeming population of more than 4000 natives, refugees, and soldiers (Hackett 1991:33).

After the American Revolution, Albany experienced the rapid development and population increase that occurred in many cities of the new nation. The population of Albany increased from 3,500 people in the 1790 census to more than 50,000 by 1850 and more than 90,000 in 1880. Albany's importance grew with the opening up of the western lands and the development of the Western Inland Lock Navigation Company's canal in the 1790s (Lord 2003), which was followed by the phenomenal successes of the Erie and Champlain canals. These canals joined and entered the Hudson River in north Albany, establishing the city as a crucial link between the eastern seaboard and the interior during the 19th century.

Albany did not begin a large-scale sanitary sewer system until the 1850s, and this was not in widespread use throughout the city until the 1880s. Archaeologists have reported similar developments in other New York cities during this period as well as limited access to these facilities. For example, Elizabeth Peña and Jacqueline Denmon (2000) note that Buffalo began sewer construction in the early 1850s, but 40 years later required a law to regulate methods of privy construction. In 1880, three-quarters of the households in Buffalo still relied on privies (Tarr et al. 1984).

In Albany, sewage was limited initially to drainage ditches, as indicated by regulations like the 1721 ordinance that required residents to "ditch and drain ye water to give it passage" (Howell and Tenney 1886:503). Problems in waste disposal in the colonial city are revealed in actions similar to one in 1773, when the Common Council prohibited the "cast[ing of]. . . . Tubs or Pots of Ordure any where but in the River" (City of Albany 1773:9–10). The drainage ditches were not adequate to remove the quantity of human waste and rubbish that accumulated, as noted by visitors such as Warren Johnson (1996:269) who described the streets of Albany in 1760 as "the Dirtiest I ever Saw." The presence of cows and pigs in the city was noted as another reason for the muddy streets of Albany (Kalm 1773; Howell and Tenney 1886).

Beginning in the 1790s, Albany began enclosing the streams, or "kills," that flowed down through the city into the Hudson River. The Rutten Kill, which crossed Pearl Street south of State Street, was channeled into a stone-arched culvert beneath the street by the early 1790s (Fisher 2004). Archaeological deposits along this ravine indicate that it was the location of large trash deposits by the early-18th century. Although the culvert was constructed primarily to eliminate a bridge, it served to prevent additional sewage and trash from accumulating in the ravine. About the same time, the Fox Kill was enclosed in a stone-arched culvert on the north side of the city (Rosenswig 1999; HAA 2002b), and the Maiden Lane culvert was constructed in 1788 in the central portion of the city (HAA 2002c).

Brick-lined and stone capped drains constructed in the late-18th and early-19th centuries that carried waste beneath Pearl Street into the Rutten Kill culvert were discovered archaeologically (Fisher 2004). The relationship between these efforts to remove waste from the street surface and the health of the city's residents is a topic that requires additional investigation. The spread of disease and its connection to polluted water were not scientifically established in the 18th century, although a correlation was vaguely recognized in observations regarding foul tasting and noxious smelling water. Peter Kalm, a Swedish naturalist, visited Albany in 1749 and noted that the Albany well water contained an abundance of little insects and "perhaps many of our diseases arise from water of this kind" (Kalm 1773: 91). Both Kalm and his servant experienced a swelling in their throats after drinking this water, "but whether the insects occasioned it, or whether it came from some other" source, he could not determine (Kalm 1773:93).

The belief that bad odors and filth caused disease may have resulted in actions that improved health conditions, such as cleaning or avoiding dirty places, even though the science was in error. A widely distributed medical text from the 18th century summarized the professional opinion that

> One common cause of putrid and malignant fevers is the want of cleanliness. ... Hence cleanliness may be considered as an object of public attention. ... If dirty people cannot be removed as a common nuisance, they ought at least to be avoided as infectious. ... In places where great numbers of people are collected, cleanliness becomes of the utmost importance. It is well known, that infectious diseases are communicated by tainted air. ... For this reason, in great towns, no filth, of any kind, should be permitted to lie upon the streets. Nothing is more apt to convey infection than the excrements of the diseased (Buchan 1785, ch. 8:n.p.).

Albany constructed a variety of water-supply systems beginning in the 17th century. In 1680, Jasper Danckaerts (1996:205) described water brought from "a spring or fountain ... and under ground into the town." These conduits are evident on the 17th-century *Plan of Albany* (Römer 1698). Archaeologist Paul Huey (2003) recorded one of these wooden, board-covered troughs in the early 1970s while monitoring an electric line installation beneath State Street and suggested it may be one of the earliest American water-supply systems.

At the same time that the city was actively removing wastewater in enclosed culverts and brick drains, new methods of providing clean water to the residents were designed. In the early 1790s, Albany requested proposals for designing and building gravity-fed systems of wooden pipes and small reservoirs that would bring water into the city and distribute it to the residents (Liebs 1971). This appears to have been an elaboration of the earlier system, possibly influenced by developments in other New England cities.

During this period, the water supply was regarded as essential for public safety, rather than necessary to improve public health. The experience of large urban fires and the associated loss in lives and property were the prime motivation for constructing water systems in the city. Two major fires occurred in Albany during the last decade of the 18th century in 1793 and 1797 (*Albany Gazette* 1793; *Albany Centinel* 1797; Munsell 1871). Following the 1793 fire, when 26 dwellings, stores, and a printing office were lost, the Common Council set out to determine how additional water could be brought into the city. In August 1795, the city contracted with Benjamin Prescott of Massachusetts to build a system of bored pitch-pine logs that would carry water from springs about 4 mi. (6.4 km) east to the city at a cost of about $4.00 per year to the residents (Liebs 1971).

By 1850, the city owned the pipes and reservoirs of the water system and constructed additional reservoirs to meet public demands. This proved insufficient to meet the increased needs of the rapidly expanding population. In 1875 the city decided to take water from the Hudson River and constructed a pump station (City of Albany 1876). This station consisted of twin pumps that brought 45 million liters (10 million gal.) of water into the city every 24 hours. The water was considerably different in 1875 when the cities of Troy, West Troy, and Cohoes were dumping their waste into the river north of Albany than it was in 1749 when the residents of Albany "for tea, brewing and washing ... commonly take the water of the river Hudson" (Kalm 1773:95). The 1875 pump station screened the water through copper mesh, which eliminated the large chunks of waste but did not prevent dangerous microorganisms from entering the water supply.

The paucity of archaeological evidence for privies during the 18th century in Albany, despite extensive excavations, suggests that residents ignored the prohibition against casting waste anywhere but in the river. The need for the prohibition indicates that people were discarding waste in other places around the city, probably on ground surfaces. The number of privies increased in the late-18th and early-19th centuries, creating other problems for the city. For example, regular maintenance of privies was required: to clean them out as they filled, move them, or build new ones when the surrounding soil became saturated. Albany passed a law that restricted the hours when the privies could be cleaned to between 11 P.M. and 3 A.M. (Albany 1829:49).

Development of the water supply increased household water consumption in the early-19th century, although the city lacked a system for removing the large quantity of wastewater until construction of a public sewer system began in the 1850s. As a result, privies became saturated, and their content seeped into the surrounding soil. This waste blocked existing culverts and permeated the city with the stench of sewage gas (City of Albany 1859, 1860). Seepage provided optimal conditions for the spread of disease in the city (Tarr et al. 1984). In 1832, a cholera epidemic in Albany was attributed to the impurity of the water, although two doctors appointed by the board of health to inspect the water from 14 wells "pronounced them all free from any impurities which could be injurious to health" (Munsell 1858:225).

Although the sewer system was under construction in the 1850s, it is not known when the existing privies were connected to this system. The business of cleaning out the night soil from privies continued and was advertised in the city directory into the 1870s (City of Albany 1874). These services, however, may have been needed to remove the debris from privies that were connected to sewers. The former practice of discarding trash into privies clogged the sewers and was prohibited by 1872 but probably continued in practice (City of Albany 1872:95).

Parasite Analysis

The methods used in this analysis were derived from several years of experimentation and are described in Warnock and Reinhard (1992). This process was refined over almost 20 years of research and is essentially a palynological technique for digesting sediment and quantifying microfossils in sediments, minus the final stage of acetolysis treatment in palynological processing that would destroy the parasite eggs (Reinhard, Mrozowski et al. 1986).

Gallon-sized soil samples were collected from archaeological deposits where parasites were anticipated, such as privies, features converted into privies, and former ground surfaces that could be temporally identified. The ground surfaces were used to investigate the possibility that waste may have been distributed around dwellings and to examine the relationship between the privy content and the general environment. Similarly, samples were collected from drains, culverts, and other features that could be used to assess the urban environment.

From these samples, soil (30 ml) from each context was selected for analysis, based on the protocol established by Warnock and Reinhard (1992). Three *Lycopodium* spore tablets, each containing approximately 12,432 ± 400 spores, were added to each sample. This addition of a known number of identifiable spores is used to determine the ratio of eggs to known spores, which results in an accurate calculation of the parasite eggs per milliliter of soil. The number of parasite eggs per gram of coprolite was calculated using the pollen concentration formula of Louis J. Mahar (1981), where

parasite eggs/g dry sediment=([eggs counted/Lycopodium counted] x 12,432)/sediment weight

Samples were washed in hydrochloric and hydrofluoric acids and then cleaned with distilled water. These acid baths remove unwanted organic material such as calcium carbonate that often forms from lime added to the latrines. The resilience and toughness of these parasite eggs is demonstrated by their tolerance of these acids. Unlike the process described by Warnock and Reinhard (1992), sonication was not used. Over the past 15 years, sonication has been found to damage pollen grains. Finally, samples were prepared on slides and microscopically examined by Reinhard for the presence of parasite eggs. Help in identification of acanthocephalan eggs was sought from Brent Nickol of the School of Biological Sciences at University of Nebraska, Lincoln. All parasite eggs and added *Lycopodium* spores were counted on a minimum of six microscope slides, with three cover slips per slide. This procedure resulted in a minimum of 18 microscopic preparations (18 x 18 mm) that were examined for each sample.

