Who Was Buried at the Varden Site (AdHa-1)? Osteological Insights into the Time of Interment and the Cultural Group Association of the Mortuary Component of a Long Point Fishing Station

Lindsay J. Foreman and Eldon Molto

This paper outlines the results of a detailed analysis of human skeletal material recovered from a disturbed burial feature at the multi-component Varden site (AdHa-1) on Long Point in Lake Erie. The goal is to reconstruct in as much detail as possible the overall health, and biological and temporal relationships between, the individuals recovered from this site. These data are then used to determine the subsistence practices of the group, their cultural affiliation, and hence their place in southern Ontario prehistory.

Southern Ontario is a biologically rich and ecologically diverse region that has been continuously occupied by human groups for over 12,000 years. These groups have selectively exploited the lithic, floral, and faunal resources available within the variety of unique microenvironments (e.g. riverine, lacustrine, black ash and elm swamp, hardwood forest, conifer forest, and prairies [Kenyon 1988]) that compose the Carolinian and Canadian biotic provinces of this region. For nearly four centuries, researchers have attempted to discern the development of the different cultural traditions present in southern Ontario at the time of initial European contact. The contemporary consensus on these traditions and the timing of their evolution are presented in Table 1. This table outlines the evolution of two distinct cultural traditions beginning in the Middle Woodland period and their occupations of the southcentral (i.e. Ontario Iroquoian Tradition) and southwestern (i.e. Western Basin Tradition) portions of Ontario respectively, from this time forward. The emphasis herein will be placed on those cultural groups belonging to the Ontario Iroquoian Tradition (OIT) of southcentral Ontario.

For over 10,000 years, the native groups occupying southern Ontario practised a seasonally mobile, hunting, gathering, and fishing mode of settlement and subsistence. This approach changed during the past 1500 years with the diffusion of maize, beans, squash, sunflower, and tobacco cultigens to the lower Great Lakes region from Central and South America. Native groups in southern Ontario began to experiment with this horticultural complex during the warm season, resulting in a period of relative settlement stability during which they tended to and harvested their crops. As the Late Woodland period progressed, the OIT groups occupying the southcentral portion of the province became increasingly dependent on these cultigens. This

Table 1. *Southern Ontario cultural chronology (Dodd et al. 1990; Ferris 1999; Ferris and Spence 1995; Fox 1990; Murphy and Ferris 1990; Smith 1997a; Timmins 1985; Williamson 1990; Wright 1966, 1972).*

Temporal Period	Pre-Iroquoian/Iroquoian Cultural Group of Southcentral Ontario	Algonquian Western Basin Cultural Group of Southwestern Ontario
Late Woodland (A.D. 700 to A.D. 1500 or 1600)	Late Ontario Iroquoian – Huron, Petun, Neutral, Erie (A.D. 1400 to A.D. 1500 or 1600) Middle Ontario Iroquoian – Uren/Middleport (A.D. 1280 to A.D. 1400) Early Ontario Iroquoian – Glen Meyer/Pickering (A.D. 900 to A.D. 1250 or 1300)	Wolf (A.D. 1400 to A.D. 1550 or 1600) Springwells (A.D. 1200 to A.D. 1400) Younge (A.D. 1000 to A.D. 1300)
Transitional Woodland (A.D. 500 to 1050)	Princess Point Culture (A.D. 500 to A.D. 1050)	Riviere au Vase Culture (A.D. 650 to A.D. 1050)
Middle Woodland (450 B.C. to A.D. 700)	Point Peninsula Culture (450 B.C. to A.D. 700) Saugeen Culture (450 B.C. to A.D. 700)	Couture Culture (300 B.C. to A.D. 500)
Early Woodland (1000 B.C. to 450 B.C)	Middlesex Culture (450 B.C. to 0 B.C.) Meadowood Culture (900 or 800 B.C. to 400 B.C.)	
Archaic (5000 B.C. to 1000 B.C.)	Laurentian Culture	
Palaeo-Indian (9000 B.C. to 5000 B.C.)	Plano Culture Clovis Culture	

trend is indicated in the archaeological record not only by the increase in village size and length of occupation, but also by a change in village location to sand plains (e.g. Caradoc, Norfolk) and regions with sandy soils for optimal crop production. The new village locations were also near a variety of microenvironments permitting the exploitation of multiple resources at the same time (Dodd 1984; Dodd et al. 1990; Ferris and Spence 1995; Lennox et al. 1987; Lennox and Fitzgerald 1990; Noble 1984; Ramsden 1990; Timmins 1997; Warrick 1984, 2000:434; Williamson 1990:306).

During the past three decades, southern Ontario archaeologists have attempted to pinpoint the geographic entry and timing of the introduction and subsequent adoption of the maize horticultural complex in the lower Great Lakes region (e.g. Crawford and Smith 1996; Crawford et al. 1997, 1998; Jackson 1983; Smith 1997a, 1997b; Smith and Crawford 1995, 1997; Stothers 1977). Most of these researchers have emphasized the recovery and quantification of floral evidence in resolving this problem. However, physical anthropologists working in the lower Great Lakes region have successfully demonstrated that human skeletal (e.g. Pfeiffer 2003) and dental pathological evidence (e.g. Crinion et al. 2003; Patterson 1984) and isotopic analyses of these materials (e.g. Harrison and Katzenberg 2003; Katzenberg 2006; Katzenberg et al. 1995; Schwarcz et al. 1985; van der Merwe et al. 2003a, 2003b) may also be used to provide insight into this question. Unfortunately, human skeletal material dating to the late Middle and early Late Woodland periods, also referred to as the Transitional Woodland period, during which maize was first introduced and adopted in southern Ontario, is not well represented. This emphasizes the importance of determining the cultural affiliation of the human skeletal sample recovered from the Varden site.

Site Description

Varden is a multicomponent archaeological site, the first of many identified during the 1980s (Fox 1985) on the Long Point sand spit that protrudes into Lake Erie from its north shore (Figure 1; MacDonald 1986a, 1986b). The site itself is located on a sand knoll that overlooks Anderson Pond to the west and Gravelly Bay to the north and east, approximately 6 km from the eastern tip of the point (Figure 1; MacDonald 1986a, 1986b). This geographic area is dominated by marshland, which is closely situated to the deciduous forest of the mainland, environmental

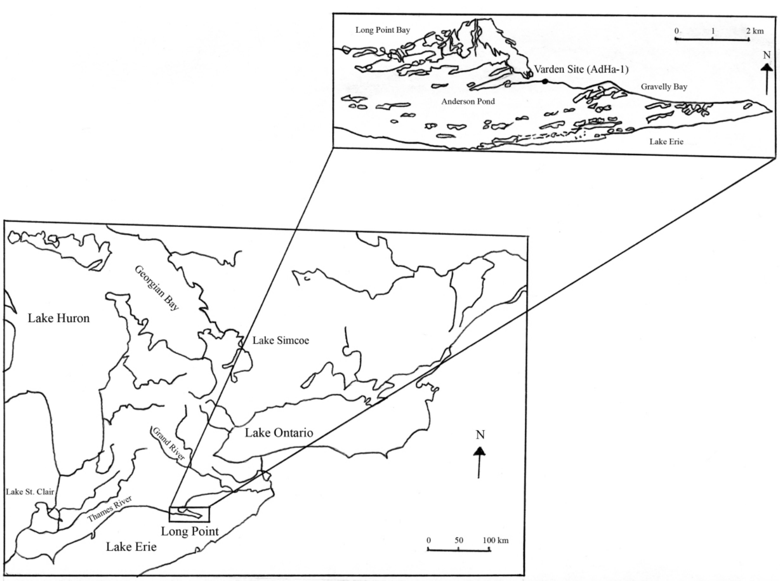

Figure 1. *The Varden site (AdHa-1) on Long Point, Lake Erie (adopted from Crawford and Smith 2002:118 and MacDonald 1986b:10).*

conditions that also existed during the late prehistoric period (MacDonald 1986a, 1986b). The faunal materials recovered during the excavation of the site indicate that a variety of fish (e.g. burbot, largemouth bass, yellow walleye, northern pike), migratory waterfowl (e.g. ducks, geese), reptile (e.g. turtle, snake), small mammal (e.g. red fox, raccoon, muskrat, meadow vole), and large mammal (e.g. white-tailed deer) species occupying the region on both a seasonal and year-round basis were successfully exploited by the inhabitants (Fox 1985; MacDonald 1986a, 1986b). Not surprisingly, the majority (i.e. 90%) of the faunal material recovered was fish, specifically, the oil-rich burbot. The abundance of fish recovered from the cultural strata of the site demonstrates its importance as a late winter to early fall (Fox 2000; MacDonald 1986b:9) fishing station over a 1000-year period.

Varden was first discovered in July of 1981 by recreational boaters who recovered a human cranium on the sand beach near Anderson Pond. Following a police investigation during August of 1981, the Ontario Ministry of Citizenship and Culture in London was notified of the site (Fox 1985), and archaeological excavations and assessments were conducted during the subsequent two summers. In July of 1982, William Fox, the Regional Archaeologist at the Ministry of Citizenship and Culture in London, and Dr. Michael Spence of the University of Western Ontario also in London, mapped, photographed, and defined the expanse of the site, excavated some preliminary test pits, and collected a variety of diagnostic artifacts (Fox 1985, 2000). These researchers also discovered and excavated a disturbed, mixed burial of partially articulated human remains eroding into the shallows of Lake Erie (Fox 1985; Figure 2). The following sections will detail the osteological analyses of these remains.

During the summer of 1983, John MacDonald then a graduate student at McMaster University, attempted to salvage what was left of the Varden site from wind and water erosion. The stratigraphy and lithic and ceramic artifacts recovered during both his, and Fox and Spence's 1982 excavations demonstrated four stratigraphically distinct cultural horizons: two Transitional Woodland Princess Point components, a Late Woodland transitional Princess Point-Glen Meyer component, and a late prehistoric/early historic Iroquoian component. The uncalibrated and calibrated radiocarbon dates obtained by MacDonald are presented in Appendix 1 along with our recalibration (Figure 3) of these dates

Figure 2. *Dr. Michael Spence searching the shallows for skeletal material.*

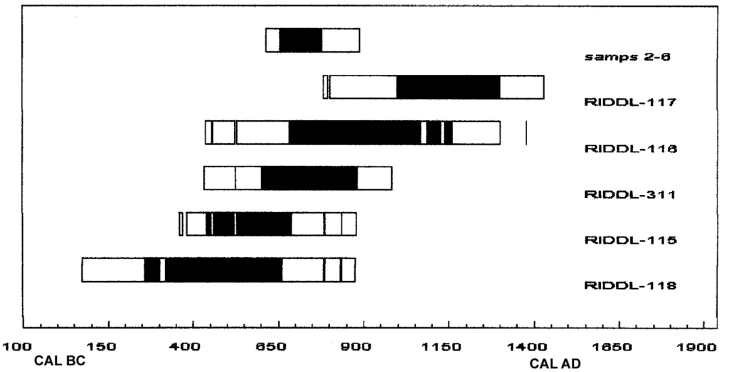

Figure 3. *1-(solid) and 2-(open) sigma calibrated Age ranges for the recalibrated radiocarbon dates from the Varden site.*

[e.g. using the probability function (Method B) of the CALIB 4.3 Programme (Stuiver and Reimer 2000)]. MacDonald's (1986a, 1986b) interpretation of the dates and the results of the statistical analyses performed during the present study are listed in Appendix 2. It is clear that three of the dates (i.e. RIDDL-115, RIDDL-116, and RIDDL-311) are representative of one or more Princess Point occupations, two dates (i.e. RIDDL-117 and RIDDL-118) are representative of one or more Glen Meyer occupations, and one date (i.e. RIDDL-312) is representative of one or more historic period occupations. These dates support the multicomponent artifactual evidence recovered from the site. However, as they were obtained from pottery residue and wood charcoal from contexts not clearly associated with the human skeletal remains, they do not provide us with approximate dates of interment and the cultural association of the individuals recovered from the Varden site. These significant contextual data must be inferred from a comparison of the overall skeletal and dental health of the individuals represented in this sample with those of other OIT groups.

Sample Description and Methods of Analysis

It should be noted at the outset that the interment pattern (e.g. articulated, disarticulated, bundled, flexed, single or multiple individuals in a grave) and the number and timing of interment events at the Varden site cannot be easily discerned. As the water levels in Lake Erie rose throughout the 1970s and 80s the site became extensively flooded and the human remains, located in two distinct burial pits, were exposed when a large elm tree (which post-dates the mortuary event) was uprooted (Fox 1985; Molto 1983a). This event resulted in the scattering of the skeletal remains across the expanse of the site and throughout the shallows of Gravelly Bay. A large portion of the skeletal material was fragmented by its exposure to the repeated wave action of Long Point Bay, as well as bleached by the sun and etched by the sand.

Given the condition of the Varden skeletal material at the time of recovery, it was classified as a commingled, ossuary sample and analyzed as a population of skeletal elements rather than a population of individuals. After first attempting to refit as many skeletal fragments as possible and sorting the material according to element and side, an estimate of the minimum number of individuals (MNI) represented by each element, and for the sample overall, was derived. All of the age and biological sex categories represented in the sample, which were determined using standard aging and biological sexing techniques (e.g. fusion of the spheno-occipital synchondrosis, dental eruption and calcification, occlusal attrition, epiphyseal fusion, degenerative changes, Suchey-Brooks pubic age determination system; Bass 1995; France 2001; Ubelaker 1978), were considered in the final MNI determination.

Next, metric data were collected from each cranium, mandible, clavicle, scapula, humerus, radius, ulna, femur, tibia, fibula, patella, talus, and calcaneus using sliding and spreading calipers, a mandibulometer, and an osteometric board following Bass (1995), Howells (1973), and Moore-Jansen et al. (1994). Appendix 3 lists these measurements according to element. Eight indices were calculated from the cranial measurements (Appendix 4) and stature was estimated from femoral and tibial measurements following the equations for White individuals given by Trotter and Gleser (1952) and the equations for Mongoloid males and White females given by Trotter (1969). Nonmetric data, which provide valuable information about the relatedness of individuals, were collected from each cranium, tooth, vertebra, sacrum, clavicle, scapula, humerus, ulna, innominate, femur, tibia, patella, talus, and calcaneus following Finnegan (1978), Molto (1979a, 1979b, 1983b), Ossenberg (1969), Saunders (1978), and Turner et al. (1991). These traits are listed in Appendix 5 along with their scoring keys.

The entire Varden skeletal sample was examined for evidence of trauma, infection, metabolic disorders, and degenerative change as indicated by the presence of active bone cells prior to, or at, the time of death. Special attention was devoted to examining the types and degree of dental pathology and the overall attritional status (i.e. degree of tooth wear) of each tooth and set of dentition recovered from the Varden site. It has been repeatedly demonstrated by both dental practitioners and physical anthropologists that the types and degree of dental pathology observed within individuals and populations are strongly dependent on the amount of carbohydrates in the diet and how frequently they are consumed, the types and degree of food processing prior to consumption, and the age of an individual. The attritional and pathological data collected from this sample follow Patterson's (1984) analysis of three OIT sites. Seven pathological categories were examined in addition to occlusal attrition, and include: tooth status (i.e. total number of teeth present in the sample and those lost ante- and postmortem), ante- and postmortem tooth trauma (i.e. in the forms of surface enamel chips and fractures of the enamel and/or dentine resulting in the loss of large tooth fragments), caries or cavities (i.e. pit and fissure, occlusal, root, radicular, tooth surface affected, degree of lesion formation), alveolar abscessing (i.e. infection of the bone holding the tooth in place), enamel hypoplasia (i.e. the presence of horizontal pits and grooves on the surface of the teeth resulting from hereditary, metabolic, and dietary conditions), calculus (i.e. the deposition, accumulation, and calcification of bacterial plaque on the surfaces of the teeth), and periodontal disease or periodontitis (i.e. the inflammation and degeneration of the tissues and ligaments composing the periodontium (e.g. gingiva, periodontal ligament, alveolar bone, cementum), resulting in gum recession and exposure of the tooth root (Lavigne and Molto 1995; Patterson 1984). The results of the pathological and attritional analysis are compared to those obtained by Anderson (in Wright and Anderson 1963) and Molto (1979a) from the Middle Woodland Donaldson site, by Patterson (1984) from the Middle Woodland Levesconte Mound site, by Cybulski (1968) from the Transitional Woodland Surma site, by Fox and Molto (1994) from the Transitional Woodland Shaman of Long Point, by Patterson (1984) from the Early Ontario Iroquoian (EOI) Bennett site, and by Patterson (1984) from the Late Ontario Iroquoian (LOI)/Historic Kleinburg Ossuary (Table 2). In so doing, it is hoped that the mode of subsistence practiced by the Varden individuals may be determined, and that the individuals may be placed in the appropriate temporal division of the Ontario groups.

The results of the dental pathological analysis will also be considered in light of the stable carbon and nitrogen isotope results obtained by Harrison and Katzenberg (2003), Katzenberg et al. (1995), and Schwarcz at al. (1985) (and most recently summarized by Katzenberg [2006]) in their examination of the contribution of maize to the diets of Ontario Iroquoian groups. Schwarcz et al. (1985:191) examined the stable carbon and nitrogen isotope ratios derived from collagen extracted from human skeletal remains recovered from nine geographically distinct archaeological sites in southern Ontario that date between 2300 B.C. and A.D. 1636. These sites included the Middle Woodland Donaldson Cemeteries (I and

Site	Radiocarbon Date	Temporal Period	Analyst(s)
Donaldson Cemetery	cal 990 (770) 250 B.C. cal 800 (760, 690, 540) 400 B.C. cal 100 B.C. (A.D. 70) A.D. 240 (Smith 1997)	Middle Woodland	Wright and Anderson (1963); Molto (1979a)
Levesconte Mound	cal AD. 80 (220) 340 cal A.D. 220 (340) 430 (Smith 1997)	Middle Woodland	Patterson (1984)
Surma Site	A.D. 700 (based on associated artifacts not radiocarbon dates)	Transitional Woodland	Cybulski (1968)
Shaman of Long Point	cal AD. 900, 912, 953	Transitional Woodland	Fox and Molto (1994)
Bennett Site	cal A.D. 1170 (1300) 1430 cal A.D. 1190 (1300) 1440 (Smith 1997)	Early Ontario Iroquoian	Patterson (1984)
Kleinburg Ossuary	A.D. 1585 to 1615	Late Ontario Iroquoian/Historic Iroquoian	Patterson (1984)

Table 2. *Comparative Middle Woodland to Late Ontario Iroquoian/Historic Period dental samples from Southern Ontario.*

II) and Levesconte Mound, as well as the Late Ontario Iroquoian/Historic Kleinburg Ossuary, sites that are included in the comparative dental analysis in this study.

Ten years later, Katzenberg et al. (1995:338) examined stable carbon and nitrogen isotope values derived from collagen extracted from human samples recovered from six additional southern Ontario sites dating between A.D. 400 and A.D.1500. These researchers wanted to further pinpoint the time during which maize horticulture was introduced into the diet of and adopted by OIT groups. Among the sites sampled were the Transitional Woodland Surma and Varden sites and the EOI Bennett site. Most recently, Harrison and Katzenberg (2003) compared the stable carbon isotope values derived from bone apatite to those derived from bone collagen (obtained by Schwarcz et al. [1985] and Katzenberg et al. [1995]) for these southern Ontario skeletal samples. They (2003:237) demonstrated that the stable carbon isotope data derived from bone apatite are capable of identifying the presence of maize in the diet earlier, in smaller proportions, and more consistently than the stable carbon isotope data derived from bone collagen. This insight has significant implications for the interpretation of the Varden site isotopic data, as will be discussed below.

All types of data collected during this study were examined as a means of assessing the relative homogeneity of the individuals represented within the Varden human skeletal sample. Such data may help us better understand the mortuary practices of these groups, but more importantly, to assess whether the individuals recovered were members of the same prehistoric group or whether they were interred by groups distanced by time and/or geography. These data will also provide insight into the overall importance of maize in the diet of Transitional and Late Woodland groups and ultimately the time and labour these groups devoted to the cultivation of this crop.

Results and Discussion

Before reporting on the results of the osteological analyses, the biased nature of human skeletal samples must be recognized. The skeletal elements and individuals recovered during excavation have been subjected to both cultural and natural taphonomic processes, which began at the time of death. These individuals are by no means representative of the group or population from which they were derived (e.g. Wood et al. 1992, Wright and Yoder 2003) but they do provide us with information about the health status of these groups and the nutritional and physical stresses they encountered.

MNI, Age and Sex Categories

A minimum number of thirteen individuals is represented by the Varden skeletal remains. The right femur is the element present in the highest frequency (N=11) with seven adults and four subadults being represented (Appendix 6). However, the left tibia of a foetal or newborn infant was also recovered and an additional adult individual is represented in the right humerii. These individuals range in age from third trimester foetus/newborn to older adult (35+ years). Table 3 lists the age categories and number of Varden individuals represented within each category. Over half of these individuals were adults, however all age categories (i.e. infant, child, adolescent, adult) were represented, indicating that age was not an influential factor in the mortuary programme of the group(s) responsible for the interment of these individuals.