The results of the examination of samples from Albany, presented in Table 1, represents the largest dataset collected up to this time from an urban context anywhere in the United States. This collection covers a period of more than 200 years and represents a variety of locations and social classes.

Descriptions of the Sites and Samples

Hundreds of gallons of soil samples were retained from dozens of different contexts on eight large archaeological sites in Albany excavated by HAA and the New York State Museum since 1998 (Figure 1). The samples were collected for a variety of cultural and environmental analyses, with parasite identification as one of these objectives. These sites included the State University Construction Fund Parking Garage (SUCF) (Reinhard 2000c; HAA 2002a), Picotte-DEC Headquarters Site (Reinhard 2000b; HAA 2002b), the nearby Maiden Lane Pedestrian Bridge (HAA 2002c; Reinhard 2002a), 40 Howard Street (Reinhard 2000a), Quackenbush Square Parking Garage and the Court of Appeals Building (Reinhard 2002b). In addition, the New York State Museum Cultural Resource Survey Program collected samples from two 18th-century barrel privies on Pearl Street at the site of the Lutheran Church Lot, and another was processed from an 18th-century ground surface excavated on North Pearl Street (Reinhard 2001; Fisher 2004).

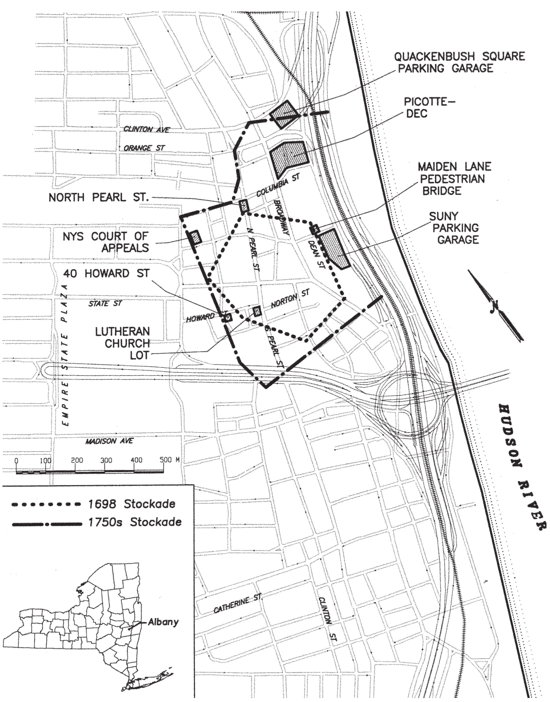

FIGURE 1. Albany, New York, with site locations referred to in the text. (Map by Lihua Shi, 2006).

In general, excavation revealed night soil deposits in the lower portion of the privies that were the source of the samples examined for parasites. This soil was covered with fill after abandonment of the features. Artifacts found in these deposits were employed to date the last use of the features. The sites, sample context, estimated date of the sample, and results of the parasite study are presented in Table 1. Dates were determined from documentary, stratigraphic, and artifact analyses of the features.

Despite the archaeological evidence that urban privies were frequently cleaned as prescribed by local law (Roberts and Barrett 1984; Duffy 1993; Geismar 1993), many of those examined archaeologically in Albany contained extensive deposits of night soil. The various reasons for these deposits in abandoned urban privies are a subject of ongoing investigation. Almost every privy excavated in Albany provided enough night soil for study because only very small samples are needed for parasite analysis and, apparently, removing night soil from the privies was never complete.

The Albany samples represent parasite infection rates over a period of 200 years and provide a source to investigate chronological trends in parasite infections. The historical and archaeological contexts of these sites indicate that the samples represented a broad range of economic and social classes in historical period Albany, including laborers, wealthy ship captains,

TABLE 1
PARASITE EGGS PER MILLILITER OF SEDIMENT

Site	Sample/Feature	Description	Date	No. Ascaris	No. Trichuris	% Trichuris	Other Finds
State University Parking Garage							
	1/20	Privy, stone	1800s	4,972	104	2	
	2/93	Dog burial	1760s	1,065	355	25	Plant fiber and maize starch
	3	Privy, stone	1810s	25,199	678	3	
	4/62	Log drain, cleaned	1780s	75	0	—	
	5/9	Well, reused as privy	1800	310,999	12,181	4	
	6/31	Privy wood	1860s	2,260	0	—	
	7/38	Privy wood	1800s	5,150	1,598	24	Strongyle eggs, horse/rodent
	8	Surface near stockade	1760s	2,019	621	24	
	9	Surface along wharf	1780s	219	0	—	Strongyle eggs
Picotte DEC							
	1/96	Privy 1, wood	1790s	89,675	3,763	4	*Hymenolepiasis nana* (dwarf tapeworm), Strongyle eggs
	2/108	Privy 2, stone, drained	1850s	1,505	250	14	
	3/112	Privy 4, wood	1760s	62,710	2,508	4	*Enterobius vermicularis* (pinworm) *Hymenolepiasis nana* (dwarf tapeworm), Strongyle eggs
	4/148	Privy 6, wood & stone	1800s	1,254	314	20	
	5/113	Privy 3, wood	1830s	251	0	—	
	6/126	Privy 5, wood	1780s	223,248	3,763	2	
	7/42	Privy 7, barrel	1740s	0	0	—	
	8/40	Privy 9, brick & stone	1860s	448	0	—	
	9/122	Privy 10, wood, drained	1860s	228	0	—	
	10/97	Privy 11, wood, drained	1850s	60,202	2,090	3	*Pediculus humanus* (louse nits)
	11/147	Privy 12, stone, drained	1850s	1,026	114	10	
Maiden Lane Pedestrian Bridge							
	59/ 11	Surface, in stone culvert	1800s	14,918	1,243	8	*Oxyuris equi* (horse pinworm)
	60/ 11	Beneath 59	1800s	0	0	—	
	61/ 11	Beneath 60	1790s	70	0	—	
	71/ 16	Surface, outside culvert	1790s	0	0	—	

TABLE 1 (CONTINUED)
PARASITE EGGS PER MILLILITER OF SEDIMENT

Site	Sample/Feature	Description	Date	No. Ascaris	No. Trichuris	% Trichuris	Other Finds
Maiden Lane Pedestrian Bridge							
	72/ 16	Beneath 71	1760s	1,249	0	—	
	73/ 16	Beneath 72	1750s	113	0	—	
40 Howard Street							
	1/2	Privy 2, wood	1830s	1,420	444	24	
	2/2	Privy 2, wood	1830s	1,709	155	8	
	3/3	Privy 3, wood	1830s	11,311	1,119	9	
	4/5	Privy 5, stone	1850s	799	178	18	
	5/5	Privy 5, stone	1850s	19,000	178	1	
	6/5	Privy 5, stone	1850s	33,561	1,243	4	
	7/10	Privy 10, wood, drained	1850s	13,851	888	6	
	8/6	Drain, brick	1830s	249	0	—	
	9/8	Drain, brick	1830s	124	62	33	
	10/Surface 1	Surface	1820s	155	0	—	*Toxocara*
	11/Surface 2	Surface	1780s	0	0	—	
	12/Surface 3	Surface	1780s	0	0	—	*Toxocara*
Quackenbush Square Garage							
	2/Outside house	Surface	1640–1700	10	1	9	
	3/Upper stratum	Privy, barrel	1830s	38,947	829	2	
	4/Lower stratum	Privy, barrel	1830s	31,607	765	2	
	5	Drain, wood	1820s	5	0	—	
	6	Privy, wood	1880s	179	0	—	
	7/Near house	Surface	1650–1670	0	0	—	
	8/Near house	Surface	1640–1700	60	0	—	
	9/South yard	Surface	1640–1700	0	0	—	
	10/Brickyard	Surface	1600s	0	0	—	
	11/Distillery	Sediment in vat	1750–1800	0	0	—	
	12/Distillery	Sediment in vat	1750–1800	0	0	—	

TABLE 1 (CONTINUED)
PARASITE EGGS PER MILLILITER OF SEDIMENT

Site	Sample/Feature	Description	Date	No. Ascaris	No. Trichuris	% Trichuris	Other Finds
Quackenbush Square Garage							
	16/Outside house	Surface	1640–1700	37	0		
	17/Distillery	Sediment in vat	1750–1800	0	0	0	
	18/Brickyard	Surface	1600s	0	0		
Court of Appeals							
	13	Midden	1820s	0	0	—	
	14	Midden	1820s	0	0	—	
	15	Privy, wood	1800–1830	497	0	—	
Pearl St. Lutheran Church Lot							
	Pearl St. 1	Privy, barrel	1780s	207	2,900	88	*Macracanthorhynchus Hirudinaceus* (thorny-headed worm)
	Pearl St. 3	Privy, barrel	1780s	266	444	63	
North Pearl St.							
	Pearl St. 2	Surface	1750s	12,153	6,145	34	

politicians, merchants, and even boardinghouse residents. Results suggest that parasite infections were not restricted to any particular segment of the population or location but, instead, affected anyone in the city who was exposed to contaminated water or food.

State University Parking Garage

Archaeological investigations for the proposed parking garage for the State University Headquarters revealed the city's riverfront construction of the 1700s and 1800s in the block east of Dock (later Dean) Street and south of Maiden Lane (Figure 1). Four samples from 18th-century contexts were examined, and parasites were identified (Table 1). These included a ground surface that was associated with the British soldiers in Albany during the 1750s (sample 8), sediments associated with a dog burial about the same time (sample 2), river sediments adjacent to the front of the 1760s bulkhead (sample 9), and sediment from the inside of a hollowed timber drain with plank caps (sample 4). Joined saplings formed a 50 ft. pole that was left inside the drain. It was used to clean out obstructions or sediments that accumulated in the drain. No privies were discovered on the site during this period, and these samples indicate that human and animal waste was dispersed on the ground surface and dumped into the river.