Of the eight adults represented in this sample, biological sex determinations were successfully made for seven of them. Considering both the cranial and infracranial remains recovered from the site, five females and two males were identified. The remaining adult skeletal remains could not be assigned to either the female or male category with certainty. These data also indicate that the mortuary programme of the group(s) interring these individuals did not appear to be influenced by biological sex.

Table 3. *Age profile of the Varden skeletal sample.*

Age Category	# Individuals
Third trimester foetus/Newborn	1
0 – 2 years	0
2 – 6 years	1
6 – 12 years	2
12 – 18 years	1
18 – 35 years	7
35+ years	1
Total	13

Cranial and Infracranial Metric Measurements

The cranial and infracranial metric data collected from the Varden skeletal sample were very uniform. Slight differences were recorded but they can most likely be attributed to sexual dimorphism and the slight variability that is present in all populations. Appendix 7 lists these measurements for each adult cranium and mandible, while Appendix 8 lists these measurements for each adult clavicle, scapula, humerus, radius, ulna, femur, tibia, fibula, patella, talus, and calcaneus.

The results of the indices for the seven adult crania are presented in Appendix 8. From these measurements, it is clear that the Varden individuals had an average or medium head or skull shape (i.e. mesocranic, orthocranic, metriocranic), an average or medium orbit size (i.e. mesoconchic), and a narrow to average or medium nasal aperture size. The female Varden individuals stood between 154.63 ± 3.72 and 157.10 ± 3.72 cm tall while the male Varden individuals stood between 166.10 ± 3.80 and 175.13 ± 3.80 cm tall. These stature estimations indicate that the Varden individuals were rather robust, a characteristic that previous researchers have noted for prehistoric southern Ontario human groups (e.g. Anderson 1964, 1968; Molto 1979a; Wright and Anderson 1963, 1969).

Cranial, Infracranial, and Dental Nonmetric Traits

It is beyond the scope of this paper to discuss the results of the nonmetric trait analysis in great detail, and as such, the most significant finds will be highlighted. A number of traits that were observed with a relatively high frequency are presented in Table 4. Traits observed with a lower, but still significant relative frequency, are listed in Table 5. Overall, the results of the nonmetric trait analyses indicate that the individuals recovered from the Varden site represent a homogeneous, closely related group (i.e. members of an extended family group or band) that lived during the same time period.

Table 4. *Nonmetric traits observed with a relatively high frequency among the varden individuals.*

Skeletal Element	Nonmetric Trait	Relative Frequency in Adult Individuals by Side	Relative Frequency in Sub-adult Individuals by Side
Cranium	Tympanic Dehiscence	12/13	4/4
	Mastoid Foramina	12/12	1/1
	Anterior Ethmoid on Frontal	9/10	2/2
	Supraorbital Foramina	10/14	2/4
	Sagittal Sinus Direction to the Right	6/7	
Atlas	Condylar Facet Form Single and Oval	8/12	
C7	Transverse Foramina Spurs	6/9	
Clavicle	Raised Rhomboid Area	5/7	
	Rough Costoclavicular Area	11/11	
Humerus	Septal Apertures	8/15	
	Pectoralis Major Fossae	12/15	
	Teres Major Fossae	16/17	
Talus	Double Inferior Talar Articular Surfaces	8/9	
Calcaneus	Peroneal Tubercles/Trochlea	4/6	
Dentition	Shovelling	35/35	
	Protostylid	21/27	

Table 5. *Nonmetric traits observed with a lower but still significant relative frequency among the Varden individuals.*

Skeletal Element	Nonmetric Trait	Relative Frequency in Adult Individuals by Side	Relative Frequency in Subadult Individuals by Side
Cranium	Marginal Foramen of the Tympanic Plate	6/12	0/4
	Hypoglossal Canal Spurs or Complete Division	6/13	2/3
	Trace or Complete Frontal Grooves	6/12	1/2
	Accessory Mandibular Foramen	5/9	0/4
	Palatine Torus	3/6	0/1
	Mandibular Torus	5/11	0/4
	Trochlear Spur	4/12	0/2
Innominate	Preauricular Sulcus	6/10	
Femur	Third Trochanter	7/12	
Dentition	Tuberculum Dentale	11/19	
	Enamel Extensions	35/60	
	Carabelli's Trait	16/26	

This conclusion is further supported by the results obtained from the application of the Sjøvold-Molto model. This model examines the relative frequency of one or more rare genetic traits within a sample of a larger human skeletal population of known context (Molto 1979b). If the probability of the trait exhibited by the individuals within the sample exceeds chance expectations, family groups can be confidently identified (Molto 1979b). The traits to be employed in this study are the trochlear spur and incisal winging and the reference population will be the OIT crania previously examined by one of us (i.e. Molto 1983b).

The trochlear spur, a small bony exostosis or protrusion on the medial side of the orbit (Figure 4) is exhibited in 4/14 cases or 28.6% of this sample. Two adult female individuals (#2 and #3) in the 18 to 35-year category exhibited trochlear spurs bilaterally (2/8 individuals = 25%). One of us (i.e. Molto 1983b) previously demonstrated that this trait characterizes Early and Middle Woodland groups that occupied southwestern Ontario. It was present in 3/10 or 30% of the individuals recovered from the first cemetery at the Donaldson site and 53/838 or 6.3% of the OIT crania (C) examined by Molto (1983b) with the trait present in 66/1428 or 4.6% of the analysable sides (S). Using the binomial theorem, the probability of obtaining trochlear spurs in 2/8 crania or 4/14 sides is respectively .0129 (C) and .0028 (S) (Molto 1979b). Thus the null hypothesis (H_0) that the sampling of the trochlear spur in Varden relative to the OIT sample occurred stochastically is rejected at $p \leq .05$. Given that anomalous skeletal traits usually have high heritabilites (Molto 1979b, 1983b), we posit that it is more likely that hereditary factors are responsible for the Varden data. Moreover, the two females with the trait probably shared a close but unknown (i.e. mother and daughter, sisters) genetic relationship. Currently, mtDNA analysis is being conducted to delineate their relationship more succinctly.

Incisal winging (Figure 5), the lingual rotation of the upper central incisors (which causes crowding of the lateral incisors and canines), is a rare autosomal dominant trait exhibited by two individuals (#4 and #5) in this sample. Individual #4 is a subadult with mixed dentition, aged between 5 and 9 years at the time of death, while Individual #5 is an adult female in the 18 to 35-year category. Although this trait was not scored by Molto (1983b), its presence in 2/8 or 25% of the Varden individuals is highly significant and indicates that these individuals were also closely and directly related. It is hypothesized that these two individuals represent either a mother-child pair or siblings that lived during the same time period prior to death.

Figure 4. *Cranial nonmetric trait: trochlear spur.*

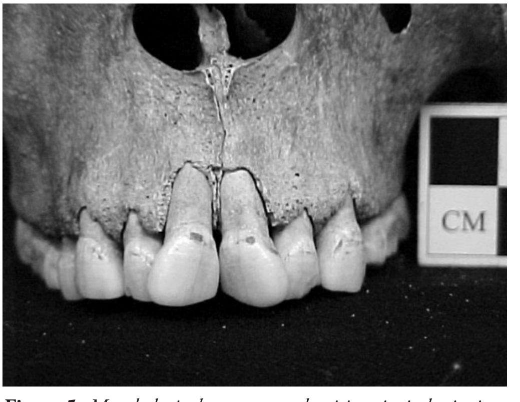

Figure 5. *Morphological permanent dentition: incisal winging.*

Cranial and Infracranial Pathology

Very few cranial and infracranial pathological conditions were present in the Varden skeletal sample, indicating that the individuals were "skeletally healthy" at the time of death. Several individuals demonstrated signs of healed, nonactive lesions of the cranial vault and in the upper orbital surfaces referred to as *porotic hyperostosis* and *cribra orbitalia* respectively, and indicative of prior periods of nutritional deficiency (i.e. anemia). Many of the adult individuals demonstrated evidence of degenerative joint disease in the form of osteoarthritis and osteophytosis in the temporo-mandibular joints, vertebral articulations, shoulder joints, elbow joints, and hip joints. One set of reassembled vertebrae (C5 to T1) demonstrated evidence of an active osteolytic lesion of unknown aetiology at the time of death. The formation of a cyst or abscess distorted the central bodies, which also appear more porous. One right clavicle had a long healed fracture, while one left tibia exhibited a presumptive massive haematoma of unknown etiology (e.g. trauma, infection) on the anterior, lateral surface of the shaft.

Dental Attrition and Pathology

The dental remains recovered from the Varden site represent a minimum of nine distinct individuals, two subadults exhibiting mixed dentition and seven adults. This is an extremely small sample size, however it is still capable of providing important insight into the diet and food processing activities of these individuals, as well as the use of teeth for other purposes (i.e. tools). Assuming that each individual was in optimal health at the time of death and that the natural and cultural factors influencing these remains following death favoured the preservation of teeth, crania, and mandibulae, each subadult would possess approximately 20 teeth and tooth sites (i.e. where each tooth is located and attached to the maxilla or mandible) and each adult would possess approximately 32 teeth and tooth sites at the time of death. The sample consists of 40 deciduous and 224 permanent teeth and tooth sites, a combined total of 264 teeth and tooth sites for study. However, only 184 teeth, 18 deciduous and 166 permanent, and 237 tooth sites, 19 deciduous and 218 permanent, were recovered from the Varden site. A thorough examination of these remains determined that the majority of the "missing" teeth were lost postmortem, with only a single individual (e.g. #7) exhibiting signs of antemortem tooth loss. Such a low overall prevalence of antemortem tooth loss in the Varden sample is indicative of a subsistence economy based on hunting, gathering, and fishing, like that practised by the groups occupying southern Ontario during the Middle Woodland period (Patterson 1984).

Table 6 presents the results of the attritional and pathological analyses of the Varden dental sample with the exception of periodontal disease (previously examined by Lavigne and Molto 1995), which will be discussed below separately. This table also summarizes the dental pathological data available for the seven OIT skeletal samples used for comparison in this study. These data will be used in the following discussion as a means of seriating the Varden skeletal sample in southern Ontario prehistory.

The occlusal attrition patterns observed in the Varden dental sample were consistent between subadults and adults. Dental wear was characterized as slight to moderate in the deciduous teeth and moderate to severe in the permanent teeth, and was concentrated in the anterior portion of the mouth (i.e. incisors, canines, premolars). This pattern is intermediate to the moderate and severe patterns observed in the Donaldson I and II and Levesconte Mound Middle Woodland samples, and the slight to moderate patterns observed in the more sedentary, maize-dependent Bennett and Kleinburg Ossuary Late Woodland samples. Had this scoring method been applied to the Surma and Shaman of Long Point samples, we would expect the values to have been similar to those of the Varden sample, patterns that characterize a predominantly hunting, gathering, and fishing mode of subsistence (Patterson 1984).

As noted in Table 6, antemortem tooth trauma in the form of chips and fractures was highly prevalent among the Varden dentitions. Many premolar and molar teeth showed evidence of chips and fractures, an indicator of the use of the teeth as grinders during masticatory and/or cultural practices and of the presence of a significant amount of abrasives in the diet. As such, we can infer that these individuals predominantly used their teeth to process their food, much like the Middle Woodland Levesconte Mound (Patterson 1984) and the Transitional Woodland Shaman of Long Point (Fox and Molto 1994) hunters, gatherers, and fishers.

Since the 1970s, international researchers (e.g. Hillson 1979; Larsen 1995; Tayles et al. 2000; Turner 1978) have repeatedly identified an increased prevalence of caries in prehistoric populations that shifted from a hunting and gathering mode of subsistence to a horticultural or agricultural one. This pattern has been demonstrated by Patterson's (1984) study of the

Table 6. *Summary of dental pathological trends of Ontario Iroquoian groups.*

Dental Pathology		Varden	Donaldson I	Donaldson II	Levesconte	Surma	Long Point	Bennett	Kleinburg
Occlusal Attrition	Values Scored	D=1, 2, 3 P=1, 2, 3, 4, 5, 6, 7			D=1, 2 P=1, 2, 3, 4, 5			D= 1, 2 P=1, 2, 3, 4	D=1, 2 P=1, 2, 3
	Description of Wear	D=slight to moderate P=moderate to severe	severe	moderate	D=slight to moderate P=moderate to severe -greatest in the anterior teeth and first molars	moderate	severe	D=slight to moderate P=moderate -more advanced in the anterior teeth	D = slight to moderate P = moderate -more advanced in the anterior teeth
Ante-mortem Tooth Trauma	Chips	D=77.8% (14/18) P=69.3% (115/166)			D=15.0% (27/180) P=24% (88/366)			D=2.9% (2/70) P=7.4% (11/149)	D=7.5% (30/402)
	Fractures	P=9.6% (16/166)			D=0.6% (1/180) P= .7% (10/366)		P=12% (3/25)		
	Chips and Fractures	P=6.0% (10/166)			D=1.1% (2/180) P=18.9% (69/366)		P=48% (12/25)		P=17.1% (480/2803)
	Teeth Most Affected	mandibular premolars and molars, maxillary lateral incisors and third molars			D=molars P=chipping uniformly distributed among the teeth, while fracturing greater in the posterior teeth			-all tooth types but the central incisors, second molars and third molars were affected -first premolars exhibited the highest prevalence of antemortem chips	D=canines P=anterior teeth
Caries	Prevalence	D=11.1% (2/18) P= 4.5% (24/166) Overall =14.1% (26/184)		D=0% (0/18) P=7.7% (12/155) Overall=12/173 (6.9%)	D=1.1% (2/17) P=6.5% (22/337) Overall=24/512 (4.7%)	P=7.4% (20/269)	P=20% (5/25)	D=13.6% (9/66) P=30.2% (45/149) Overall=54/215 (25.1%)	D=29.2% (121/415) P=40.6% (1153/2842) Overall=1274/3257 (39.1%)
	Teeth Most Affected	D=cemento-enamel/root junction of the maxillary molars P=occlusal surface (i.e. pits and fissures) and buccal pits of the molars		P=mandibular teeth, especially third molars	D=crown and root surfaces of the maxilla P=all surfaces of the maxillary teeth, especially third molars	P=occlusal surface (i.e. pits and fissures) of the molars	P=cemento-enamel junction caries of the molars due to severe occlusal attrition	D=mandibular tooth crowns P=maxillary tooth crowns	D=occlusal and crown surfaces of the mandibular molars P=occlusal and crown surfaces of the maxillary and mandibular teeth
Alveolar Abscesses	Prevalence	D=0% (0/19) P=3.7% (8/218)	-alveolar infection and abscesses exhibited by one adult female -1/4 or 25% of adults in this sample	P=0% (0/160)	D=0.31% (1/322) P=10.0% (55/548)	P=2.9% (7/238)	P=3.1% (1/32)	D=0% (0/80) P=14.1% (29/206)	D=1.3% (19/1509) P=12.7% (1558//12288)
	Teeth Most Affected and Possible Causes	D=premolars and molars -caused by a combination of attrition, antemortem fracture, and caries	-premolars and molars		D=not due to dental pathology P=premolars and molars	P=caused by pulp exposure due to dental caries	P=molar	P =premolars and mandibular molars	D =canines and molars P =all tooth types affected
Enamel Hypoplasia	Prevalence	D = 0% (0/18) P =11.4% (19/166)	P=20.3% (13/64)	P=63.3% (88/139)	D=0% (0/180) P=19.6% (61/312)		P=0% (0/25)	D=0% (0/70) P=28.2% (42/149)	D=0% (0/415) P=10.6% (281/2642)
	Teeth Most Affected	P=mandibular canines and maxillary M2		P =canines	P=mandibular canines			P=mandibular canines	P=mandibular canines
Calculus	Prevalence	D=100% (18/18) P=100% (166/166)			D=52.2% (93/178) P =89.0% (301/344)		P=100% (25/25)	D=55.7% (34/61) P= 4.8% (127/134)	D=36.3% (145/400) P=82.6% (2158/2614)
	Teeth Most Affected	molars			molars		slight development	molars	molars

Note: D = deciduous dentition, P = permanent dentition; all values represent # of teeth observed, with the exception of alveolar abscesses in which the value represents the # tooth sites observed.

prehistoric groups of southern Ontario. The observed caries prevalence depends on the type of carbohydrate being consumed (e.g. maize, rice, taro, sorghum, millet, wheat), the manner in which it is prepared (e.g. fresh, cereal or gruel, bread), the frequency of consumption, and the degree of oral care practiced by the individual and group. Noteworthy at Varden is that the caries themselves are usually located on the occlusal surfaces of the teeth.

Comparing the Varden caries data to those reported for the Donaldson I and II, Levesconte Mound, Surma, Shaman of Long Point, Bennett and Kleinburg dental remains, it appears that the Varden data most closely resemble the data reported for the Donaldson II, Surma, and Shaman of Long Point individuals, all of which were members of possible incipient horticultural groups. In the Varden sample, caries are present in the molar teeth of both the deciduous and permanent dentitions, with some premolars also being affected in the latter. It was noted that caries have a higher prevalence in the mandible than the maxilla in this sample. Further, the presence of caries in subadults is highly significant, indicating the introduction of complex carbohydrates into the diet at a very early age. These patterns are characteristic of incipient horticulturalists defined by Patterson (1984:314) as exhibiting "a very low prevalence among deciduous dentitions with only molars being affected and a low occurrence among permanent teeth with molars being moderately affected and premolars and anterior [teeth] with low prevalences." Therefore, the data imply that the individuals in the Varden skeletal sample were consuming a moderate amount of carbohydrates, most likely maize, which caused a higher prevalence of caries than would be expected for a strict hunting, gathering, and fishing group (i.e. Levesconte Mound; Molto 1983a).

Although most of the samples (with the exception of Donaldson II) presented alveolar abscesses, the prevalence of abscesses greatly differed among the samples as did the aetiology of the disease. However, the abscesses most commonly occurred in the premolar and molar teeth, and were influenced by attrition, antemortem fracture, and caries. Both this study and a previous one by Patterson (1984:316) have demonstrated that alveolar abscesses are generally not very useful in differentiating OIT groups unless the prevalence is age adjusted which was not done in Patterson's analysis. At Varden, only older individuals had periapical abscesses.

Patterson (1984) noted that enamel development is very sensitive to variations in metabolic processes during calcification and maturation of the teeth. Any disturbances that occur during this critical time period produce defects in the enamel known as *hypoplasias*. These defects are most often visible in the permanent canines, premolars, and second molars, which form during late childhood (e.g. between the ages of 4 and 6 years; Patterson 1984).

For all samples examined in this study, the mandibular canines demonstrated the highest prevalence of hypoplastic defects. None of the deciduous dentitions exhibited hypoplasia, while the prevalence rates varied for the permanent teeth in each sample. This variance reflects the individuality of diet, weaning patterns, and nutritional and metabolic stresses specific to each group. In general, children between the ages of two and six years appear to be most susceptible to nutritional stresses associated with weaning and the adoption of a diet for which they do not yet have the necessary masticatory apparatus for processing (Patterson 1984).

Table 6 also demonstrates that each tooth type from each sample exhibited dental calculus. Although the cheek teeth (i.e. the premolars and molars) are most commonly affected, no other distinctive patterns can be devised and calculus is used as a general indicator of the overall periodontal health of a population (Patterson 1984:293).

Periodontal disease was previously examined in the seven Varden adult dentitions by Lavigne and Molto (1995). These researchers devised a new system modified from the Ramfjord index for periodontal disease that measures the mean attachment loss (i.e. distance in mm between the cemento-enamel junction of a tooth and the alveolar bone of the maxilla or mandible that results from the recession of the gingiva) in archaeological dry bone specimens. By applying this system to the Varden dentitions, Lavigne and Molto (1995) noted that one individual exhibited early periodontitis (i.e. an attachment loss of 1-2 mm), four exhibited moderate periodontitis (i.e. an attachment loss of 2.5-4.5 mm), and two exhibited advanced periodontitis (i.e. an attachment loss greater than 4.5 mm) at the time of death.

Anderson (Wright and Anderson 1963) noted the presence of periodontal disease in 2/4 or 50% of the adults, one male and one female, in the Donaldson I sample, while Molto (1979a:20) noted the presence of *slight* periodontal disease in 1/5 or 20% of the adult dentitions in the Donaldson II sample. Periodontal disease was observed in 52/254 or 20.5% of the Levesconte Mound deciduous dentitions and in 283/443 or 63.9% of the permanent dentitions, with disease concentrated in the premolar and molar teeth of the deciduous maxillae and in the canine and premolars of the permanent maxillae (Patterson 1984:170, 297). Cybulski (1968) did not discuss the presence or prevalence of periodontal disease in the Surma dentitions, however, Fox and Molto (1994:28) noted *minimal to moderate resorption* of the alveolar bone at 5/32 tooth sites in the Shaman of Long Point's dentition.