Archaeological evidence of formal privies was found in contexts dating from the late-18th and 19th centuries at the site. This block was inhabited by some of Albany's leading merchants, but dockworkers, servants, and slaves were present as well. The largest number of parasite eggs was found in sample 5, which was obtained on the lot owned by the merchant-captain Stewart Dean from a well that silted in and had been converted into a privy. Dean had a number of children and three slaves in his household in 1790, according to the census. The well lacked a builders' trench because it was constructed at the time the fill was added to the lot behind his 1780s waterfront bulkhead. Dean was known locally for his successful 1785 trip to Canton, China, and his return with a wealth of trade goods on his ship. Dean developed this lot after the Revolutionary War and abandoned it by 1810.

Dean's neighbor was another merchant and a sail maker, Abraham Eights, who resided on his lot with a wife, 11 children, and slaves. Sediment from the base of their wooden privy, sample 7, revealed parasites were present but not in the quantity found in Dean's privy. The different quantities of parasites in these features may be a result of a severe uncontrolled infestation among a few residents in Dean's household.

In the southern portion of this site, three privies were constructed in the first half of the 19th century on lots occupied by boardinghouses and warehouses. Sample 3 was from the night soil recovered from a small stone-lined privy in use about 1810. The privy was on the lot owned by the Uriah Benedict's widow, who operated a boardinghouse at this location. This sample yielded the second greatest concentration of parasite eggs at the site.

Two large common privies were also discovered in this portion of the site. They were probably associated with boardinghouses but straddled lot lines of several commercial and residential properties. The common stone privy was connected to a stone drain that carried waste into the street. The sediment at the base of the privy (sample 1) was deposited in the first decade of the 19th century and contained a large number of parasite eggs. Sample 6 was obtained from a large wood-lined privy that was associated with several adjacent properties, housing warehouses, storefronts, and a boardinghouse on the riverfront during the 1860s. The rate of parasite infection at this location appears to have been relatively low, possibly due to improvements in Albany's sanitary conditions by the middle of the 19th century.

All of the 18th-century samples from the waterfront contained some parasite eggs, which suggests that the waterfront environment during this period was highly contaminated with parasites. Archaeologists did not locate privies here from this period, which suggests that other, less-sanitary waste-management strategies were in use. The early-19th-century privies at the site, despite the increased number of parasite eggs they contained, may indicate a more effective waste-management system. Because the privies concentrated human waste, they may be expected to have greater quantities of parasites. The extent of the residents' success at containing parasites within these structures is still unknown, as is whether parasites also increased in the general environment. It is known that privies seeped, people handled chamber pots, cleaned privies, and spread night soil as fertilizer, thus continuing the life cycle of the parasites.

Picotte DEC

The Picotte DEC site in Albany was investigated by archaeologists prior to the construction of a new office building for the New York State Department of Environmental Conservation. The site, encompassing approximately two city blocks of almost one acre each (Figure 1), was a surface parking lot at the time of the investigations. It was located along the Hudson River at the northern limits of the colonial boundary of the city and situated approximately one block north of the SUCF site and south of the Quackenbush Parking Garage site. Eleven samples from privy sediments were collected and processed for identification of parasites. Samples 7 (privy 7), 3 (privy 4), and 6 (privy 5) were from features used between 1740 and the 1780s. Samples 1 (privy 1), 4 (privy 6), and 5 (privy 3) were collected from privy soils deposited between 1790 and 1840. Samples 2 (privy 2), 10 (privy 11), 11 (privy 12), 8 (privy 9), and 9 (privy 10) were obtained from privy soils that were deposited between 1850 and 1870 (Table 1).

Although this portion of the city was the location of a few early settlements and industries, urban development began at the close of the 18th century when the city expanded beyond the former limits of the protective stockade wall. This was prime real estate near the riverfront and north dock for wealthy merchants, professionals, and tradesmen. After the opening of the Erie and Champlain canals in the 1820s, the increased commercial traffic brought large numbers of laborers and new immigrants to this neighborhood, while the wealthier residents moved uptown. By the 1850s, this location was the scene of increased industrial activity, including a lumberyard and coalhouse. Construction of railroad tracks through this area in the 1860s effectively ended the residential use of this site.

Parasite samples obtained from privies documented the change in the neighborhood from wealthy merchants and tradesmen on the edge of the city to workers and riverfront boarders at the core. The earliest privy (7) discovered and investigated was a wooden barrel used before the French and Indian War. Soil recovered from within the barrel did not contain any parasite eggs. The late-18th-century privies (4 and 5) are difficult to assign to specific owner-occupants, although members of the DeFreest family owned the lots at 633, 635, and 637 Broadway. They were successful tradesmen, merchants, and farmers who had large agricultural holdings outside the city by the time these features were constructed.

Privies 1, 3, and 6 contained evidence of parasites during the late-18th and early-19th centuries. Privy 1 was a wooden structure with spaces about 0.79 cm (2 in.) wide between the planks for drainage. It was located on the property of John Bogart, a sailor and soldier during the Revolutionary War, who later became a merchant. Improvements to Bogart's property at 611–613 Broadway included a dwelling, storehouse, and stable. He lived there with his wife, four children, and four slaves until the fire of 1797 destroyed his house. The privy was located in the rear of the lot and contained a very large number of parasite eggs. Bogart and his household were concerned about their health and could afford popular medicines such as a bottle of Robert Turlington's Balsam of Life and another unmarked medicine bottle recovered from a pit at the site. No evidence shows the effectiveness of these treatments on intestinal worms, nor the identity of the medicines the bottles contained, but the presence of these bottles shows Bogart had a perceived need for medicines and access to apothecaries.

In contrast to the Bogart's privy, Henry Abeel's privy on the lot at 30 Orange Street had a very small number of parasite eggs. Privy 3 was another wooden structure with spaces between the planks that enabled liquid waste to seep out of the privy. Abeel was the city's fire inspector in 1823.

Privy 6 was wooden with one stone wall, probably the remains of an earlier foundation. The property at 637 Broadway was owned by the DeFreests and had a number of occupants during the period the night soil containing parasites was deposited in the privy. In the early 1800s when the privy 6 structure was in use, the neighborhood contained shops and dwellings.

Five sediment samples were obtained from privy night soil deposited in the 1850s and 1860s. Privies 2, 11, and 12 were in use during the 1850s, while samples from privies 9 and 10 were acquired from deposits that formed in the 1860s.

In the 1850s, William Keyser, a physician and apothecary, rented the dwelling at 633–635 Broadway where privy 2 was located. This privy was a cut stone structure with a brick drain. Parasite infection was present with relatively low quantities of worms and provides ambiguous evidence of his professional abilities. Similarly, his status is difficult to assess since he was a professional but did not own his residence. Instead, he rented quarters in a commercial and industrial section of the city.

Thomas Higgins, a laborer, was the occupant of 38 Water Street where privy 11 was encountered. The privy was made of wood and had a wooden drain that contained a large number of parasite eggs. Privy 12 was built of cut stone on the lot of Aaron Griswold at 16 Orange Street. Griswold was a lumber merchant who experienced considerable economic success. As expected within drained privies of this type, Griswold's privy contained low quantities of parasites. Privies 9 and 10 were associated with two different boardinghouses owned by Jacob Ten Eyck at 19 Columbia Street during the 1860s. Privy 9 was a brick and stone structure with a stone floor and was used by the laborers who resided at the Buffalo House. Workers and transients occupied the neighboring American House and used privy 10, which was made of wood with a cement drain. Both of these privies had a low number of parasite eggs in comparison to the earlier sediment samples from this site.

Maiden Lane Pedestrian Bridge

A pedestrian bridge was constructed within the present Maiden Lane to connect the modern city of Albany with green space along the Hudson River that was separated by the construction of Interstate 787. Only the western piers and landing of this new bridge were investigated archaeologically because the remainder of the bridge was built upon fill deposited in the 20th century in the former Albany Basin. The western portion included the original river shore of the colonial city and the intentionally created land deposited along the river in the 18th and 19th centuries.

Six soil samples from 18th-century contexts associated with feature 11 and feature 16 were subjected to parasitological analysis. The Maiden Lane Culvert, feature 11, was constructed in 1788 beneath the street. The culvert consisted of a segmented arch against thick masonry walls with an interior wooden plank floor. The lower levels of fill within the culvert contained brick, burnt planks, and other building debris that may have resulted from the clean up and reconstruction after the large downtown fires in 1793 and 1797.

The two samples from the lower levels within the culvert contained low numbers of parasite eggs. This finding may be related to the successful functioning of the culvert. Fast-moving water along the wooden plank floor and smooth sidewalls did not allow for significant accumulation of sediment. Once the building debris from the 1790s fires collected in the feature, the water flow was restricted, and parasite-contaminated sediments developed. More parasite eggs were found within the culvert than in the samples outside the feature. The quantity of parasite eggs in the later culvert sample is comparable to many of the other privies in the city reported here.

The 1788 culvert construction cut into an earlier deposit, referred to as feature 16. It was a horizontal layer of logs, formerly used in the colonial stockade, which was dismantled in the 1760s at the conclusion of the French and Indian War. These logs were reused in the development of the riverfront. Soil deposited upon the logs included a variety of mid-18th-century material, such as delft ceramic sherds, window leads, and numerous clamshell fragments from wampum manufacturing. The logs found here in a horizontal position may have served as a corduroy road or as a base for the fill deposited to raise the elevation of the street surface along the river.

Sample 71 was collected from the dark sandy silt on the surface of the logs. The absence of parasite eggs from this sediment indicates that the logs were exposed for a brief time because other 18th-century ground surfaces from the adjacent site, SUCF, were contaminated. Sample 72 was obtained from dark sandy silt directly below the logs and had a quantity of eggs that is more consistent with the other 18th-century ground surfaces in Albany. This suggests that the silt below the logs was exposed as a ground surface for a period sufficient to accumulate parasite eggs. The deeper sample 73 was obtained from light brown sand beneath sample 72. Parasite eggs were present in this sample and indicate the contamination of ground surfaces in the colonial city.