The prevalence of periodontal disease in the deciduous dentitions of the Late Woodland Bennett sample was 25/62 or 40.3% and 166/201 or 82.6% in the permanent dentitions (Patterson 1984:213). Periodontal disease was most often exhibited in the anterior portion of the deciduous maxillae and in the canines, premolars, and molars of the permanent maxillae (Patterson 1984:293). In the late precontact Kleinburg sample, 82/755 or 10.9% of the deciduous dentitions and 6597/8479 or 77.8% of the permanent dentitions exhibited periodontal disease (Patterson 1984:256). Like the Levesconte Mound deciduous dentitions, the maxillae of the Kleinburg deciduous dentitions exhibited much more periodontal disease than the mandibular dentitions, with an increased involvement of the posterior teeth. The mandible was more greatly affected in the Kleinburg permanent dentitions with an increase in the prevalence of periodontal disease in the canines and posterior teeth (Patterson 1984:293).

As was demonstrated above, prior to the development of Lavigne and Molto's (1995) system researchers merely noted the presence and prevalence but not the severity of periodontal disease in their sample populations. Very few researchers included deciduous dentitions in their examinations, as periodontal disease is generally thought of as a disease primarily affecting adults (i.e. especially middle-aged to older adults; Lavigne and Molto 1995; Patterson 1984:86). Given the different observation methods employed by the researchers who examined the comparative samples included in this study, it is difficult to interpret clear subsistence- or temporal-related patterns within prehistoric southern Ontario. As a result, the periodontal data may merely be considered in the characterization of the overall dental health at the time of death in these samples.

To summarize, the Varden dentitions are characterized by a low rate of antemortem tooth loss, moderate-to-severe occlusal attrition, a high prevalence of antemortem tooth chips and fractures, a moderate prevalence (i.e. 26/184 or 14.1%) of caries, a low prevalence of alveolar abscesses (i.e. P = 8/218 or 3.7%), a moderate prevalence of enamel hypoplasia (P = 19/166 or 11.4%), a high prevalence of dental calculus (D = 18/18 and P = 166/166), and periodontal disease exhibited by all adult individuals. These data indicate that the Varden individuals used their teeth extensively to process their food, and that they were consuming a moderate amount of a complex carbohydrate, most likely maize, that was sticking to the occlusal and crown surfaces of the premolar and molar teeth, resulting in the development of caries. It may therefore be suggested that the Varden individuals were members of a group who practised a seasonally mobile subsistence economy based primarily on hunting, fishing, and gathering, but who supplemented their diet with small amounts of maize.

Summary of Stable Isotopic Evidence of the Earliest Maize Consumption and Incipient Horticulture in Southern Ontario

As was previously noted, three studies (Harrison and Katzenberg 2003; Katzenberg et al. 1995; Schwarcz et al. 1985) conducted over the past two decades have employed stable carbon and nitrogen isotope values obtained from samples of prehistoric human bone collagen and apatite in order to determine when maize, a non-native C_4 plant, was first consumed by Ontario native groups and its dietary importance to these groups throughout prehistory. The results of isotopic studies conducted in other regions of North, Central, and South America where maize was and continues to be an important dietary staple, led southern Ontario researchers to make the following assumption: collagen $\delta^{13}C$ values in the -11 to -13‰ range are indicative of a diet largely dependent on maize, while those near -1‰ correspond to a relatively maize-free diet (Katzenberg et al. 1995:341). Given this assumption, the findings of Schwarcz et al. (1985), presented in Table 7, may be interpreted as follows:

1) the Archaic and Middle Woodland groups subsisted on a diet rich in native C_3 plant types and animals that also consumed these plants;

2) C_4 content, and hence consumption of maize, begins to become significant in the diets of the Late Woodland groups and reaches its peak just prior to European contact (which may also be associated with the consumption of the meat of maize-eating dogs and deer);

3) no significant shift was observed in the $\delta^{15}N$ values derived from human bone collagen from the Archaic to the late prehistoric time period, thus demonstrating that the main sources of protein were stable over time.

Katzenberg et al.'s (1995) subsequent study attempted to pinpoint the earliest groups consuming maize, and hence the incipient horticulturalists of the OIT. Samples dating between A.D. 400 and 1500, including those from Transitional Woodland sites, were collected and processed using the same collagen extraction technique as Schwarcz et al. (1985), in order to ensure that the comparisons between the two data sets were reliable. The Varden site was included in Katzenberg et al.'s (1995) analysis, and the stable carbon and nitrogen isotope values derived from this sample are presented in Table 8. This table demonstrates that the Varden collagen $\delta^{13}C$ values tightly cluster around -19.4 ± 0.2‰ and that the $\delta^{15}N$ values cluster around 11.2 ± 0.4‰ (Katzenberg et al. 1995:343), a further indication of the homogeneity of this skeletal sample. These values are compared to those available from the prehistoric OIT sites chosen above in the comparison of dental data, in Table 9, while Table 10 presents the overall temporal trends observed by Katzenberg et al. (1995:343), trends which support those established a decade earlier by Schwarcz et al. (1985).

Although these two studies demonstrate that maize did not become an important dietary staple until EOI times, at face value the slightly higher collagen $\delta^{13}C$ values reported by these researchers (Table 9) suggests that this domestic crop appears to have first been consumed and, by association, grown by some Middle Woodland (e.g. Donaldson I and II) and Transitional Woodland (e.g. Surma, Varden?) groups. However, Katzenberg et al. (1995) provided an alternative explanation for these observed values. Based on an earlier study by Katzenberg (1989, reiterated recently by van der Merwe et al. [2003a, 2003b]), Katzenberg et al. (1995:344) suggested that the consumption of large amounts of Great Lakes carnivorous fish (e.g. walleye, pike and burbot with bone collagen $\delta^{13}C$ values around -18‰ and enriched $\delta^{15}N$ values compared to fish that feed on plant material and detritus), or migratory waterfowl that feed on these fish, would result in human collagen carbon isotope ratios with values between -17 and -19‰ that may otherwise suggest a small amount of C_4 plant food in the diet, and $\delta^{15}N$ values near 12 and 13‰ as a result of the consumption of an abundance of N-rich fish oil and flesh or migratory bird flesh (Katzenberg et al. 1995:344).

In examining the collagen $\delta^{13}C$ and $\delta^{15}N$ values listed in Table 9, this explanation appears to be probable for the Donaldson I and II and the Surma sites, but not for Varden. The Varden $\delta^{15}N$ values are quite low, in fact some of the

Table 7. *Stable nitrogen and carbon isotopic values obtained for the different southern ontario temporal periods examined by Schwarcz et al. (1985:199).*

Temporal Period	$\delta^{15}N$ (‰, AIR) (x±σ)	$\delta^{13}C$ (‰, PDB) (x±σ)	PC_4 (%)* (x±σ)
Archaic	12.3 ± 0.4	-20.8 ± 1.4	1 ±8
Middle Woodland	12.5 ± 1.1 to 13.7 ± 0.2	-19.0 ± 0.9 to -21.1 ± 0.7	0.0 to 11± 5
Early Ontario Iroquoian	11.8 ± 0.4 to 12.5 ± 0.0	-12.6 ± 0.7 to -15.8 ± 2.9	30 ± 17 to 50 ± 4
Middle Ontario Iroquoian	11.8 ± 0.4	-11.3 ± 1.1	57 ± 6
Late Ontario Iroquoian	11.8 ± 0.7 to 12.2 ± 0.1	-12.2 ± 0.4 to -12.6 ± 0.9	49 ± 5 to 52 ± 2
Historic Iroquoian	11.2 ± 0.6 to 13.2 ± 0.6	-12.2 ± 1.0 to -13.6 ± 1.4	44 ± 8 to 52 ± 6

*Percentage C_4 plants in diet, calculated as $PC_4 = [(\delta_c - \delta_3 + \Delta_{dc}) / \delta_4 - \delta_3](100)$, where δ_c = the measured δ-value of the collagen, Δ_{dc}= the offset between the isotopic composition of the diet and the collagen (-5‰ in this case), δ_3= the assumed value for the isotopic composition of the C_3 components (-26‰ in this case), and δ_4 = the assumed value for the isotopic composition of the C_4 components (-9‰ in this case).

Table 8. *Nitrogen and carbon collagen and carbon carbonate (from apatite) isotope data for the Varden samples (Harrison and Katzenberg 2003; Katzenberg et al. 1995).*

Sample Number	$\delta^{15}N$ (‰, AIR)	$\delta^{13}C$collagen (‰, PDB)	$\delta^{13}C$carbonate (‰)
1	11.1	-19.1	
2	11.2	-19.5	-11.0
3	11.1		
4	11.4	-19.4	
5	11.2	-19.6	-14.4
6	11.1		
7	11.2	-19.2	-11.3
8	11.4	-19.4	
9	10.8	-19.5	-10.5
10	10.8	-19.5	
11	12.3	-19.0	-12.9
Mean	11.2	-19.4	-12.0

lowest from southern Ontario sites studied to date, clustering around 11.2‰. We are thus left with the consumption of moderate quantities of maize as the only explanation for these stable carbon isotope values, but is this a justifiable interpretation? Harrison and Katzenberg's (2003) analysis of the stable carbon isotope values derived from bone apatite from the same OIT samples also sheds some light on this hypothesis.

Harrison and Katzenberg's (2003) research drew on Ambrose's studies of the early 1990s, in which he (1993:110) hypothesized that:

> at low levels of maize consumption it is likely that carbon from maize would be underrepresented in collagen, especially if humans had high protein diets. The initial shift to maize consumption should be reflected by very high $\delta^{13}C_{CA(carbonate)-CO(collagen)}$ values because collagen $\delta^{13}C$ values should be less affected than carbonate values by consumption of small amounts of C_4 carbohydrates.

Harrison and Katzenberg (2003:228) drew further attention to the fact that:

> With respect to the actual diet, collagen may over-represent the dietary importance of protein that is enriched in ^{13}C (e.g. marine animals) and under-represent ^{13}C enriched plant foods that are low in protein (e.g. maize).

Table 9. *Mean nitrogen and carbon collagen and carbon carbonate isotope values obtained for OIT sites examined in this study (Harrison and Katzenberg 2003:234; Katzenberg et al. 1995; Schwarcz et al. 1985:199).*

Site	N	δ^{15}N (‰, AIR)	δ^{13}Ccollagen (‰, PDB)	δ^{13}Ccarbonate (‰)	Analysts
Donaldson I	1	13.7 ± 0.2	-19.2 ± 0.3	-	Schwarcz et al. 1985
	1	12.5	-19.5	-9.5	Harrison and Katzenberg 2003
Donaldson II	3	12.6 ± 1.1	-19.0 ± 0.9	-	Schwarcz et al. 1985
	2	-	-	-12.1	Harrison and Katzenberg 2003
Levesconte	4	13.4 ± 0.2	-21.9 ± 0.4	-	Schwarcz et al. 1985
	5	13.3	-21.1	-15.1	Harrison and Katzenberg 2003
Surma	4	12.8	-17.7 ± 1.4	-	Katzenberg et al. 1995
	3	12.7	-18.4	-12.0	Harrison and Katzenberg 2003
Varden	8	11.2 ± 0.4	-19.4 ± 0.2	-	Katzenberg et al. 1995
	5	11.3	-19.4	-12.0	Harrison and Katzenberg 2003
Bennett	1	12.1	-11.5	-	Schwarcz et al. 1985
Kleinburg	4	12.2 ± 0.1	-12.2 ± 0.4	-	Schwarcz et al. 1985
	3	12.2	-12.0	-5.4	Harrison and Katzenberg 2003

Note: - = value not available. When N=1, value does not represent a mean.