40 Howard Street

Additional samples for parasite analysis were obtained from the proposed site of the New York State Comptrollers Office building at 40 Howard Street in Albany, currently including two city blocks between State Street and Beaver Street on the west side of Pearl Street. This area was created by the completion of the Rutten Kill culvert and the filling in of the associated ravine by about 1830 to provide enough land for the development of approximately 20 urban lots. The boardinghouses located on lots fronting Howard Street and Beaver Street were the focus of the archaeoparasitological study.

Privy 5 was a substantial, rectangular stone feature that was associated with a boardinghouse located at 73 Beaver Street between 1832 and 1860. Level 1 (sample 4) contained dense yellow brown clay that sealed the last period of use and resulted in a lower quantity of parasite eggs than the night soil deposits below it. Level 4 (sample 6) was the earliest deposit of night soil but was sealed from level 3 (sample 5) by a layer of lime, apparently employed as a catalyst for anaerobic decomposition as well as a deodorizing agent.

Privy 10 (sample 7) was a drained privy that was made of wood and associated with a boardinghouse at 75 Beaver Street. The sample from this privy contained parasite eggs, but not in the quantity found in privy 5. Privy 10 drained into Beaver Street, where a large brick vault beneath the street served as a septic tank in the 1850s. Archaeologists hypothesized that this system worked better than a simple drain where the refuse discarded in the privies had to be removed regularly to maintain the flow of liquids. The lower number of parasite eggs in privy 10 may have resulted from the connection to the brick vault, which served as a settling tank that reduced the quantity of refuse in the drains.

The two privies on Howard Street were large, wooden, rectangular structures lacking drains. Privy 2 (samples 1 and 2) was associated with a boardinghouse at 34 Howard Street and privy 3 (sample 3) was related to the boardinghouse at 32 Howard Street. These were among the first buildings in the 40 Howard Street site, and the privies were used during the 1830s. The small number of parasite eggs in privy 2 was not anticipated in a structure that lacked a drain. The low incidence of parasites may be a result of disinfecting or cleaning this privy, or a result of medical practices to control the number of parasites.

The samples from the ground surfaces at this site contained relatively few parasite eggs and provide evidence for the general absence of settlement in the area before the creation of the urban lots. During the 1820s, the city market stood on the corner of Howard Street and Pearl Street and may account for the low quantity of parasite eggs present at that time. An important discovery in these samples (10 and 12) is the parasite *Toxocara canis*, a roundworm of dogs that is in the same family (*Ascaridae*) as the human parasite *Ascaris lumbricoides* and the pig parasite *A. suum*. Eggs of this parasite are passed in dog feces and can be passed to humans if ingested. These worms can cause blindness and problems in the central nervous systems of humans, especially children. An 1819 drawing of the market depicts dogs scavenging through the waste that surrounded the market on the 40 Howard Street site was included in a pamphlet opposing this location for the market (Davis 1820).

Quackenbush Square Parking Garage

Archaeological investigation at the proposed parking garage at Quackenbush Square revealed deposits from a 17th-century brickyard, the remains of the brick maker's house, and a rum distillery, initially constructed in the 1750s and in operation until approximately 1800. This distillery was situated along the Hudson River shore, just north of the city's north dock that existed during the 18th and 19th centuries. The excavations did not locate a privy associated with the brick maker's house, but samples were collected from 17th-century ground surfaces around the house. Samples 2, 7, 8, 9, and 16 were obtained from surface middens adjacent to the house that were deposited between 1640 and 1700. Samples 2 and 8 contained parasite eggs. Samples 10 and 18 were collected from the surface of the brickyard and did not evidence parasite eggs.

Samples 11, 12, and 17 were sediments collected from the bottoms of two wooden fermentation vats in the distillery that operated from 1750 to 1800. These vats were routinely filled with water, probably drawn from the Hudson River. No evidence of parasites was found in these samples. The greatest number of parasite eggs at the site was obtained from samples 3 and 4, collected from a stratified deposit in a wooden barrel privy in use until the 1830s. The iron-banded barrel had a capacity of about 84 gallons, which corresponds with the standard size of a puncheon. The samples were drawn from two night soil layers separated by a deposit of lime.

The privy was located on one of several lots along Montgomery Street and south of Quackenbush Street that were owned by Hugh Bradford, a builder. He managed construction projects and hired masons, carpenters, joiners, and other tradesman as needed, similar to a modern general contractor. These lots may have been under development at the time the privy was used.

A wood-lined privy from the 1880s was the source of sample 6, which was almost devoid of parasite eggs. This privy was constructed of horizontal planks supported by posts in the corners and was associated with a warehouse owned by the New York Central and Hudson River Railroad at that time and, most likely, used by a number of laborers.

Sample 5, which contained few parasite eggs, was collected from a wooden drain in use in the 1820s. The source and function of the drain has not been determined.

Court of Appeals

The Court of Appeals excavations were carried out during the proposed expansion of the present building onto the land occupied by a surface parking lot to the east. This location was on the hill on the west edge of the city during the middle of the 18th century and within the downtown section of the expanding city by the early-19th century (Figure 1). Two samples, 13 and 14, from shallow middens deposited during the 1820s were examined. At that time, Frederic Wormer, who kept a tavern nearby, owned the lot. He may have had a tenant in a small, undocumented building on this lot. These samples did not produce evidence of parasite eggs.

Sample 15, from a wood-lined privy in use during the 1830s, contained a deposit of night soil with parasite eggs. The privy had a metal grate in one wall where it connected to a brick drain. Workers used this feature during the construction of the New York State Court of Appeals building from 1834 to 1842. There were no previous residents at this site, and only the builders were present during the construction period.

Pearl Street

Archaeologists from the New York State Museum developed a plan to monitor and recover archaeological information from Pearl Street in Albany during the street reconstruction project sponsored by the New York State Department of Transportation. Samples for parasite identification from the Lutheran Church Lot and North Pearl Street sites were collected and examined. Samples 1 and 3 were collected from the organic deposits at the base of white oak wooden barrels buried beneath the center of the modern Pearl Street. These privies were along the property line between a narrow lane to the Church Lot deeded in 1680 and the Schuyler house.

Philip Pietersen Schuyler, a very successful fur trader and the first mayor of Albany, built the Schuyler house by 1667 (Huey 1993). His descendents, including the Revolutionary War General Philip Schuyler, lived in this house until 1782 when it became the City Tavern. Both of these privies may have been used until the early 1790s when Pearl Street was expanded over these features and the City Tavern was demolished. The privies contained numerous seeds of berries and fruits and small pieces of burned limestone, along with other 18th-century artifacts. The most recent artifact recovered was a sherd of blue hand-painted pearlware in the fill above sample 1, suggesting the night soil was deposited during the Schuyler's residency.

Sample 2 was obtained from buried mid-18th-century deposits beneath North Pearl Street that was outside of the north gate of the early city stockade wall. This low-lying portion of the street was filled during the Seven Years War to incorporate it into the expanded city, to accommodate the increased urban population of soldiers and refugees (Fisher 2004). Taken from a street context instead of a specific urban lot, this sample contributes to the understanding of general parasite contamination in the city.

The presence of parasite eggs in these samples was expected because the previous studies carried out by Reinhard on Albany archaeological sediments consistently demonstrated parasite contamination. The discovery of differences in the relative amounts of specific parasites in the Lutheran Church Lot barrel privies from other Albany sites was not anticipated and is further discussed here.

Archaeologically Identified Parasites

The population density within Albany and the absence of both a supply of clean water and a sanitary system of waste removal are largely responsible for the poor health conditions found in this urban environment. The cultural resource management studies cited here have archaeologically documented the rise of parasite infections among the residents of Albany during the 17th and 18th centuries. The description of the parasites and their respective life cycles creates a new perspective on the historical living conditions in this city. Five different human parasites were identified in the archaeological samples collected from Albany. They include the *Ascaris* (roundworm), *Trichuris* (whipworm), *Taenia* (tapeworm), *Hymenolepiasis nana* (dwarf tapeworm), and the first archaeological observation of the parasite *Macracanthorhynchus hirudinaceus* (thorny-headed worm). Other eggs were observed as oval, transparent, and embryonate eggs that contained a small worm that could be from a number of species. These eggs were classified as strongylates.

A roundworm of dogs, *Toxocara canis,* was discovered from 40 Howard Street during the period the city market was located here, before the residential development of the lots. Eggs of this parasite can be passed from dogs to humans. In addition to these parasites, analysis of sediment samples from the Picotte-DEC site revealed evidence of pinworm (*Enterobius vermicularis*) and louse nits (*Pediculus humanus*). The presence of lice is relevant to the health conditions in the city because they can transmit typhus.

Ascaris (roundworm) is the most common of all parasitic worms worldwide. Roundworm adults live up to two years in humans and can grow to a length of 30.5 cm (12 in.) with a diameter of 0.1 cm (0.25 in.). The female can produce up to 200,000 eggs per day. The eggs are passed with the feces, eventually ending up in the soil where they can remain viable for more than 14 years (Stephenson 1987:89). Humans ingest eggs from contaminated soils by eating contaminated, unwashed food, eating without washing contaminated soil from their hands, or drinking contaminated water. The eggs hatch into larvae in the small intestine, burrow through the intestine walls, and enter into the blood system. The larvae migrate to the lungs where they mature, penetrate the lung walls, ascend to the throat, and are finally swallowed to the stomach. The worms grow into adulthood in the small intestine. In two to three months, the female produces more eggs, and the cycle is repeated (Figure 2) (CDC 2006a).

In adults, roundworm infection is more of a nuisance than a major health threat. The pathology of infection can be viewed in three stages: migration of larvae, presence of adults in the intestine, and movement of adults outside of the intestine. Migration of the larvae through the lungs can cause severe pathology (hemorrhagic pneumonia) if many larvae emerge at once. More commonly, smaller worm burdens cause breathing difficulties, pneumonia, and fever. The larvae are very allergenic and can cause allergic hypersensitivity reactions such as asthma. Once the adults become established in the intestine, the most common pathology includes vague digestive disorders. In large infections, malnutrition can occur. In very heavy infections, fatal blockage can occur.