Temporal Period	δ^{15}N (‰, AIR)	δ^{13}C (‰, PDB)
Middle Woodland	11.2	-20.5
Transitional Woodland	10.8 to 13.4	-15.6 to -19.6
Early Ontario Iroquoian	12.1 to 14.4	-11.5 to -14.6
Late Ontario Iroquoian	10.1 to 11.4	-11.3 to -12.8

Table 10. *Nitrogen and carbon collagen isotopic values obtained for the different southern Ontario temporal periods examined by Katzenberg et al. (1995:343).*

Table 11. *Harrison and Katzenberg's (2003) observed characteristics of δ^{13}C values derived from apatite and collagen.*

Group	Apatite δ^{13}C Values (‰)	Collagen δ^{13}C Values (‰)	Interpretations
I	-14 to -15	-19 to -21	C_3 based diets
II	-9 to -14	-17 to -20	relatively small amounts of maize in the diet are reflected in the isotopic signature of carbonate but not in the isotopic signature of collagen
III	-4 to -6	-10 to -12	C_4 plants form a significant portion of the diet

Table 9 lists the stable carbon isotopes derived from apatite by Harrison and Katzenberg (2003) for the OIT sites included in this study. The values presented in this table and those reported for other OIT sites examined by Harrison and Katzenberg (2003:234-235) reiterate the timing of the intensification of maize consumption first established by the bone collagen δ^{13}C values. In order to compare the sensitivity of these two types of stable carbon isotope data, Harrison and Katzenberg (2003) plotted the δ^{13}C apatite values against the δ^{13}C collagen values. Table 11 outlines the three distinct groups of data that resulted from this comparison. The stable carbon isotope values derived from the Varden samples fit into Group II, and as such, one may safely conclude that the Varden individuals included small-to-moderate amounts of maize in their diet.

As was previously noted, Harrison and Katzenberg's (2003:237) study successfully demonstrated that the stable carbon isotope data derived from bone apatite reflects the presence of maize in the diet earlier, in smaller proportions, and more consistently than the stable carbon isotope data derived from bone collagen (Harrison and Katzenberg 2003:237). From these two lines of evidence Harrison and Katzenberg (2003:241) suggested that in southern Ontario:

> maize was first introduced into the diet at around A.D. 500, perhaps as a trade item, but did not become a dietary staple, when it comprised a sizeable portion of diet, until approximately A.D. 1000. During the transitional period when maize is consumed but is not a dietary staple, its isotopic signature can be observed in the $\delta^{13}C$ value of carbonate but not collagen.

The Surma and Varden sites both fall within the "transitional" period of maize consumption and it is highly probable that they were among the earliest incipient horticulturalists of southern Ontario. Given this evidence, it is most probable that the Varden skeletal remains are associated with one or both of the Transitional Woodland Princess Point components of the site. If these remains were associated with either the transitional Princess Point-Glen Meyer component or the late precontact/early Historic component of the site, then the stable carbon collagen and apatite ratios would be much lower, indicating the increased dietary dependence of these groups on maize. This trend would also be observed in the dental data as follows: the Varden dentitions would be characterized by slight-to-moderate occlusal attrition, a decreased prevalence of antemortem trauma (i.e. chips and fractures) and an increased prevalence of caries.

The previous two sections support the hypothesis that maize was included in the diet of the Varden individuals at least on a seasonal basis. Unfortunately, no maize kernels were recovered from the site to further test these dental pathological and isotopic interpretations. Perhaps maize remains were present prior to the identification and salvage excavations of the Varden site, but were lost as a result of post-occupational disturbance. Alternatively, given the wet and unprotected nature of the Long Point environment, it is quite possible that the Princess Point groups occupying the site realized that this was not an ideal location to grow maize. Further, depending on the season of occupation (e.g. early or late spring, summer, early fall), it is possible that the Varden individuals would have already exhausted their maize stores for the year prior to occupying this fishing site.

Conclusions

Although the Varden skeletal sample lacked sound archaeological provenience, the homogeneity shown in terms of the cranial and infracranial metrics and nonmetrics, the cranial, dental, and infracranial pathology, and the stable carbon and nitrogen isotope values derived from both collagen and apatite, indicate that the sample was accumulated over a short time period (i.e. a few decades). Cranial, infracranial, and dental morphology demonstrates genetic ties among the thirteen individuals recovered from the site. Such ties are also shared with other southwestern Ontario Woodland period skeletal assemblages (Molto 1983b).

Eight adults (i.e. five females and two males) and five subadults were recovered from the site. These robust individuals were "skeletally healthy" at the time of death and were carefully interred by others in their group. Clearly the mortuary programme was not influenced by the biological factors of age and sex.

The pattern of dental pathology, characterized by moderate-to-severe occlusal attrition, a high prevalence of antemortem tooth chips and fractures, and a moderate prevalence of caries indicate that the Varden individuals used their teeth extensively to process their food. These data also suggest that they were consuming a moderate amount of a complex carbohydrate, most likely maize. The results of the stable carbon and nitrogen isotope analyses of the Varden skeletal material further support this hypothesis. The mean collagen $\delta^{13}C$ value of -19.4 ± 0.2‰ derived by Katzenberg et al. (1995) and the mean apatite $\delta^{13}C$ value of -12.0‰ derived by Harrison in Katzenberg (2003) indicate that slight-to-moderate amounts of maize were in fact being consumed by the Varden individuals. These data, when considered in light of the radiocarbon dates obtained from materials at the site, place this assemblage within the Transitional Woodland Princess Point culture.

We conclude that the Varden individuals represent members of a seasonally mobile hunting, fishing, and gathering band that was either trading for maize or growing small amounts of it themselves. If the latter is true then these individuals would be among the earliest incipient horticulturalists in the region, and the first to practise a mixed subsistence economy. Assuming that our seriation is correct, this assemblage represents the largest Transitional Woodland human skeletal sample excavated in southern Ontario to date.

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Lindsay J. Foreman and Eldon Molto
Department of Anthropology, University of Western Ontario

Appendix 1. *Uncalibrated and calibrated radiocarbon dates from the Varden site.*

Unit	Level	Sample Description	RIDDL#	Radiocarbon	MacDonald's Calibrated (1σ)	MacDonald's Calibrated (2σ)	Cal Age(s) A.D./B.C	Recalibrated 1σ cal age range(s) with probabilities cal A.D./B.C.	Recalibrated 2σ cal age range(s) with probabilities cal A.D./B.C.
80-97	1-2	Carbon Residue from Vessel 1	115	1440±120	cal A.D. 593±*89*	cal A.D. 415-770	cal A.D. 623, 628, 638	cal A.D. 438-453 (.046) cal A.D. 460-520 (.183) cal A.D. 527-688 (.771)	cal A.D. 359-367 (.004) cal A.D. 382-784 (.945) cal A.D. 787-835 (.028) cal A.D. 835-879 (.023)
80-98	1-2	Carbon Residue from Vessel 20	116	1120±240	cal A.D. 918±164	cal A.D. 590-1245	cal A.D. 899, 920, 958	cal A.D. 681-1065 (.884) cal A.D. 1084-1123 (.077) cal A.D. 1138-1157 (.039)	cal A.D. 437-454 (.003) cal A.D. 457-521 (.019) cal A.D. 527-1299 (.975) cal A.D. 1375-1375 (.003)
90-91	1-2	Wood charcoal from flotation	117	850±190	cal A.D. 1138±134	cal A.D. 870-1405	cal A.D. 1212	cal A.D. 998-1301 (1.000)	cal A.D. 783-797 (.005) cal A.D. 802-1430 (.995)
88-92	4	Wood charcoal from excavation	118	1560±190	cal A.D. 418±184	cal A.D. 50-785	cal A.D. 533	cal A.D. 258-284 (.054) cal A.D. 287-300 (.027) 319-660 (.919)	cal A.D. 75-784 (.969) cal A.D. 788-833 (.017) cal A.D. 837-877 (.014)
96-97	4	Carbon residue from same sherds as RIDDL-311	119	2350±160	cal 473±159 B.C.	cal. 790-155 B.C.	cal 400 B.C.	cal 760-681 B.C. (.176) cal 667630 B.C. (.075) cal 592-577 B.C. (.030) cal 560-350 B.C. (.512) cal 317-229 B.C. (.183) cal 220-208 B.C. (.024)	cal 803-86 B.C. (.985) cal 83-53 B.C. (.015)
96-97	4	Carbon residue from same sherds as RIDDL-119	311	1330±140	cal A.D. 675±118	cal A.D. 440-910	cal A.D. 674	cal A.D. 601-785 (.716) cal A.D. 786-882 (.284)	cal A.D. 434-525 (.066) cal A.D. 525-983 (.934)
95-95	1-2	Wood charcoal from excavation	312	300±170	cal A.D. 1673±139	cal A.D. 1395-1950	cal A.D. 1637	cal A.D. 1440-1682 (.767) cal A.D. 1734-1807 (.190) cal A.D. 1930-1947 (.043)	cal A.D. 1335-1335 (.001) cal A.D. 1401-1955 (.999)

Appendix 2. *Interpretation of the Varden radiocarbon dates.*

RIDDL#	MacDonald's Interpretation	Results of Statistical Analyses
115	-date is too early due to contamination	-part of the statistically valid grouping
116	-date accepted if viewed as a separate occupation of Level 1-2; date most likely representative of a late Princess Point occupation	-part of the statistically valid grouping
117	-date accepted if viewed as a separate occupation of Level 1-2; date most likely representative of a Glen Meyer occupation	-part of the statistically valid grouping
118	-date was deemed too early and most likely representative of the age of the tree rather than the cultural activity of burning the tree	-part of the statistically valid grouping
119	-date rejected as it is too early for Princess Point cultural activities	-an outlier
311	-date accepted as an early Princess Point occupation	-part of the statistically valid grouping
312	-date representative of an intrusive Historic period deposit that occurred as a result of animal activity	-an outlier