Ascarids are the most active parasites and freequently move outside of the intestine. In reaction to variation in food, or overcrowding, or the presence of only one sex in the intestine,

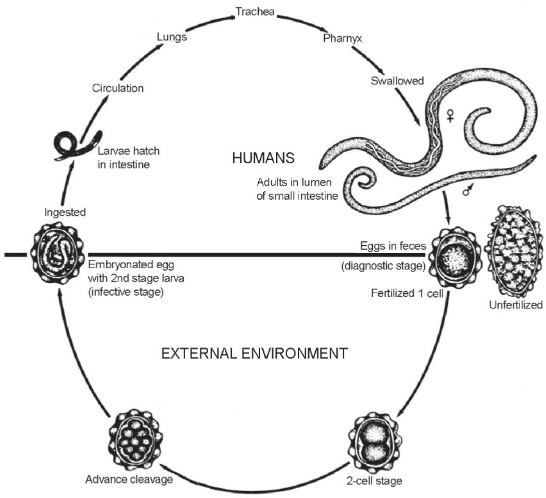

FIGURE 2. Life cycle of the intestinal roundworm *Ascaris lumbricoides* in a human host, 1982; after Public Health Image Library, No. 5231 <http://phil.cdc.gov/phil/home.asp>. (Courtesy of Division of Parasitic Diseases, Centers for Disease Control and Prevention, National Center for Infectious Diseases, Atlanta, GA.)

the worms will migrate (Crompton 1994:187). They can migrate and exit through the anus, or they can cause more significant problems. They can move aimlessly into, and block, the bile duct and cause jaundice. When they enter the stomach, the acid causes the worms to writhe, and they can be vomited up. Fatality can occur if the vomited worm is aspirated. When people are sleeping, the worms can reach the esophagus and can cause suffocation, or they can reach the Eustachian tubes and cause ear damage. They can cause appendicitis when they perforate that organ, which can result in fatal peritonitis. They can even cause suffocation if they wander to the trachea.

In children and infants, however, the effects of infection are more pronounced since it can cause acute intestinal pain, malnourishment, and even underdevelopment in severe cases (Stephenson 1980, 1994). In some areas of the world where roundworms are common today, up to 35% of all deaths due to peritonitis in children result from *Ascaris* infections (Reinhard 2000b). The size and visibility of the adult worms make it likely that the population of Albany was aware of roundworms and their health implications. Documentary evidence reveals that residents of Albany, at least the wealthy ones, were aware of the parasites, as indicated in the recipe collection of an Albany family. Elizabeth Van Rensselaer, who recorded recipes between 1799 and 1835 that are included in this collection, suggested a sage tea with molasses as a "cure for worms" in a young child (Kellar et al. 1986:79). The Van Rensselaer family, among the richest people in New York State in the early 1800s, had a mansion in Albany and extensive landholdings in the surrounding area. Medical books from the 18th century contained numerous remedies for expelling worms that are strong purgatives, including rhubarb, calomel, jalap, and salad oil (Buchan 1785). These continued in use in the 19th century, as evidenced by an early patent medicine manufacturer who claimed his pills for worms were different from his competitors because they "contained no mercury" (Young 1961).

By contrast, the *Trichuris* (whipworm) is no larger than 0.6 cm (1.6 in.) in length and was not as obvious to the residents of Albany. The adult worm lives in the human colon where the female may lay 10,000 eggs per day, which are then passed with the stool to contaminate the surrounding soil. After ingestion of contaminated soils, the eggs hatch into larvae in the small intestines and migrate to the colon to mature into full adults. Human adults may not experience any symptoms, but children can suffer abdominal pain and growth retardation (Figure 3) (CDC 2006c).

Although the *Taenia* or human tapeworm was found in only one sample at the SUCF site and evidenced by only one egg, it is still worthwhile to discuss here. The tapeworm is a giant parasite usually between 2 and 7 m (6.6 and 22.9 ft.) long that can grow up to 25 m (82 ft.) in length and may live up to 30 years. The worms break into sections called gravid proglottids (up to 1,000 in all) and each gravid proglottid produces from 50,000 to 100,00 eggs. A single tapeworm has the capacity to produce nearly 10 million eggs. The eggs invade the surrounding soils where they can survive for years. Domesticated animals (usually a pig or cow) may then ingest the contaminated soils, and the eggs migrate into the blood stream and eventually end up in the muscle tissue. They pass to humans who consume a contaminated animal that is not thoroughly cooked. In the human host, the egg develops into an adult tapeworm and attaches itself to the small intestine (CDC 2006b).

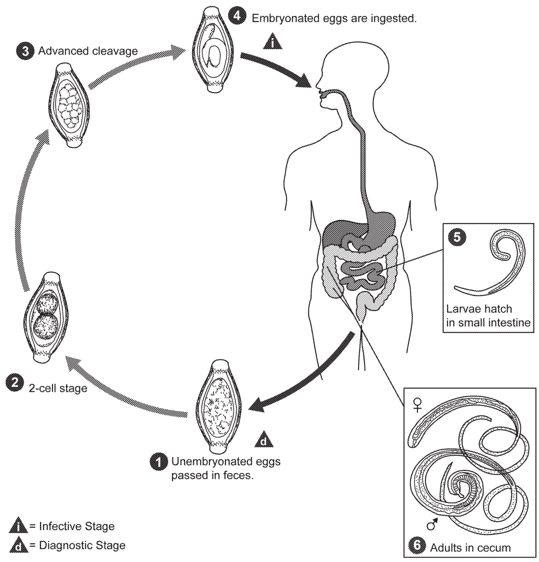

FIGURE 3. Life cycle of the intestinal whipworm *Trichuris trichiura* in a human host, 2002; after Public Health Image Library, No. 3424 <http://phil.cdc.gov/phil/home.asp>. (Courtesy of Division of Parasitic Diseases, Centers for Disease Control and Prevention, National Center for Infectious Diseases, Atlanta, GA.)

Given the large number of eggs that can be produced by the tapeworm, their extremely low occurrence in the archaeological samples indicates that tapeworms did not pose a major health threat in historical period Albany. The tapeworm is much more difficult to contract relative to the other parasites present archaeologically, especially since it needs an intermediary host. On the other hand, the presence of only a single egg of this parasite may be a result of the manner of food preparation in Albany. Perhaps residents liked their pork chops extremely well done, thus eliminating any chance of tapeworm contamination.

The find of *Macracanthorhynchus hirudinaceus* is very interesting, in part because it is the first occurrence of this parasite in the archaeological record. *M. hirudinaceus* is an acanthocephalan, whose common name is thorny-headed worm. A parasite primarily found in pigs, the thorny-headed worm also can infect humans. The one example was recovered from a wooden barrel privy beneath Pearl Street, suggesting either that pig feces were deposited into the latrine or that a human was infected. An experimental infection by a physician in the late-19th century defined the pathology (Reinhard 2001). He reported intestinal pain, diarrhea, and malaise before eggs began to pass in his stools and he recovered. The pathology is caused partly by the "thorny head" of the parasite. This organ protrudes from the anterior of the parasite and is coated with tiny hooks. It punctures the intestinal wall and serves to anchor the parasite. Thorny-headed worms, like tapeworms, are "gutless wonders" that lack a mouth or intestinal track.

Parasite Contamination in Albany

The sediment samples from Albany can be divided into two principal types: 29 were collected from nonprivy contexts, including ground surfaces, drains, and culverts, and the remainder from privies where human waste was concentrated. Generally, archaeologists in Albany have not been successful in locating or identifying privies that date before the mid-18th century, in spite of the numerous large-scale excavations that have taken place in the city (Figure 1). Only one can be clearly associated with the 1750s, and just five others have been identified from the late-18th century (Table 1). The presence of parasites, especially *Ascaris* (roundworms), in the soils surrounding structures from the 17th and 18th centuries indicates that waste was discarded on the ground surface, nearby middens, or in planting beds around buildings during this period.

At least one roundworm or whipworm egg was recovered from 43 of the 55 samples submitted for analysis (Table 1). The whipworm and roundworm were found together in all but 15 samples, similar to conditions in modern populations (Crompton 1994). The privy samples averaged 30,499 roundworm eggs and 1,259 whipworm eggs per milliliter of soil, which is about 0.2 of a teaspoon. The calculated egg counts do not necessarily reflect the rate of infection because the different parasites produce eggs at different rates. For example, an *Ascaris* (roundworm) female produces nearly 20 times the number of eggs as the *Trichuris* (whipworm). When the egg production rates are considered, both parasites were present in approximately equal numbers in historical period Albany. An interesting exception to this was found in the samples from the Pearl Street privies, where the sediments reflect an actual infection of about 20 *Trichuris* females to each *Ascaris* female.

The analysis demonstrates that roundworms were present in large numbers in the environment in Albany and had probably been infecting the inhabitants of the city since the 17th century. The samples from the earliest occupations at the Quackenbush Square brick maker's house, dating from approximately 1640 to 1700, evidence the earliest infestation. The greatest number of roundworm eggs per sample outside of privies were those obtained from the Maiden Lane culvert at the end of the 18th century when it was filled with debris and trapped contaminated sediments, the mid-18th-century deposits in Pearl Street and Maiden Lane, and the sediments at the SUCF site associated with the French and Indian War in the mid-18th century. Except for the Maiden Lane culvert sample, the others were deposited during a period of conflict and rapid population increase within the confined space of the walled city. The large number of parasites recovered from the Maiden Lane culvert reflects another period of rapid population growth following the end of the American Revolution.

The increase in the number of privies and the prohibitions on open-air dumping in the late-18th century appear to correlate with the decreasing number of parasite eggs in the ground surface samples (City of Albany 1773: 9–10). The use of privies did not eliminate parasites but helped contain the majority of parasite eggs within privy shafts. Parasite eggs remained present in large quantities within privy contexts until about the 1830s, when the number of worm eggs declined to about one-sixth of the number present in the 1780s (Table 2). By 1860, few parasite eggs of any kind were observed in the samples, and the single sample from 1880 contained less than 200 parasite eggs. The population of the city experienced rapid growth during the same period, with the number of residents in 1870 more than twice that of 1840 (Table 2).

The initial decline in the number of parasite eggs in the 1830s corresponds to a general shift in the method of privy construction. The earlier wooden barrels in the ground were replaced with wooden box vaults in the early-19th century, which were augmented later by the use of stone-lined vaults. This trend reflects the effort to control seepage of waste from the privies into the surrounding soil.

TABLE 2
ESTIMATED PARASITE EGGS IN PRIVY SAMPLES PER DECADE

Decade	Average No. Eggs	Population of Albany[a]
1760	65,218	1,500
1770	0	–
1780	76,943	–
1790	93,438	3,498
1800	84,143	5,349
1810	25,877	9,356
1820	0	12,630
1830	12,722	24,209
1840	0	33,762
1850	19,269	50,763
1860	979	62,367
1870	0	69,422
1880	179	90,758

[a]Bielinski (2002).

Archaeological evidence from Albany contrasts with the public emphasis on sanitary reform indicated by strict New York State laws in the 1830s that were intended to control the disposal of human waste (Geismar 1993). Increased parasite quantities were observed again in Albany by the mid-19th century before declining after 1850 (Table 2). Reasons for the temporary increase may be the doubling of population between 1830 and 1850; the new boardinghouse district that developed during this time and was reflected in the 40 Howard Street samples; or the initial impact of the sewer system that began in the 1850s and may have decreased parasites in the general environment. The sewers were not immediately available to all residents, but economic means and attitudes about the relationship between filth and disease interacted in a complex manner that contributed to the cycle of parasite contamination during this period. Future investigation of additional sediment samples will be necessary to examine this problem further.

Residents' Responses to Parasite Contamination

Both the presence and quantities of parasite eggs have yielded new information about the health conditions in the city. In modern populations, there appears to be a strong correlation between heavy roundworm infection and heavy whipworm infection as evident in egg counts in the feces (Crompton 1994). This is generally true of the archaeological evidence from Albany.

Relative amounts of the specific parasites provided evidence of additional efforts on the part of residents to control the contamination. Results from the two samples from the Pearl Street privies were quite different in comparison to the others reported here. Specifically, the proportion of roundworm eggs to the total parasite egg count is lower than in the other locations within the city. Whipworm eggs were 88% (privy 1) and 56% (privy 3) of the parasite eggs identified from the Lutheran Church Lot privies (Table 1). In contrast, the highest percentage of whipworm eggs in the other Albany privy samples was only 24% of the identified parasite eggs in sample 7 from feature 38 at SUCF and 24% of the sample from privy 2 at 40 Howard Street. Whipworm eggs were less than 10% of the estimated eggs from 17 of the privy samples.

When the actual egg production of these parasites is considered, the Pearl Street samples are even more significant. Greater quantities of roundworms may be expected, since each female produces 20 times more eggs than each whipworm female. The Pearl Street samples, however, indicate the opposite relationship, or an infection rate due to about 20 whipworm females to each roundworm female.

This drop can only be a result of medical treatment by the residents of Pearl Street. The wealthy, educated Schuyler family, along with their servants and slaves, probably used medicines that affected roundworm infection to a greater degree than whipworm infection. Fecal contamination was a problem for all of the Albany sites studied, as indicated by the similar whipworm egg counts. Once the worms reached maturity and move into the intestine, the identified parasites have different adaptations to their host. Roundworms live freely in the lumen of the intestine, which makes them susceptible to a variety of chemotherapies. Drugs that even temporarily paralyzed the roundworms would result in their removal from the intestine through peristaltic contractions of the intestine.

Whipworms, in contrast, burrow almost entirely into the intestinal wall and are protected from drugs that affect roundworms. This creates a major obstacle to the medical treatment of whipworm infections in both medical and veterinary parasitology (Reinhard 2001).

The 18th-century medical profession, along with the occupants of Albany, was not aware of the relatively tiny (less than 1 in.) whipworms until their discovery in the early-19th century (Reinhard, Araújo et al. 1986). European investigators documented *Trichurids* in the 1840s. Professionals in New York acknowledged them by the mid-19th century, for example, Levi Shafer (1849) lists them among the five known species of intestinal worms. Most likely, whipworms were not well known earlier due to their small size of only a few centimeters in length, almost necessitating a microscope to observe them. The roundworm, in contrast, can exceed 30.5 cm (12 in.) in length and may be 0.1 cm (0.25 in.) in cross section. Their size makes them hard for their hosts to ignore them, and early Europeans had varieties of treatments for roundworm infections (Buchan 1785).

The absence of medical knowledge regarding the life cycle of parasites and how these worms infected people, their small size, and the prevalent theory that worms developed from spontaneous generation combined to reduce the possibility that whipworm infections would be treated. An alternative hypothesis proposing that worms developed from eggs that infested the human body began appearing in the professional literature in the mid-19th century, although the common belief that worms resulted from spontaneous generation remained (Shafer 1849).

Despite the lack of necessary knowledge and sanitary conditions to combat parasites, the inhabitants of Pearl Street managed to control their roundworm infections. Relative to the samples from other parts of the city, apparently the residents of Pearl Street reduced their *Ascarid* worm burdens by more than 80% in relation to their *Trichurid* worm burdens. This, in turn, resulted in lowered risk of appendicitis, intestinal blockage, and other complaints related to *Ascarid* infection.

The most obvious differences among the sites studied appear to be their location and the wealth of the occupants. Modern studies of public health have demonstrated a relationship among poverty, poor sanitation, and greater parasite infections (CDC 2006a). Pearl Street was situated on the State Street hill, well above the Hudson River waterfront where the major archaeological excavations at SUCF, Picotte-DEC, Maiden Lane, and Quackenbush Square took place. Wealthy merchant families were resident on the waterfront, but large numbers of workers, sailors, slaves, and immigrants were also present. Wealthy, well-connected, and established Albany families that included the Staats, Livingstons, and Schuylers lived along Pearl Street during the colonial period (Munsell 1871, 1876). They owned large houses and numerous parcels of land, held powerful political positions, and were wealthy enough to have their portraits painted. If medical treatments were known, these families would have had access to them.

Jack Larkin (1988:88) has described physicians' treatments of the time as "bleeding and blistering, purging and puking." Mercury and lead, along with other dangerous elements, were used regularly in these medical procedures, and both were evident in greater amounts in the trace elements found in the skeletal remains of a wealthy individual buried in the cemetery near the Pearl Street privies (Emsley 1986; Fisher 2003). As noted earlier, a recipe for a sage tea to remove worms was known to the Van Rensselaer family, among the wealthiest people in New York State in the early 1800s (Kellar et al. 1986:79). Medical books from the 18th century, such as one published by physician William Buchan (1785), contained numerous remedies for expelling worms, including red wine, rhubarb, calomel (chloride of mercury), and salad oil. The latter, Buchan recommended, was most effective when administered in an enema. A New York Doctor, Robert Thomas, published a medical manual for home use in 1829 that listed typical treatments for many known problems (Hanson 2004). He included calomel, fern root, and tin filings among the medicines for expelling worms, along with dozens of substances that were useful as purgatives. Later treatments continued to prescribe these medicines for treatment of worms. Shafer (1849) recommended antihelmintics, medications used to remove worms from the stomach and intestines and purgatives for effective treatment. The antihelmintics served to weaken the parasites, while the purgatives increased peristaltic action of the intestines to expel them. Wormseed (chenopodium), calomel, fern root, tin powder, bark of pomegranate root, and others are included in Shafer's treatments. Documentary evidence suggests that massive doses of cathartics and laxatives served to eliminate roundworms from some of the Pearl Street residents. This may have occurred among wealthy individuals in other parts of the city, but the current archaeological evidence does not support this conclusion. The mixture of economic and occupational classes along the waterfront may have obscured medical treatments used by a minority of wealthy individuals in the area. Clearly, this is a problem for future research.

Summary

Large numbers of parasites were found in the archaeological samples from Albany, New York. Parasites were discovered on the ground surface adjacent to a house occupied in the 1600s and the mid-18th-century riverfront and streets. The greatest number of parasite eggs was found in soils and privy fill associated with the expansion of the city during the late-18th century. During the colonial period, the residents of Pearl Street had a better health outlook than other areas of Albany, but it was not a result of better sanitation. They controlled *Ascarid* infection through medicinal treatment. Parasites were present throughout the city, regardless of the distance from the Hudson River or elevation relative to the water table.

By 1830, the number of eggs in privy samples dropped well below that seen in the earlier period. The average estimate of eggs in 1830 was less than one-half the 1810 quantity, and only about 15% of the 1800 average. During this time, the Erie and Champlain canals opened with Albany as the eastern terminus. Furthermore, between 1800 and 1830, the population of the city increased more than four times. Samples after the mid-19th century contained greatly reduced numbers of parasite eggs. Remarkably, Albany controlled the parasite infestation while the city population almost doubled from 53,000 in 1830 to 90,000 in 1880. Successful control of parasites was related to several factors, including prohibitions on open-air dumping of waste in the city, new technologies of privy construction that included wooden box and stone-lined vaults, drains from the privies that controlled seepage, new water supply and sewage disposal systems, and dangerous medical treatments. Preliminary studies of soil chemistry in the privies and the ground surfaces around them indicate that the presence of some heavy metals is limited to the night soil in the privies and not a result of modern contamination of the general environment (Arnason et al. 2003). These metals appear to have been used in medicines intended to purge infected residents.

Despite these efforts, the lack of a scientific understanding of the problem prevented the elimination of the parasites. Not all privies were successfully drained, people handled dirty chamber pots, the privies were cleaned by hand, and the night soil was often distributed on ground surfaces or used as fertilizer on gardens. In 1854, the city began construction of a public sewer system that was not widely accessible until the 1880s. All of the waste from this system drained into the Hudson River. Unfortunately, by the time this sanitary system was in use, the city was forced to obtain larger quantities of water from the river to meet the needs of the residents. By pumping the polluted river water back into the city, another cycle of health problems was initiated with more than 1,000 cases of typhoid reported in 1891 and 1892 in Albany (City of Albany 1997). In the future, additional archaeological samples from the late-19th century may shed light on the rates of parasitic infections following the city's conversion to the Hudson River for drinking water.