Appendix 3. *metric measurements by element.*

Element	Measurement	Element	Measurement
Cranium	Maximum Cranial Length (GOL)	Humerus	Maximum Length
	Maximum Cranial Breadth (XCB)		Maximum Length
	Foramen Magnum Length (FOL)		Maximum Diameter at Midshaft
	Foramen Magnum Breath (FOB)		Minimum Diameter at Midshaft
	Basion-Bregma Height (BBH)		Maximum Vertical Head Diameter
	Basion-Prosthion Length (BPL)		Epicondylar Breadth
	Basion-Nasion Length (BNL) or Cranial Base Length		Distal Articular Breadth
	Biauricular Breadth (AUB)	Radius	Maximum Length
	Foramen Ovale Breadth (OVB)		Sagittal Diameter at Midshaft
	Bistylo-Mastoid Foramen Breadth (SMB)		Transverse Diameter at Midshaft
	Biasterionic Breadth (ASB)		Sagittal Diameter of Head
	Maxillo-Alveolar Breadth (MAB)		Transverse Diameter of Head
	Maxillo-Alveolar Length (MAL)		Maximum Distal Breadth
	Bizygomatic Breadth (ZYB)	Ulna	Maximum Length
	Bifrontal Breadth (FMB)		Dorso-Volar Diameter
	Orbital Breadth (OBB)		Transverse Diameter
	Orbital Height (OBH)		Physiological Length
	Biectoconchion Breadth (EKB) or Biorbital Breadth		Minimum Circumference
	Interorbital Breadth	Femur	Maximum Length
	Nasion-Prosthion Height (NPH) or Upper Facial Height (UFHT)		Bicondylar Length
	Upper Facial Breadth (UFBR)		Epicondylar Breadth
	Nasal Height (NAH)		Anterio-Posterior Subtrochanteric Diameter
	Nasal Breadth (NAB)		Transverse Subtrochanteric Diameter
	Minimum Nasal Breadth (WNB)		Anterio-Posterior Diameter at Midshaft
	Minimum Frontal Breadth (MFB)		Transverse Diameter at Midshaft
	Nasion-Bregma Chord or Frontal Chord (FRC)		Circumference at Midshaft
	Bregma-Lambda Chord (BLC) or Parietal Chord		Maximum Head Diameter
	Lambdic-Opisthion Chord (LOC) or Occipital Chord		Head Circumference
	Mastoid Height or Mastoid Length (MDH)	Tibia	Maximum Length
	Total Facial Height		Maximum Epiphyseal Breadth of Proximal Tibia
Mandible	Maximum Length of Mandible or Mandibular Length (MBL)		Maximum Epiphyseal Breadth of Distal Tibia
	Mandibular Height		Maximum Diameter at Nutrient Foramen
	Maximum Ramus Height		Transverse Diameter at Nutrient Foramen
	Minimum Breadth of Ascending Ramus		Circumference at Nutrient Foramen
	Bicondylar Breadth (BCB)	Patella	Maximum Thickness
	Height of Symphysis Menti or Chin Height		Maximum Height
	Mandibular Angle		Maximum Breadth
Clavical	Maximum Length	Talus	Maximum Length
	Sagittal Diameter at Midshaft		Maximum Height
	Vertical Diameter at Midshaft		Maximum Width
Scapula	Maximum Height	Calcaneus	Maximum Length
	Maximum Breadth		Maximum Height
	Maximum Glenoid Fossa Breadth		Maximum Width
	Maximum Glenoid Fossa Length		Middle Breadth of Calcaneus

Appendix 4. *Cranial indices.*

Index	Formula
Cranial Module	Length + Breadth + Height/3
Cranial Index	(Maximum Cranial Breadth/Maximum Cranial Length) (100)
Length-Height Index	(Basion-Bregma Height/Maximum Length) (100)
Breadth-Height Index	(Basion-Bregma Height/Maximum Cranial Breadth) (100)
Facial Height/Total Facial Index	(Total Facial Height/Bizygomatic Breadth) (100)
Upper Facial Height Index	(Nasion-Prosthion Height/Bizygomatic Breadth) (100)
Orbital Index	(Orbital Height/Orbital Breadth) (100)
Nasal Index	(Nasal Breadth/Nasal Height) (100)

Appendix 5. *Nonmetric traits and scoring keys: cranium and madible.*

Trait	Scoring System	Trait	Scoring System
Metopic Suture	P, A, -	Notochord Remnant	P, A, -
Trace of Os Japonicum	P, A, -	Lateral Pterygoid Plate Foramen	P, A, -
Infra-orbital Suture	P, A, T, -	Frontal Groove	P, A, T, -
Tympanic Dehiscence	P, A, -	Supra-Orbital Foramen	2, 1, A, -
Foramen Spinosum Open	P, A,	Parietal Foramen	P, A, -
Ovale-Spinosum Confluent	P, A, IN, -	Mastoid Foramen	2, 1, A, -
Mendosal Suture	P, A, -	Posterior Condylar Canal Absent	P, A, -
Pseudo-Mastoid Suture	P, A, -	Parietal Process of Temporal	P, A, -
Occipital Suture	P, A, -	Vesalian Foramen	P, A, -
Marginal Foramen of the Tympanic Plate	P, A, -	Zygomatico-Facial Foramen Absent	2, 1, A, -
Pterygo-Spinous Bridge	P, A, S, -	Accessory Infra-Orbital Foramen	P, A, -
Pterygo-Basal Bridge	P, A, S, -	Accessory Optic Canal	P, A, -
Spino-Basal Bridge	P, A, S, -	Extra Ethmoid Foramen	1, A, -
Clino-Clinoid Bridge	P, A, S, -	Anterior Ethmoid on Frontal	P, A, -
Carotico-Clinoid Bridge	P, A, S, -	Accessory Mental Foramen	P, A, -
Squamo-Parietal Synostosis	P, A, -	Accessory Mandibular Foramen	P, A, -
Trochlear Spur	P, A, -	Coronal Ossicle	P, A, -
Intermediate Condylar Canal	P, A, -	Bregmatic Ossicle	P, A, -
Divided Hypoglossal Canal	P, A, S, -	Saggital Ossicle	P, A, -
Divided Jugular Canal	P, A, S, -	Lambdic Ossicle	P, A, -
Odonto-Occipital Facet	P, A, -	Lambdoidal Ossicle	P, A, -
Precondylar Tubercle	P, A, -	Asterionic Ossicle	P, A, -
Ossified Apical Ligament	P, A, -	Occipito-Mastoid Ossicle	P, A, -
Paracondylar Process	P, A, -	Parietal Notch Ossicle	P, A, -
Palatine Torus	P, A, T, -	Pterionic Ossicle	P, A, -
Maxillary Torus	P, A, T, -	Sagittal Sinus Direction	C, R, -
Mandibular Torus	P, A, T, -	Discrete Occipital Condyles	P, A,-
Mylo-hyoid Bridge	P, A, -	Pharyngeal Fossa	P, A, -
Staphne Defect	P, A, -	Maxillary 3rd Molar Agenesis	P, A, -
		Mandibular 3rd Molar Agenesis	P, A, -

Note: P = present, A = absent, - = indeterminate, 1 = one, 2 = two, S = spur, T = trace, C = centre, R = right, IN = incomplete, Dentition Scales (0 to 3, 0 to 4, 0 to 7) = degree of trait expression (see Turner et al. 1991)

Appendix 5 (cont.'d). *Nonmetric traits and scoring keys: dentition and infracranial.*

Element	Trait	Scoring System	Element	Trait	Scoring System
Dentition	Winging	0 to 4, IN, -	Ulna	Distal Ulnar Tuberosity	P, A, -
	Shoveling	0 to 7, IN, -		Trochlear Notch Form	separate, continuous
	Tuberculum Dentale	0, 1, IN, -	Innominate	Acetabular Crease	P, A, -
	Enamel Extensions	0 to 3, IN, -		Acetabular Mark	P, A, -
	Carabelli's Trait	0 to 7, IN, -		Accessory Hip Facets	P, A, -
	Protostylid	0 to 7, IN, -		Preauricular Sulcus	P, A, -
Atlas	Condylar Facet Form	single, double, oval, hourglass	Femur	Third Trochanter	P, A, -
	Posterior Atlas Bridge	P, A, -		Depression on the Femur	P, A, -
	Lateral Bridge	P, A, -		Exostosis in the Trochanteric Fossa	P, A, -
	Retroarticular Bridge	P, A, notch, -		Medial Gastrocnemius Tubercle or Fossa	tubercle, fossa
	Anterior Arch Deficient	P, A, -		Hypotrochanteric Fossa	P, A, slight, -
	Incomplete Costal Process	P, A, -	Tibia	Medial Tibial Squatting Facet	P, A, -
Axis	Ossified Apical Ligament	P, A, -		Lateral Tibial Squatting Facet	P, A, -
C3-C7	Transverse Foramen Bipartite	P, A, S, -	Patella	Vastus Notch	P, A, -
L1-L5	Mamillary Foramen	P, A, IN, -		Vastus Fossa	P, A, -
Sacrum	Accessory Sacral Facets	P, A, -		Vastus Facet	P, A, -
	Sacralization of the Coccyx	P, A, -		Emarginate/Bipartite Patella	P, A, -
Clavicle	Subclavian Facet Development	P, A, -	Talus	Os Trigonum	P, A, -
	Rhomboid Pit/Fossa	raised, fossa , -		Medial Talar Facet	P, A, -
	Costoclavicular Area	rough, smooth, -		Inferior Talar Articular Surface	single, double
	Conoid Tubercle	very slight, slight, moderate, pronounced, very pronounced	Calcaneus	Anterior Calcaneal Facet Absent	P, A, -
Scapula	Acromial Articular Facet/ Humeral Facet	P, A, -		Anterior-Medial Calcaneal Facet Form	discrete, hourglass, single, small anterior facet
	Suprascapular Foramen or Notch	foramen, notch, A, -		Bipartite Anterior Calcaneal Facet	P, A, -
	Circumflex Sulcus	P, A, -		Posterior Facet Extension	P, A, -
	Glenoid Fossa Extension	P, A, -		Peroneal Tubercle/Trochlea	P, A, -
	Unfused Acromial Epiphysis	P, A, -			
Humerus	Supracondylar Process	P, A, -			
	Supratrochlear Spur	P, A, -			
	Septal Aperture	P, A, -			
	Distal Humeral Spur	P, A, -			
	Pectoralis Major Fossa	P, A, -			
	Teres Major Fossa	P, A, -			

Note: P = present, A = absent, - = indeterminate, 1 = one, 2 = two, S = spur, T = trace, C = centre, R = right, IN = incomplete, Dentition Scales (0 to 3, 0 to 4, 0 to 7) = degree of trait expression (see Turner et al. 1991)

Appendix 6. *The minimum number of individuals represented by the different skeletal elements recovered from the Varden site.*