Although the parasites found in large numbers in the archaeological sites studied in Albany were not a major threat to public health, they are indicators of other more dangerous, fecal-borne diseases that were present, such as parasitic protozoa, including *Giardia lamblia* and *Entamoeba histolytica*. Only recently have methods been developed for testing archaeological soils for residues of these parasites (Gonçalves et al. 2002, 2004). These methods should be applied to latrine sediments in the future. Bacterial diseases are indicated by these parasites as well, including cholera, *Salmonella*, responsible for salmonella poisoning, and typhoid that posed a real risk for the residents of the city. In addition, these studies demonstrate the persistent discomfort of living with the parasite infections that undoubtedly affected the quality of daily life.

Acknowledgments

These excavations were carried out within the framework of cultural resource management projects by archaeologists working for Hartgen Archeological Associates, Inc. (HAA) and the New York State Museum. We thank the large crews of dedicated and energetic people who worked on these challenging projects in both the lab and field. We are grateful for the support of John P. Hart, director of Research and Collections at the New York State Museum, and Karen S. Hartgen, president of HAA. We also thank the Centers for Disease Control and Prevention for allowing us to illustrate the article with their diagrams of parasite life cycles. George Hamel directed us to several useful sources. We are grateful to Lihua Shi for preparing Figure 1 and to Statistical Research, Inc., (SRI) and Margaret Robbins of SRI for refining the figures for publication. The comments of Richard Veit, Kathleen Wheeler, Terry Majewski, and an anonymous reader are appreciated. Any errors in this text, of course, are the responsibility of the authors.

References

ALBANY CENTINEL
1797 Dreadful Conflagration. *Albany Centinel* 8 August. Albany, NY.

ALBANY, CITY OF
1773 *Laws and Ordinances of the Mayor, Recorder, Alderman and Commonalty of the City of Albany.* Alexander and James Robertson, Albany, NY.
1829 *Laws and Ordinances of the Common Council of the City of Albany*. D. M'Glashan, Albany, NY.
1859 Minutes of August 9, City Common Council. Albany County Hall of Records, Albany, NY.

1860 Minutes of September 4, City Common Council. Albany County Hall of Records, Albany, NY.

1872 *The Ordinances of the City of Albany*. The Argus Company Printers, Albany, NY.

1874 *Albany Directory for the Year 1874*. Sampson, Davenport, & Co., Albany, NY.

1876 Report to the Common Council of the City of Albany: Transmitting the Report of the Superintendent of the Water Works for the Year 1875. The Quackenbush Water Works Report-Events Leading to Quackenbush Station and Events After Quackenbush Pumping Station, compiled by Robert J. Dillon. Manuscript, Department of Water and Water Supply, Albany, NY.

1997 The Water was "Scarcely Drinkable." *Water for a City* 2(2). City of Albany Department of Water and Water Supply, Albany, NY.

Albany Gazette

1793 No title. *Albany Gazette* 19 November. Albany, NY.

Arnason, John, Justin DiVirgilio, and Tracy Miller

2003 They That Have this Medicine Well-Made Need but Few Others. Paper presented at the Council for Northeast Historical Archaeology Annual Meeting, Lowell, MA.

Bell, Edward L.

1987 A Preliminary Report on Health, Hygiene, and Sanitation at the Boott Mills Boardinghouse: An Historical and Archaeological Perspective. In *Interdisciplinary Investigations of the Boott Mills, Lowell, Massachusetts. Volume I: Life at the Boarding Houses*. Cultural Resource Management Study, No. 18, Division of Cultural Resources, North Atlantic Regional Office, National Park Service, U.S. Department of the Interior, Boston, MA.

Bielinski, Stefan

2002 Albany Population. *The People of Colonial Albany Web Site.* New York State Museum, Albany. <http://www.nysm.nysed.gov/albany/welcome.html>. Accessed 27 Dec. 2004.

Buchan, William

1785 *Domestic Medicine,* 2nd ed. Scholar's Showcase, Riverside, CA. Originally published in London by the Royal Society in 1769 <http://www.americanrevolution.org/medicine.html>. Accessed 27 Dec. 2004.

Centers for Disease Control and Prevention (CDC)

2006a Fact Sheet: Ascaris Infection. Division of Parasitic Diseases, Centers for Disease Control and Prevention, National Center for Infectious Diseases, Atlanta, GA <http://www.cdc.gov/ncidod/dpd/parasites/ascaris/factsht_ascaris.htm>. Accessed 9 Mar.

2006b Taeniasis: PDPx-Lab Assistance. Division of Parasitic Diseases, Centers for Disease Control and Prevention, National Center for Infectious Diseases, Atlanta, GA <http://www.dpd.cdc.gov/dpdx/HTML/Taeniasis.htm>. Accessed 9 Mar.

2006c Trichuriasis: PDPx-Lab Assistance. Division of Parasitic Diseases, Centers for Disease Control and Prevention, National Center for Infectious Diseases, Atlanta, GA <http://www.dpd.cdc.gov/dpdx/HTML/Trichuriasis.htm>. Accessed 9 Mar.

Crompton, D. W. T.

1994 Ascaris lumbricoides. In *Parasitic and Infectious Diseases*, Marilyn E. Scott and Gary Smith, editors, pp. 175–195. Academic Press, New York, NY.

Danckaerts, Jasper

1996 Journal of a Voyage to New York and a Tour in Several of the American Colonies in 1679–1680. *In Mohawk Country, Early Narratives about a Native People*, Dean R. Snow, Charles T. Gehring, and William A. Starna, editors, pp. 193–220. Syracuse University Press, Syracuse, NY.

Davis, Nancy

2003 The Cultural Landscape at the Site of the Lutheran Church Lot and Burial Ground. In *People, Places, and Material Things: Historical Archaeology of Albany, New York,* Charles L. Fisher, editor, pp. 71–81. New York State Museum Bulletin, No. 499, University of the State of New York, State Education Department, Albany, NY.

Davis, Robert

1820 *Citizens Rights and Free Trade*. Robert Davis, Albany, NY.

Duffy, John

1968 *A History of Public Health in New York City, 1625–1866*. Russell Sage Foundation, New York, NY.

1993 Health, Sanitation, and Foodways in Historical Archaeology: Commentary. *Historical Archaeology* 27(2):2–5.

Emsley, John

1986 When the Empire Struck Lead. *New Scientist* 25(Dec./Jan.):64–67.

Fisher, Charles L.

2003 Trace Elements and Stable Isotope Analysis of the Human Remains from the Lutheran Church Lot. In *People, Places and Material Things: Historical Archaeology of Albany, New York,* Charles L. Fisher, editor, pp. 63–68. New York State Museum Bulletin, No. 499, University of the State of New York, State Education Department, Albany, NY.

2004 Draft Cultural Resources Survey Report for PIN 1753.58.121, Pearl Street Reconstruction Part I: Archaeological Mitigation Report, City of Albany, New York. Report to New York State Department of Transportation, Albany, from Cultural Resources Survey Program, New York State Museum, Albany, NY.

Geismar, Joan H.

1993 Where is the Night Soil? Thoughts on an Urban Privy. *Historical Archaeology* 27(2):57–70.

GONÇALVES, MARCELO L., ADAUTO ARAÚJO, R. DUARTE, J. PEREIRA DA SILVA, KARL J. REINHARD, FRANÇOISE BOUCHET, AND LUIZ FERNANDO FERREIRA
2002 Detection of *Giardia duodenalis* Antigen in Coprolites Using a Commercially Available Enzyme-Linked Immunosorbent Assay. *The Transactions of the Royal Society of Tropical Medicine and Hygiene* 96(6):640–643.

GONÇALVES, MARCELO L., V. L. DA SILVA, C. M. DE ANDRADE, KARL J. REINHARD, G. D. DA ROCHA, MATTIEU LE BAILLY, FRANÇOISE BOUCHET, LUIZ FERNANDO FERREIRA, AND ADAUTO ARAÚJO
2004 Amoebiasis Distribution in the Past: First Steps Using an Immunoassay Technique. *The Transactions of the Royal Society of Tropical Medicine and Hygiene* 98(2): 88–91.

HACKETT, DAVID G.
1991 *Rude Hand of Innovation: Religion and Social Order in Albany, New York 1652–1836.* Oxford University Press, New York, NY.

HANSON, JAMES A.
2004 Bad Medicine: Medical Knowledge and Practice of the Upper Missouri Fur Trade. *Museum of the Fur Trade Quarterly* 40(3):2–20.

HARTGEN ARCHEOLOGICAL ASSOCIATES, INC. (HAA)
2002a At the River's Edge: Two-Hundred-Fifty Years of Albany History. Data Retrieval, SUCF Parking Structure, Maiden Lane, Albany, New York. Report to State University Construction Fund, State University Plaza, Albany, NY, from Hartgen Archeological Associates, Rensselaer, NY.
2002b On the Outside Looking in: Four Centuries of Change at 625 Broadway, Archeology at the DEC Headquarters, 625 Broadway, Albany, New York. Report to The Picotte Companies, Corporate Woods Boulevard, Albany, NY, from Hartgen Archeological Associates, Rensselaer, NY.
2002c Phase IB/III Archeological Investigations Hudson River Way Pedestrian Bridge, Maiden Lane, City of Albany, Albany County, New York, Volume I: Archeology. Report to Harrison and Burrowes Bridge Constructors, Glenmont, NY, from Hartgen Archeological Associates, Rensselaer, NY.

HOWELL, GEORGE R., AND JONATHAN TENNEY (EDITORS)
1886 *History of the County of Albany, New York, from 1609 to 1886*. W. W. Munsell & Co. Publishers, New York, NY.

HOWSON, JEAN
1992–1993 The Archaeology of Nineteenth-Century Health and Hygiene at the Sullivan Street Site in New York City. *Northeast Historical Archaeology* 21–22:137–160.