Element	Right	Left	MNE	Element	Right	Left	MNE
Cranium			9	Humerus	10	9	10
Mandible			8	Radius	7	5	7
Atlas (C1)			6	Ulna	10	8	10
Axis (C2)			5	Scaphoid/Navicular	1	1	1
C3			4	Lunate	1	1	1
C4			4	Triquetal	1	0	1
C5			4	Pisiform	0	0	0
C6			5	Trapezium/Greater Multangular	1	0	1
C7			7	Trapezoid/Lesser Multangular	0	1	1
T1			5	Capitate	2	0	2
T2			5	Hamate	0	1	1
T3			5	Metacarpal I	4	0	4
T4			5	Metacarpal II	3	0	3
T5			3	Metacarpal III	5	0	5
T6			4	Metacarpal IV	5	0	5
T7			5	Metacarpal V	3	1	3
T8			4	Innominate	9	9	9
T9			6	Femur	11	8	11
T10			7	Tibia	7	7	7
T11			9	Fibula	2	7	7
T12			8	Patella	3	2	3
L1			6	Talus	5	5	5
L2			7	Calcaneus	5	6	6
L3			9	Cuboid	1	1	1
L4			8	Navicular	3	4	4
L5			3	Medial/First Cuneiform	2	2	2
Sacrum			8	Intermediate/Second Cuneiform	2	4	4
Coccyx			2	Lateral/Third Cuneiform	3	5	5
Sternum			4	Metatarsal I	4	3	4
Rib I	7	2	7	Metatarsal II	4	6	6
Rib II	6	4	6	Metatarsal III	5	5	5
Clavicle	6	6	6	Metatarsal IV	4	5	5
Scapula	5	6	6	Metatarsal V	3	5	5

Appendix 7. *Results of the metric measurements (in mm) of each adult Varden cranium and mandible.*

	Measurement	#2	#3	#5	#6	#7	#8	#9
Cranium	Maximum Cranial Length (GOL)	176	175	169	185	181	179	-
	Maximum Cranial Breadth (XCB)	(138)	(142)	(137)	140	146	(147)	-
	Foramen Magnum Length (FOL)	-	38	38	-	39	42	-
	Foramen Magnum Breadth (FOB)	32	32	33	-	31	(31)	-
	Basion-Bregma Height (BBH)	133	129	131	130	139	134	(129)
	Basion-Prosthion Length (BPL)	-	95	87	98	100	-	-
	Basion-Nasion Length (BNL) or Cranial Base Length	104	98	98	100	(111)	(100)	98
	Biauricular Breadth (AUB)	122	126	125	132	132	137	-
	Foramen Ovale Breadth (OVB)	47	44	45	52	48	49	-
	Bistylo-Mastoid Foramen Breadth (SMB)	82	85	86	92	85	85	-
	Biasterionic Breadth (ASB)	104	110	(109)	112	(114)	(107)	-
	Maxillo-Alveolar Breadth (MAB)	-	59	58	60	(59)	-	-
	Maxillo-Alveolar Length (MAL)	-	55	46	55	(53)	-	-
	Bizygomatic Breadth (ZYB)	-	-	-	-	-	-	-
	Bifrontal Breadth (FMB)	95	98	93	102	107	(95)	-
	Orbital Breadth (OBB)	-	37	38	42	42	-	42
	Orbital Height (OBH)	-	33	34	36	37	-	36
	Biectoconchion Breadth (EKB) or Biorbital Breadth	-	97	92	103	106	-	-
	Interorbital Breadth	-	24	20	23	24	-	-
	Nasion-Prosthion Height (NPH) or Upper Facial Height (UFHT)	-	67	69	71	(63)	-	-
	Upper Facial Breadth (UFBR)	(104)	(104)	(100)	(108)	115	(106)	-
	Nasal Height (NAH)	-	51	48.5	50	55.5	-	-
	Nasal Breadth (NAB)	-	25	21	24	27	-	-
	Minimum Nasal Breadth (WNB)	-	6	10	13	10	-	-
	Minimum Frontal Breadth (MFB)	96	91	92	99	93	(101)	-
	Nasion-Bregma Chord or Frontal Chord (FRC)	105	110	104	110	109	112	(104)
	Bregma-Lambda Chord (BLC) or Parietal Chord	109	-	109	114	112	110	-
	Lambdic-Opisthion Chord (LOC) or Occipital Chord	-	-	87	-	90	94	-
	Mastoid Height or Mastoid Length (MDH)	Left 23	Right 25 Left 26	Right 28 Left 27	Left 30	Right 25 Left 23	Right 24 Left 25	Left 23
	Total Facial Height	-	118	116	(108)	-	-	-
Mandible	Maximum Length of Mandible or Mandibular Length (MBL)	108	100	98	(108)	(110)	106	-
	Mandibular Height	52	60	55	(47)	-	61	-
	Maximum Ramus Height	63	62	64	53	(73)	Right 67 Left 65	-
	Minimum Breadth of Ascending Ramus	34	35	33	33	(38)	Right 38	-
	Bicondylar Breadth (BCB)	125	Broken Right (127)	120	-	-	126	-
	Height of Symphysis Menti or Chin Height	35	30	33	32	31	38	-
	Mandibular Angle	131o	115 o	117 o	131 o	-	(117 o)	-
	Note: - = measurement could not be acquired, ( ) = measurement is an estimate							

Appendix 8. *Results of the metric measurements (in mm) of the adult Varden infracranial remains.*

Element	Measurement	Right								Left					
		#1	#2	#3	#4	#5	#6	#7	#8	#1	#2	#3	#4	#5	#6
Clavical	Maximum Length	140	142	(141)											
	Sagittal Diameter at Midshaft	11	10	-											
	Vertical Diameter at Midshaft	9	9	-											
Scapula	Maximum Height	-	-	-						-	-				
	Maximum Breadth	-	-	-						-	-				
	Maximum Glenoid Fossa Breadth	23	27	29						-	24				
	Maximum Glenoid Fossa Length	34	39	-						35	33				
Humerus	Maximum Length	293	316	307	311	-		-	-	283	-	281	-		-
	Maximum Diameter at Midshaft	20	22	25	24	-		-	-	20	-	17	-		-
	Minimum Diameter at Midshaft	14	15	15	16	-		-	-	14	-	13	-		-
	Maximum Vertical Head Diameter	37	43	42	44	41		43	43	38	-	39	-		-
	Epicondylar Breadth	54	60	55	62	54		-	-	-	60	-	54		-
	Distal Articular Breadth	36	39	41	43	-		-	-	-	38	-	-		36
Radius	Maximum Length	239	250	250	-	-				219			-		
	Sagittal Diameter at Midshaft	11	10	11	-	-				9			-		
	Transverse Diameter at Midshaft	12	13	15	-	-				12			-		
	Sagittal Diameter of Head	-	19	22	-	19				19			-		
	Transverse Diameter of Head	18	19	21	-	20				19			-		
	Maximum Distal Breadth	29	31	33	32	-				28			32		
Ulna	Maximum Length	269	273	-	-	-				-	-	264	-		
	Dorso-Volar Diameter	11	11	13	12	(12)				12	11	12	11		
	Transverse Diameter	12	15	15	14	(13)				13	12	13	12		
	Physiological Length	245	244	-	-	-				232	218	238	-		
	Minimum Circumference	33	36	-	-	-				36	34	37	-		

Appendix 8 (cont.'d). *Results of the metric measurements (in mm) of the adult Varden infracranial remains.*

Femur	Maximum Length	407	415	435	417	(445-448)	-	-		415	437	477	417		-
	Bicondylar Length	400	408	429	410	-	-	-		408	432	472	410		-
	Epicondylar Breadth	71	-	-	68	-	-	-		71	-	-	68		-
	Anterio-Posterior Subtrochanteric Diameter	28	30	28	28	29	25	27		29	30	30	28		30
	Transverse Subtrochanteric Diameter	28	23	28	23	23	28	29		28	25	28	28		27
	Anterio-Posterior Diameter at Midshaft	26	23	29	25	-	-	-		26	26	31	25		-
	Transverse Diameter at Midshaft	25	21	23	21	-	-	-		25	24	25	23		-
	Circumference at Midshaft	81	71	83	74	-	-	-		80	78	90	76		-
	Maximum Head Diameter	38	-	-	38	-	-	-		39	-	46	-		-
	Head Circumference	123	(133)	-	123	132	-	-		123	(146)	147	-		-
Tibia	Maximum Length	342	-	-	-					346	(341)	-			
	Maximum Epiphyseal Breadth of Proximal Tibia	66	-	-	-					65	-	-			
	Maximum Epiphyseal Breadth of Distal Tibia	46	-	-	-					46	(41)	-			
	Maximum Diameter at Nutrient Foramen	30	(37)	(31)	31					29	27	32			
	Transverse Diameter at Nutrient Foramen	20	(23)	(22)	21					22	22	22			
	Circumference at Nutrient Foramen	82	(98)	(86)	84					82	77	85			
Patella	Maximum Thickness	18								17					
	Maximum Height	38								37					
	Maximum Breadth	37								37					
Talus	Maximum Length	54	50	59						51	55	49	55	59	
	Maximum Height	31	29	34						31	30	29	31	34	
	Maximum Width	47	46	53						44	49	47	48	54	
	Maximum Length	75	69	80	72					69	71	71	82		
Calcaneus	Maximum Height	45	39	43	43					41	42	45	44		
	Maximum Width	43	39	50	-					(48)	(38)	44	-		
	Middle Breadth of Calcaneus	38	36	42	-					38	37	38	-		

Note: - = measurement could not be acquired, ( ) = measurement is an estimate

Appendix 9. *Varden cranial relationships and indices.*

Index	Formula	#2	#3	#5	#6	#7	#8	#9
Cranial Module	Length + Breadth + Height/3	(149.00)	(148.67)	(145.67)	151.67	155.33	(153.33)	-
Cranial Index	(Maximum Cranial Breadth/Maximum Cranial Length) (100)	(78.41)	(81.14)	(81.07)	75.68	80.66	(82.12)	-
Length-Height Index	(Basion-Bregma Height/Maximum Length) (100)	75.57	73.71	77.51	70.27	76.80	74.86	-
Breadth-Height Index	(Basion-Bregma Height/Maximum Cranial Breadth) (100)	(96.38)	(90.85)	(95.62)	92.86	95.21	(91.16)	-
Facial Height/Total Facial Index	(Total Facial Height/Bizygomatic Breadth) (100)	-	-	-	-	-	-	-
Upper Facial Height Index	(Nasion-Prosthion Height/Bizygomatic Breadth) (100)	-	-	-	-	-	-	-
Orbital Index	(Orbital Height/Orbital Breadth) (100)	-	89.19	89.47	85.71	88.10	-	85.71
Nasal Index	(Nasal Breadth/Nasal Height) (100)							

Note: - = measurement could not be acquired, ( ) = measurement is an estimate