HUEY, PAUL R.
1993 Early Albany: Buildings before 1790. In *Albany Architecture*: *A Guide to the City,* Diana S. Waite, editor, pp. 21–58. Mount Ida Press, Albany, NY.
2003 Thirty Years of Historical Archaeology in the City of Albany, New York. In *People, Places, and Material Things: Historical Archaeology of Albany, New York*, Charles L. Fisher, editor, pp. 11–21. New York State Museum Bulletin, No. 499, University of the State of New York, State Education Department, Albany, NY.

JOHNSON, WARREN
1996 Journal of Warren Johnson, 1760. *In Mohawk Country, Early Narratives about a Native People*, Dean R. Snow, Charles T. Gehring, and William A. Starna, editors, pp. 250–273. Syracuse University Press, Syracuse, NY.

KALM, PEHR [PETER]
1773 *Travels into North America,* 2nd edition. John Reinhold Forster, translator. Originally published in 2 volumes in 1773 by T. Lowndes, London, England. Online facsimile edition created in 2003 by Wisconsin Historical Society and National History Day, <http://www.americanjourneys.org/aj-032>. Accessed 27 Dec. 2004.

KAMMEN, MICHAEL
1975 *Colonial New York*. Oxford University Press, New York, NY.

KELLAR, JANE CARPENTER, ELLEN MILLER, AND PAUL STAMBACH (COMPILERS AND EDITORS)
1986 Cure for Worms of Van Rensselaer, Elizabeth (1799–1835). *On the Score of Hospitality, Selected Receipts of a Van Rensselaer Family Albany, New York 1785–1835,* revised edition. Historic Cherry Hill, Albany, NY.

KELSO, GERALD K.
1999 Report on Pollen Analysis of Soil Profiles at Howard Street and Norton Street, Pearl Street Reconstruction Project, Albany, NY. Manuscript, Cultural Resource Survey Program, New York State Museum, Albany, NY.

LAIN, ANDREA, AND MARTIN SOLANO
2003 The People of the Albany Almshouse. Paper presented at the Council for Northeast Historical Archaeology Annual Meeting, Lowell, MA.

LARKIN, JACK
1988 *The Reshaping of Everyday Life, 1790–1840*. Harper & Row, New York, NY.

LIEBS, CHESTER
1971 A Documentary History of Early Waterworks and Water Supply Technology in the City of Albany, 1793–1850. Manuscript, New York State Library, Albany, NY.

Lord, Philip, Jr.
2003 *The Navigators: A Journal of Passage on the Inland Waterways of New York (1793)*. New York State Museum Bulletin, No. 498, University of the State of New York, State Education Department, Albany, NY.

LoRusso, Mark S., and Karen van Wagenen
1990 A Cultural Resource Survey Report of Wadsworth Center for Laboratories and Research, Summer Boiler Project and Virus Building Demolition, City of Albany, Albany County, for the New York State Office of General Services. Manuscript, Division of Research and Collections, New York State Museum, Albany, NY.

Mahar, Louis J.
1981 Statistics for Microfossil Concentration Measurements Employing Samples Spiked with Marker Grains. *Review of Paleobotany and Palynology* 32(2-3): 153–191.

McCarthy, John P., and Jeanne A. Ward
2000 Sanitation Practices, Depositional Processes, and Interpretive Contexts of Minneapolis Privies. *Historical Archaeology* 34(1):11–129.

Moore, P. D.
1981 Life Seen from a Medieval Latrine. *Nature* 294(17): 614.

Mrozowski, Stephen A.
1993 The Dialectics of Historical Archaeology in a Post-Processual World. *Historical Archaeology* 27(2): 106–111.

Munsell, Joel
1858 *Annals of Albany,* Vol. 9. Munsell & Rowland, Printers, Albany, NY.
1871 *Collections on the History of Albany,* Vol. 4. Joel Munsell, Albany, NY.
1876 *Men and Things in Albany Two Centuries Ago.* Joel Munsell's Sons, Albany, NY.

Peña, Elizabeth S., and Jacqueline Denmon
2000 The Social Organization of a Boardinghouse: Archaeological Evidence from the Buffalo Waterfront. *Historical Archaeology* 34(1):79–96.

Phillips, Shawn
2003 Skeletal Analysis of the Human Remains from the Lutheran Church Lot, 1670–1816. In *People, Places, and Material Things: Historical Archaeology of Albany, New York,* Charles L. Fisher, editor, pp. 57–62. New York State Museum Bulletin, No. 499, The University of the State of New York, State Education Department, Albany, NY.

Pike, A. W.
1975 Parasite Eggs: The Organic Content of Cesspit Soil from Southampton, and Their Significance for the Archaeologist and Biologist. In *Excavation in Medieval Southampton 1953–1969*, C. Platt and R. Colemen-Smith, editors, pp. 347–348. Leicester University Press, Leicester, England.

Reinhard, Karl J.
1990 Archaeoparasitology in North America. *American Journal of Physical Anthropology* 82(2):145–163.
1994 Sanitation and Parasitism at Harpers Ferry, West Virginia. *Historical Archaeology* 28(4):62–67.
2000a Archaeoparasitology of Features from the 40 Howard Street site, Albany, New York. Manuscript, Hartgen Archeological Associates, Troy, NY.
2000b Archaeoparasitology of Features from the Picotte-DEC site, Albany, New York. Manuscript, Hartgen Archeological Associates, Troy, NY.
2000c Archaeoparasitology of Features from the SUCF site, Albany, New York. Manuscript, Hartgen Archeological Associates, Troy, NY.
2000d Parasitic Disease at Five Points: Parasitological Analysis of Sediments from the Courthouse Block. In *Tales of Five Points: Working-Class Life in Nineteenth-Century New York, Volume II, An Interpretive Approach to Understanding Working-Class Life*, Rebecca Yamin, editor, pp. 391–404. John Milner Associates, West Chester, PA.
2001 Archaeoparasitological Analysis of Sediments from the Pearl Street Excavations, Albany, New York. Manuscript, Cultural Resource Survey Program, New York State Museum, Albany, NY.
2002a Archaeoparasite Analysis of Sediments from the Albany River Walk, Albany, New York. In Phase IB/III Archeological Investigations Hudson River Way Pedestrian Bridge, Maiden Lane, City of Albany, Albany County, New York, Volume I: Archeology. Appendix 4. Report to Harrison and Burrowes Bridge Constructors, Glenmont, NY, from Hartgen Archeological Associates, Rensselaer, NY.
2002b Archaeoparasite Analysis of Sediments from the Niagara-Mohawk Power Corporations State Street Site, the Quackenbush Square Parking Garage Site, and the Court of Appeals Site. Manuscript, Hartgen Archeological Associates, Troy, NY.

Reinhard, Karl J., Adauto Araújo, Luiz Fernando Ferriera, and Bernd Herrmann
1986 Recovery of Parasite Remains from Coprolites and Latrines: Aspects of Paleoparasitological Technique. *Homo* 37(4):217–239.

Reinhard, Karl J., Stephen A. Mrozowski, and K. A. Orloski
1986 Privies, Pollen, Parasites and Seeds: A Biological Nexus in Historic Archaeology. *MASCA Journal* 4(1):31–36.

Roberts, Daniel G., and David Barrett
1984 Nightsoil Practices of the Nineteenth Century and the Origin of Artifacts in Plowzone Proveniences. *Historical Archaeology* 18(1):108–115.

Römer, Colonel Wolfgang W.
1698 *Plan of the City of Albany*. New York State Archives, Cultural Education Center, Albany, NY.

Rosenswig, Robert M.
1999 Nineteenth-Century Urbanism and Public Health: The Evidence of Twelve Privies in Albany, New York. *Northeastern Anthropology* 58:27–45.

Shafer, Levi
1849 Entezoa: Intestinal Worms. Candidate for Degree of Doctor of Medicine, Albany Medical College, Albany, NY.

Sidell, Nancy Asch
1999 Report of Seed Analysis from the Privy and Pit Features Found at Howard Street, Pearl Street Reconstruction Project, Albany, New York. Manuscript, Cultural Resources Survey Program, New York State Museum, Albany, NY.

Stephenson, Lani S.
1980 The Contribution of Ascaris Lumbricoides to Malnutrition in Children. *Parasitology* 81:221–233.
1987 *The Impact of Helminth Infections on Human Nutrition, Schistosomes and Soil-Transmitted Helminths*. Taylor & Francis, London, England.
1994 Helminth Parasites, a Major Factor in Malnutrition. *World Health Forum* 15:169–172.

Tarr, Joel A., J. McCurley III, F. C. McMichael, and T. Yosie
1984 Water and Wastes: A Retrospective of Wastewater Technology in the United States, 1800–1932. *Technology and Culture* 25(2):226–263.

Veit, Richard
1996 "A Ray of Sunshine in the Sickroom": Archaeological Insights into Late-Nineteenth- and Early-Twentieth-Century Medicine and Anesthesia. *Northeast Historical Archaeology* 25:33–50.

Warnock, P., and Karl J. Reinhard
1992 Methods of Extracting Pollen and Parasite Eggs from Latrine Soils. *Journal of Archaeological Science* 19(3): 261–264.

Yamin, Rebecca (editor)
2000 *Tales of Five Points: Working-Class Life in Nineteenth-Century New York, Volume II. An Interpretive Approach to Understanding Working-Class Life*. John Milner Associates, West Chester, PA.

Young, James Harvey
1961 *The Toadstool Millionaires: A Social History of Patent Medicines in America before Federal Regulation.* Princeton University Press, Princeton, NJ. 2002, *Quackwatch by Stephen Barrett*, MD <http://www.quackwatch.org/13Hx/TM00.html>.

Charles L. Fisher
Division of Research and Collections
New York State Museum
Empire State Plaza
Albany, NY 12230

Karl J. Reinhard
PathoEcology Services
2610 A Street
Lincoln, NE 68502

Matthew Kirk
Hartgen Archaeological Associates, Inc.
1744 Washington Avenue Extension
Rensselaer, NY 12144

Justin DiVirgilio
Hartgen Archaeological Associates, Inc.
1744 Washington Avenue Extension
Rensselaer, NY 12144